analysis of rainfall and crop water requirements of sambalpur district

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Abstract-Rainfall reports of Sambalpur district for the past 20 years (2000-2020) recorded at the NIC, Sambalpur, Odisha were analyzed. The aim is to study the "rainfall pattern and predict the crop water requirement of Sambalpur district". The study area has a geographical area of 6702 sq. km. lies between 20º40' to 22º11'N latitude and 82º39' to 85º15' East longitude. The average rainfall in the Sambalpur district is around 1501.375714 mm. It provides an irrigation potential of 1,59,106 Ha during Kharif and 1,08,385 Ha during the Rabi season through a system of canals. The present crop pattern is mainly based on rice and a very small amount of cultivation of other crops is going on. The phenomenon of crop rotation is not practiced in these parts and hence the quality of the soil is degrading day by day. The farmers are applying more fertilizers and irrigation water for the cultivation process. In this study, CROPWAT 8.0, has been applied to increase the irrigation efficiency of the existing system to bring benefits to the farmers of the locality.

Index Terms - Rainfall, Crop, Soil, Irrigation, CROPWAT, EVAPOTRANSPIRATION

I. INTRODUCTION

Water is the greatest resource of humanity. It not only helps in survival but also helps in making life comfortable and luxurious. Besides various other uses of water, the largest use of water in the world is made for irrigating lands. Irrigation is defined as "a continuous and reliable water supply to the different crops following their different needs". When sufficient and timely water does not become available to the crops, the crops fade away, resulting in lesser crop yield, consequently creating famines and disasters. Irrigation can thus save us from such disasters. The term precipitation denotes all forms of water that reach the earth from the atmosphere. The usual forms are rainfall, snowfall, hail, frost, and dew. Of all these, only the first two contribute significant amounts of water. Rainfall is the predominant form of precipitation causing streamflow, especially the flood flow in a majority of rivers in India. The magnitude of precipitation varies with time and space. Differences in the magnitude of rainfall in various parts of a country at a given time and variations of rainfall at a place in various seasons of the year are obvious and need no elaboration. It is this variation that is responsible for many hydrological problems, such as floods and droughts. The study of precipitation forms a major portion of the subject of hydrometeorology. The atmosphere must have moisture, there must be sufficient nuclei present to aid condensation, Weather conditions must be good for condensation of water vapor to take place, and the products of condensation must reach the earth. Under proper weather conditions, the water vapor condenses over nuclei to form tiny water droplets of sizes less than 0.1 mm in diameter. The nuclei are usually salt particles or products of combustion and are normally available in plenty. Wind speed facilitates the movement of clouds while its turbulence retains water droplets of sizes less than 0.1mm in diameter. The nuclei are usually salt particles or products of combustion and are normally available in plenty. Wind speed facilitates the movement of clouds while its turbulence retains the water droplets in suspension. Precipitation results when water droplets come together and coalesce to form larger drops that can drop down. A considerable part of this precipitation gets evaporated back into the atmosphere. The net precipitation at a place and its form depend upon several meteorological factors, such as the weather elements like wind, temperature, humidity, and pressure in the volume region enclosing the clouds and the ground surface at the given place. To feed the ever-increasing population of India, it is emphasized that agricultural production should be improved on a sustainable basis by efficiently and judiciously utilizing the available resources. A review of prevailing constraints and the existing status of land and water resources gives an idea about the availability and utilization pattern of these resources, the difference between actual and potential output, and the scope for improvement in the performance of the system, which is represented by its measured levels of achievement in terms of one or several parameters that are chosen as indicators of the system's goals. The basic concept is that irrigation managers must modernize their operations with the appropriate technical and managerial components. Many factors influence the performance of irrigated agriculture. The system managers have to see how irrigated agriculture is performing within various settings. Several workers have proposed indicators depending on the purpose of the performance assessment. The major purpose of the assessment is to assist irrigation managers to improve water delivery service to users. The purpose of this study is to apply a set of comparative performance indicators that will allow for a comparative analysis of irrigation performance in the head, middle and tail reaches of the Sambalpur Distributaries canal command. Some researchers have proposed indicators for the performance evaluation of irrigation systems. Rainfall distribution is uneven concerning time as well as space, and frequently erratic. The mismatching of rainfall and crop-water requirements is quite common. A large part of the country is arid and semiarid as rainfall is not sufficient to ensure even a single crop. Furthermore, the low-rainfall areas of the country have a fairly high coefficient of variation. Droughts are experienced quite often in one part of the country or another. Irrigation is, therefore, an inseparable part of the welfare of Indian agriculture. The management of irrigation in India differs conceptually from that practiced in those developed countries where limited water is not a constraint. Good management, efficient operation, and well-executed maintenance of irrigation systems are essential to the success and sustainability of irrigated agriculture. They result in better performance, better crop yields, and sustained production. One of the key objectives in the management of an irrigation system is to provide levels of service as agreed with the relevant government authorities and the consumers at the minimum achievable cost. In many parts of the world, irrigation systems are performing well below their potential. The problem of poor irrigation performance has stimulated the interest of a whole range of development professionals. There is a unanimous agreement among them on the need to improve the operation of irrigation systems to increase productivity. In most countries, great importance is now placed on programs for the rehabilitation, operation, and maintenance of existing projects. However, works included in these programs are often limited to canal lining, land leveling, construction of additional control structures, rehabilitation of existing control structures, improvement of access roads, and non-physical components such as staff training, improvement of cost recovery systems, and so on. Too often, not enough attention is paid to alternative approaches to irrigation management, system operation, and design.

MATERIALS AND METHODS

PROCEDURE:- The available rainfall data were collected from two meteorological stations which were of 20 years from (2000-2020) on a monthly as well as yearly basis. Then, it was analyzed by using MS Excel, and show the values of the data using MS Word.

II. STUDY AREA

2.1. LOCATION

The command lines are in the central part of the Orissa on the eastern coast of India. It extends from 20° 40'N to 22° 11'N latitude and from 82° 39'E to 85° 15'E longitude. which is come under the toposheet number 73C/3 or F45M3 collected from **SOI (SURVEY OF INDIA)**. A part of the command area of approximately 5 km x 5 km has been selected for the study.

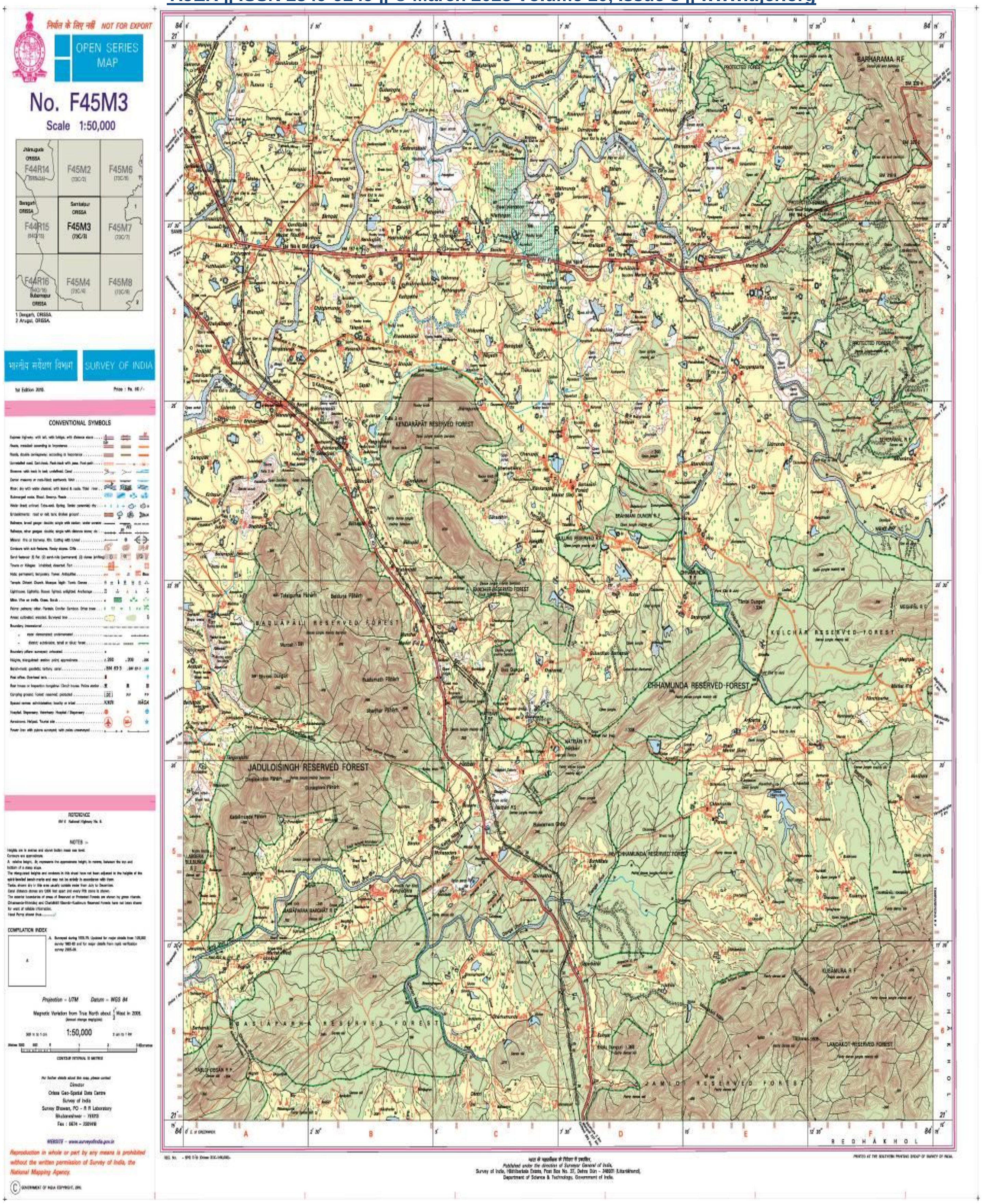


Fig. 1: Study Area

III. METHODOLOGY

The performance of irrigation systems is judged in different ways by different people. But for irrigation engineers, the criteria of good system performance is efficient delivery of water from headworks to outlet. The main criterion of performance are productivity, equity, and stability, where productivity is the agricultural output, equity is the fairness in the distribution of resources and benefits, and stability is the performance over time.

3.1. CROPWAT

CROPWAT 8.0 for Windows is a computer program for the calculation of crop water requirements and irrigation requirements from existing or new climatic and crop data. Furthermore, the program allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns. This Windows version is based on the DOS versions CROPWAT 5.7 of 1992 and CROPWAT 7.0 of 1999. Apart from a completely redesigned user interface, CROPWAT 8.0 for Windows includes a host of updated and new features. These include Monthly, decade, *and daily* input of climatic data for calculation of Eto backward compatibility to allow the use of data from CLIMWAT database possibility to estimate climatic data in the absence of measured values decade *and daily* calculation of crop water requirements based on updated calculation algorithms including adjustment of crop coefficient values calculation of crop water requirements and irrigation scheduling for dry crops *and paddy & upland rice* interactive user-adjustable irrigation schedules Daily soil water balance output tables easy saving and retrieval of sessions and user-defined irrigation schedules graphical presentations of input data, crop water requirements, and irrigation schedules easy import/export of data and graphics through clipboard or ASCII text files extensive printing routines, supporting all windows-based printers context-sensitive help system.

3.2. The data input modules of CROPWAT are:

1. Data for Climate/ETo:

2. Data for Rain:

3. Data for Crop

4. Data for Soil:

5. Data for Crop pattern:

6. Data for CWR - for Crop Water Requirements

7. Data for Schedules 8. Data for the Scheme – of water supply

IV. DATA COLLECTION AND INTERPRETATION

Once those performance indicators have been defined, the data collection process starts. This process should be concise and not be too data-intensive, nor require a special field survey. Collection of rainfall data: -The Burla upstream and downstream rainfall data was collected from “the govt. of the India Ministry of Jal Shakti, Central water commission, Mahanadi & eastern rivers organization, Bhubaneswar”. The Sambalpur rainfall data was collected from the “officer in charge, National informatics center, Orissa”. Crops and soil data were collected from “Districts of india.com”. Calculation of data: -The calculation of rainfall data of both Burla station and Sambalpur station was done in such a way that it would provide us with arithmetic rainfall as compared to normal rainfall.

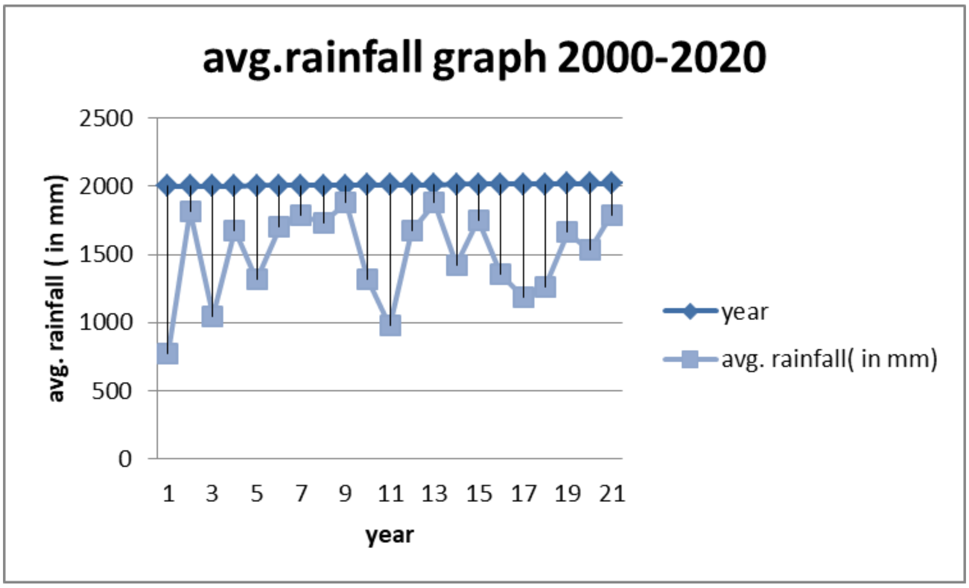
4.1. Details of data collection

Table.1 2000 to 2020 Sambalpur rainfall data in mm by the arithmetic mean method: -

YEAR	Average Rainfall (mm)
2000	776.03
2001	1818.39
2002	1048.69
2003	1677.86
2004	1316.62
2005	1698.00
2006	1785.17
2007	1732.96
2008	1879.37

2009	1315.08
2010	978.42
2011	1672.6
2012	1878.3
2013	1423.9
2014	1749.7
2015	1351.8
2016	1187.2
2017	1260.5
2018	1660.5
2019	1529.3
2020	1788.5

Fig.2. Average rainfall graph (in mm) from 2000 to 2020.



➢**For this process, data are collected from 42 different stations for my study area as per a hydrological report from the chief engineer and basin manager, Mahanadi basin, Burla they are** Ghorari, Nandaghat, Seorinarayan, Champa, Saradihi, Tarapur, Deogaon, Khairmal, Barmul, Belgaon, Mundali, Rajim, Sigma, Andhyarkore, Gatora, Sankara, Baikunthpur, Pendraroad, Mahendragarh, Bangodam, Korba, Bmandihi, Basantpur, Raipur, Dharmajayagarh, Kurubhatta, Thetatanger, Sundargarh, Burla, Parmanpur, Surajgarh, Jamadarpali, Salebhatta, Khairmal, Kantamal, Kesinga, Phulbani, Seorinarayan, Kelo, Rf/Burla, Hirakud, Bheden.

➢**For my study area as per a hydrological report from the SRC, ODISHA at Sambalpur. There are 9 sub-stations in the Sambalpur station/Sambalpur district:-**

Jujumura,dhankauda,rengali,maneswar,kochinda,jamankia,bamra,rairakhol, and naktideul.

4.2. The soil module is essentially data input, requiring the following general soil data:

• Total Available Water (TAW)

• Maximum infiltration rate

• Maximum rooting depth

• Initial soil moisture depletion

4.3. Soil data

• The soil parameters important for irrigation scheduling and required for irrigation scheduling using the FAO CROPWAT program are described below:

– Total available soil moisture content (SMta), is defined as the difference in soil moisture content between field capacity (FC) and wilting point (PWP). This is the total amount of water available to the crop and depends on texture, structure, and organic matter content;

– Initial soil moisture depletion indicates the dryness of the soil at the start of irrigation. This is expressed as a depletion percentage from FC;

– Maximum rooting depth will in most cases be determined by the genetic characteristics of the plant. In some cases, the root depth can be restricted by limiting layers;

– Maximum rain infiltration rate allows for an estimate of the surface runoff for the effective rain Calculation. This is a function of rain intensity, soil type, and slope class.

4.4. Effective rainfall

• To account for the losses due to runoff or percolation, a choice can be made of one of the four Methods given in CROPWAT 8.0 (Fixed percentage, Dependable rain, Empirical formula, USDA Soil Conservation Service).

• In general, the efficiency of rainfall will decrease with increasing rainfall. For most rainfall Values below 100 mm/month, the efficiency will be approximately 80%. Unless more detailed Information is available for local conditions; it is suggested to select the Option “Fixed Percentage” and give 80% as the requested value.

• In the water balance calculations included in the irrigation scheduling part of CROPWAT, a Possibility exists to evaluate actual Efficiency values for different crops and soil conditions.

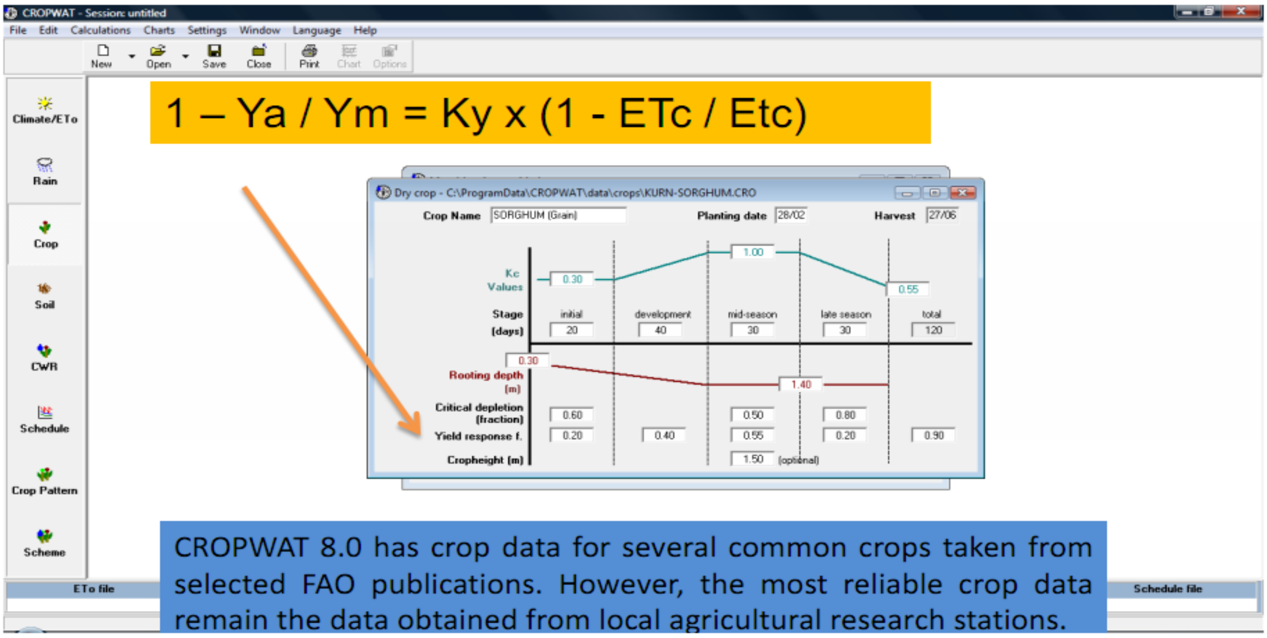


Fig.3.snapshot of CROPWAT software crop section

4.5. Yield response factor (Ky)

• The response of yield to the water supply is quantified through the Yield response factor (Ky) this relates relative yield decrease to relative evapotranspiration deficit. Water deficit of a given magnitude, expressed in the ratio of Crop evapotranspiration under non-standard conditions (ETc) and Crop evapotranspiration under standard conditions (ETcadj), may either occur continuously over the total growing period of the crop or it may occur during any one of the Individual growth stages.

• In general, for the total growing period, the decrease in yield is proportionally less than the increase in water deficit (Ky< 1) for crops such as alfalfa, groundnut, safflower, and sugar beet while it is proportionally greater (Ky>1) for crops such as banana, maize, and sugarcane. For the individual growth periods, the decrease in yield due to water deficit during that growth period is relatively small for the vegetative and ripening periods and relatively large for the flowering and yield formation periods. Water deficit during a particular growth period can also be expressed as a water deficit over the total growing period when the relationship between ETc. of that growth period, and ETc. of the total growing period is known. The figure below provides an example of the relationship between relative evapotranspiration and yield.

4.6. Critical depletion fraction (P)

• The Critical depletion fraction (p) represents the critical soil moisture level where the first drought Stress occurs affecting crop evapotranspiration and crop production. Values are expressed as a fraction of Total Available Water (TAW) and normally vary between 0.4 and 0.6, with lower values taken for sensitive crops with limited rooting systems under high evaporative conditions, and higher values for deep and densely rooting crops and low evaporation rates. In addition, the fraction p is a function of the evapotranspiration power of the atmosphere.

• At lower rates of ETc., the values of fraction p are higher than at high rates of ETc. The influence of ETc. on p is summarised in the following figure.

• For a list of values of p for different crops, users are invited to consult publication No. 56 of the Irrigation and Drainage Series of FAO, entitled "Crop evapotranspiration - Guidelines for computing crop water requirements".

4.7. Initial soil moisture depletion

• The Initial soil moisture depletion indicates the dryness of the soil at the start of the growing season that is at seeding in the case of non-rice crops, or at the beginning of land preparation, in the case of rice.

• The Initial soil moisture depletion is expressed as a percentage of the Total Available Water (TAW), in terms of depletion from Field Capacity (FC). The default value of 0 % represents a fully wetted soil profile at FC, and 100 % is soil at Wilting Point (WP).

• In most cases only an estimate can be made of the initial soil moisture condition, depending on previous crop and periods of a preceding fallow or dry season period.

4.8. Kc VALUES

Crop coefficients are properties of plants used in predicting evapotranspiration (ET). The most basic crop coefficient, Kc, is simply the ratio of ET observed for the crop studied over that observed for the well-calibrated reference crop under the same conditions.

PET=Kc*RET

Where PET means potential evapotranspiration is the evaporation and transpiration that potentially could occur if a field of the crop had an ideal unlimited water supply. RET is the reference ET often denoted as ETo. Even in crops, where ideal conditions are approximated as much as is practical, plants are not always growing (and therefore transpiring) at their theoretical potential. Plants have growth stages and states of health induced by a variety of environmental conditions.

RET usually represents the PET of the reference crop's most active growth. Kc then becomes a function or series of values specific to the crop of interest through its growing season. These can be quite elaborate in the case of certain maize varieties but tend to use a trapezoidal or leaf area index (LAI) curve for common crop or vegetation canopies. Stress coefficients, Ks, account for diminished ET due to specific stress factors. These are often assumed to combine by multiplication.

ETestimate=Kw*Ks1*Ks2*Kc*ETo

Water stress is the most ubiquitous stress factor, often denoted as Kw. Stress coefficients tend to function ranging between 0 and 1. The simplest are linear, but thresholds are appropriate for some toxicity responses. Crop coefficients can exceed 1 when the crop Evapotranspiration exceeds that of RET.

4.9. Water stress coefficient (Ks)

• The Water stress coefficient (Ks) allows for describing the effect of soil water deficit on crop

Evapotranspiration is assumed to decrease linearly in proportion to the reduction of water available in the root zone.

• Ks are given by:

Ks = (TAW - Dr) / (TAW - RAW)

Where:

TAW = Total Available Water   Dr = Root zone depletion   RAW = Readily Available Water

ETcadj = ETc * Ks

The estimation of Ks requires a daily water balance computation for the root zone.

4.10. Rooting depth

The depth of the soil profile where roots develop (in m). The rooting depth of a species is primarily governed '-y heredity, but depth is also a product of the environment in which the plant grows. Regardless of ideal environmental conditions, roots will penetrate only as deep as that plant's genetic makeup allows. Specific environmental conditions may cause this depth to vary from plant to plant within a species. Nutrients available from the aerial parts and soil, oxygen supply, soil moisture content, osmotic pressure, soil temperature, pathogens, soil pore size, and soil compaction may vary root penetration (Russell and Russell AS73, Weaver and Clements 1938). These specific factors are further discussed in additional papers on rooting ecology.

V. RESULTS AND DISCUSSIONS

By the comparison of normal rainfall and actual rainfall, the **NIC Sambalpur** concluded that the result of the intensity of rainfall tends to be a disaster or not. For example, Monsoon 2020 witnessed spates of heavy to very heavy rainfall in different parts of the State during July & August 2020. Especially, Almost all the districts received substantial rainfall from 26.8.2020 to 28.08.2020 due to Low pressure over the Bay of Bengal and an active Monsoon. Heavy rainfall occurred in the lower as well as upper catchments of Mahanadi, Brahmani, Baitarani, Budhabalanga & Subarnarekha River Systems from 26.8.2020. During this period also lower catchments of the Mahanadi River System received heavy rainfall which caused severe floods. The data like rainfall, soil moisture content, and crop data were collected from the **Sambalpur Agriculture Office and Sambalpur Irrigation Department Burla** and were inputted in CROPWAT for the necessary results and ultimately the crop pattern.

Study of the climatic data of Sambalpur stations using CROPWAT.

Figures 4 to 6 present the details of the climatic data of the Sambalpur stations

The various charts obtained from CROPWAT are as follows:

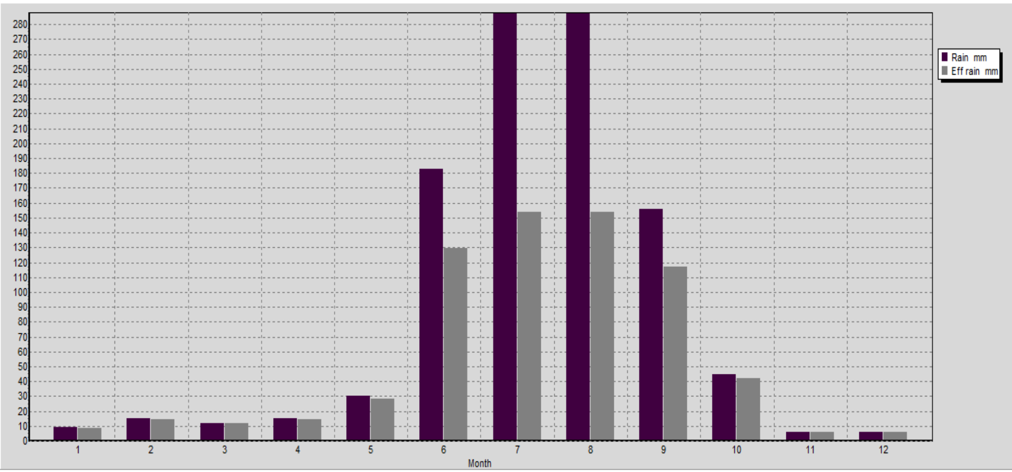


Fig.4.Rain and effective rain at Sambalpur station

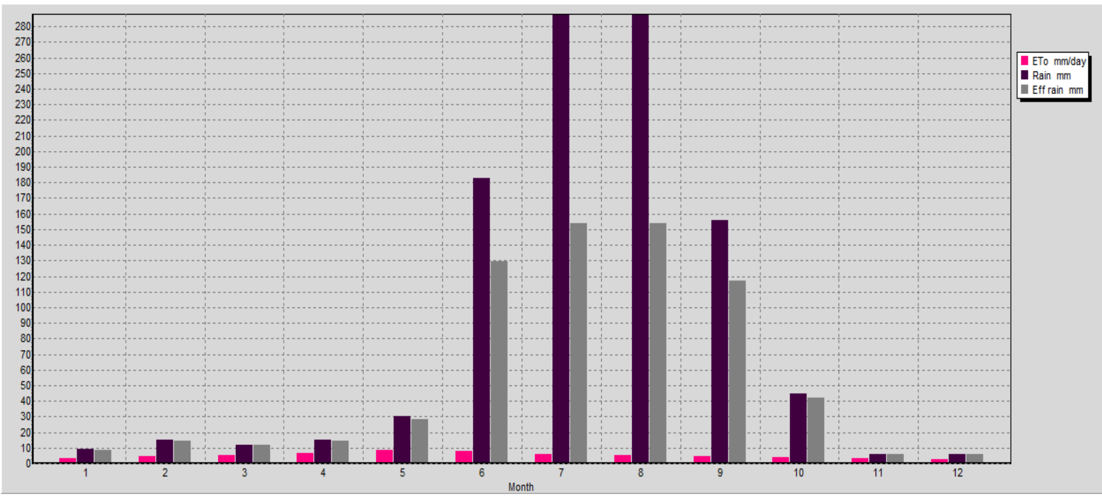


Fig.5.Rain, effective rain, and ETo of Sambalpur station

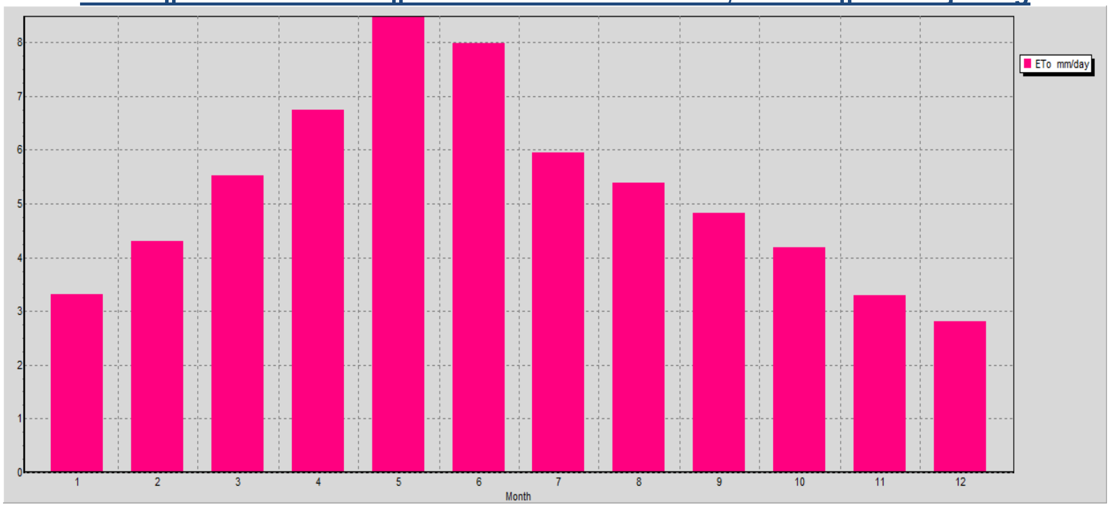


Fig.6. ETO of Sambalpur station.

Fig.6 shows that the requirement of water for rice is maximum in April, which decreases from April to October.

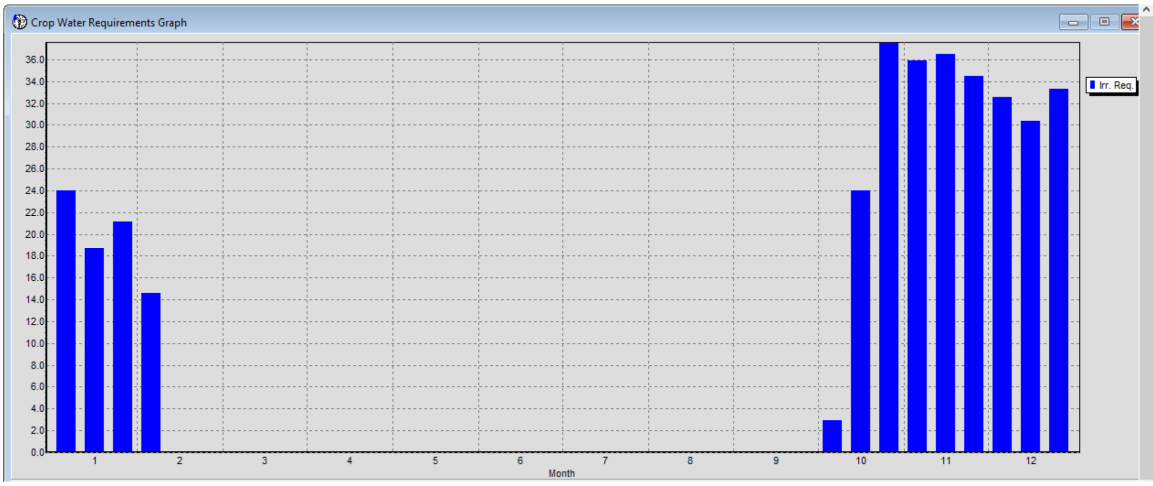


Fig.7.Fig-crop water requirement of potato

Fig.8.Fig-crop schedule of potato

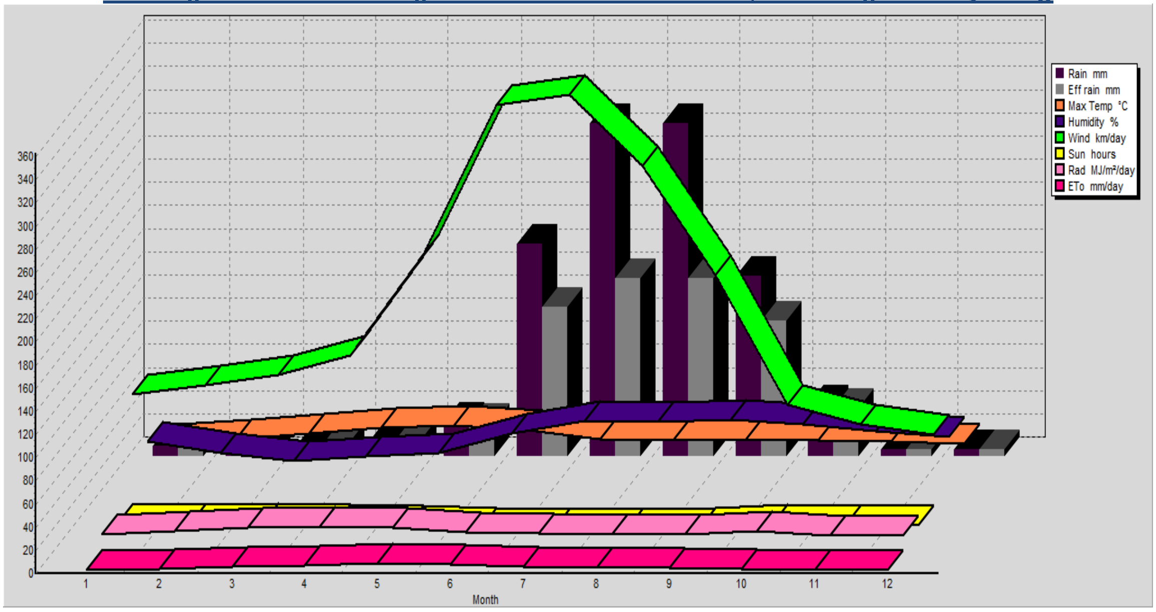


Fig.9.showing ETO rain, humidity, effective rain, maximum temperature, etc. of Sambalpur station.

Fig.9. and fig.10. Present the comparisons of crops between Sambalpur and Odisha.

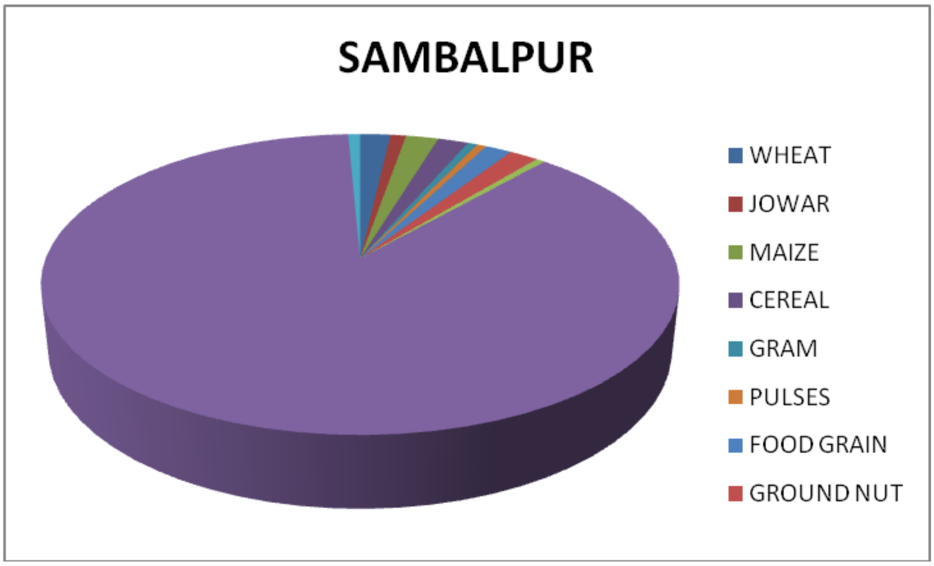


Fig.10.sambalpur crops chart

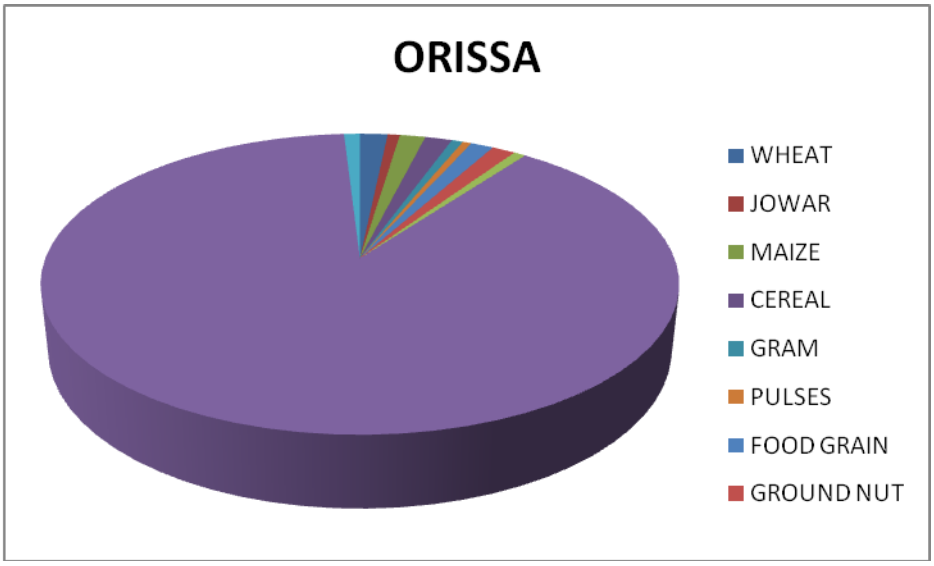


Fig.11. Odisha crop chart

Table 3:- Sambalpur data for the year 2017 by using the Thiessen polygon method

station no	AREA IN sqr km	precipitation(mm)	area*precipitation
P1	610	3.5324	2154.764
P2	408	3.7208	1518.0864
P3	141	3.07007	432.87987
P4	295	3.4903	1029.6385
P5	518	4.0141	2079.3038
P6	685	2.9589	2026.8465
P7	1162	3.589	4170.418
P8	779	2.7457	2138.9003
P9	474	3.767	1785.558
total	5072		17336.39537
	Pavg.=	3.418059024	

Table 4 Sambalpur data of the year 2018 by using the Thiessen polygon method

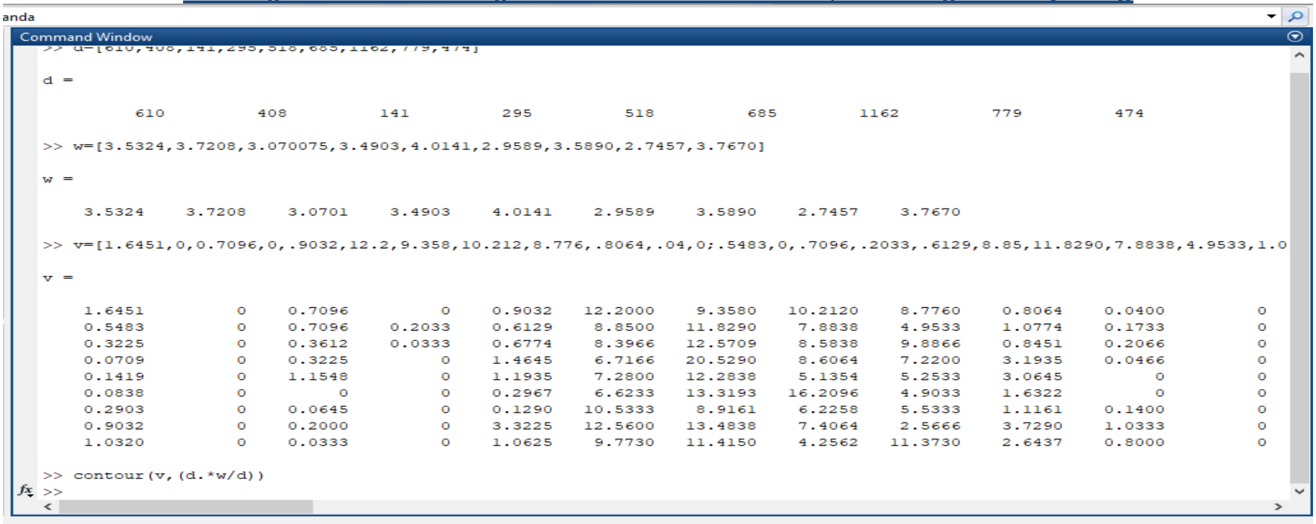
station no	AREA IN sqr km	precipitation(mm)	area*precipitation
P1	610	11.5367	7037.387
P2	408	15.1135	6166.308
P3	141	11.4378	1612.7298
P4	295	12.674	3738.83
P5	518	11.5729	5994.7622
P6	685	10.7285	7349.0225
P7	1162	9.1428	10623.9336
P8	779	11.2201	8740.4579
P9	474	8.9971	4264.6254
total	5072		55528.0564
	Pavg.=	10.94796065	

The MATLAB software is applied for data 2017 (Sambalpur station) to draw the Isohyets of the station in Fig 14 and Fig.15 is used for the year 2018.

Table. 5 Commands for isohyets methods (2017)

```
Command Window
>> d=[610,408,141,295,518,685,1162,779,474]

d =

        610        408        141        295        518        685       1162        779        474

>> w=[3.5324,3.7208,3.070075,3.4903,4.0141,2.9589,3.5890,2.7457,3.7670]

w =

    3.5324    3.7208    3.0701    3.4903    4.0141    2.9589    3.5890    2.7457    3.7670

>> v=[1.6451,0,0.7096,0,.9032,12.2,9.358,10.212,8.776,.8064,.04,0;.5483,0,.7096,.2033,.6129,8.85,11.8290,7.8838,4.9533,1.0

v =

    1.6451         0    0.7096         0    0.9032   12.2000    9.3580   10.2120    8.7760    0.8064    0.0400         0
    0.5483         0    0.7096    0.2033    0.6129    8.8500   11.8290    7.8838    4.9533    1.0774    0.1733         0
    0.3225         0    0.3612    0.0333    0.6774    8.3966   12.5709    8.5838    9.8866    0.8451    0.2066         0
    0.0709         0    0.3225         0    1.4645    6.7166   20.5290    8.6064    7.2200    3.1935    0.0466         0
    0.1419         0    1.1548         0    1.1935    7.2800   12.2838    5.1354    5.2533    3.0645         0         0
    0.0838         0         0         0    0.2967    6.6233   13.3193   16.2096    4.9033    1.6322         0         0
    0.2903         0    0.0645         0    0.1290   10.5333    8.9161    6.2258    5.5333    1.1161    0.1400         0
    0.9032         0    0.2000         0    3.3225   12.5600   13.4838    7.4064    2.5666    3.7290    1.0333         0
    1.0320         0    0.0333         0    1.0625    9.7730   11.4150    4.2562   11.3730    2.6437    0.8000         0

>> contour(v,(d.*w/d))
>>
```

Tabulation. 6. Commands for isohyets methods (2018)



```
Command Window
>> d=[610,408,141,295,518,685,1162,779,474]

d =

        610         408         141         295         518         685        1162         779         474

>> w=[3.5324,3.7208,3.070075,3.4903,4.0141,2.9589,3.5890,2.7457,3.7670]

w =

    3.5324    3.7208    3.0701    3.4903    4.0141    2.9589    3.5890    2.7457    3.7670

>> v=[1.6451,0,0.7096,0,.9032,12.2,9.358,10.212,8.776,.8064,.04,0;.5483,0,.7096,.2033,.6129,8.85,11.8290,7.8838,4.9533,1.0

v =

    1.6451         0    0.7096         0    0.9032   12.2000    9.3580   10.2120    8.7760    0.8064    0.0400         0
    0.5483         0    0.7096    0.2033    0.6129    8.8500   11.8290    7.8838    4.9533    1.0774    0.1733         0
    0.3225         0    0.3612    0.0333    0.6774    8.3966   12.5709    8.5838    9.8866    0.8451    0.2066         0
    0.0709         0    0.3225         0    1.4645    6.7166   20.5290    8.6064    7.2200    3.1935    0.0466         0
    0.1419         0    1.1548         0    1.1935    7.2800   12.2838    5.1354    5.2533    3.0645         0         0
    0.0838         0         0         0    0.2967    6.6233   13.3193   16.2096    4.9033    1.6322         0         0
    0.2903         0    0.0645         0    0.1290   10.5333    8.9161    6.2258    5.5333    1.1161    0.1400         0
    0.9032         0    0.2000         0    3.3225   12.5600   13.4838    7.4064    2.5666    3.7290    1.0333         0
    1.0320         0    0.0333         0    1.0625    9.7730   11.4150    4.2562   11.3730    2.6437    0.8000         0

>> contour(v,(d.*w/d))
>>
```

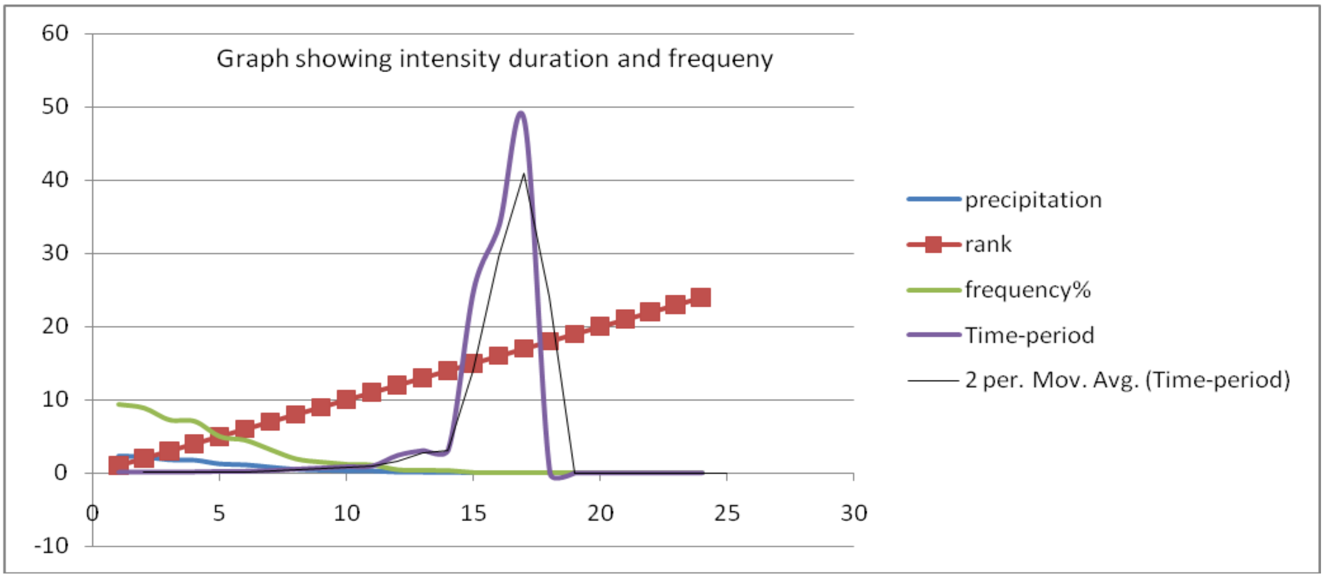


Fig. 12. Intensity duration and frequency of the Sambalpur stations for the year 2017.

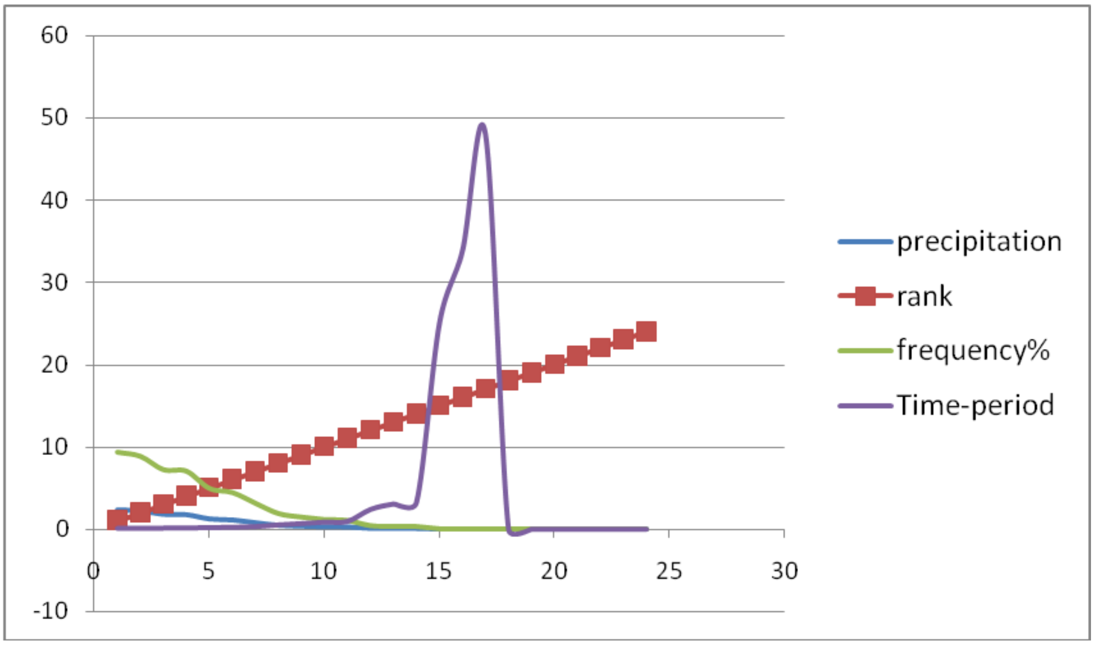


Fig.13. Intensity duration and frequency graph of the Sambalpur stations for the year 2017.

The snapshot of the CROPWAT is indicated from Fig .18 to 20 as given below.

Sambalpur rain data graph 2018

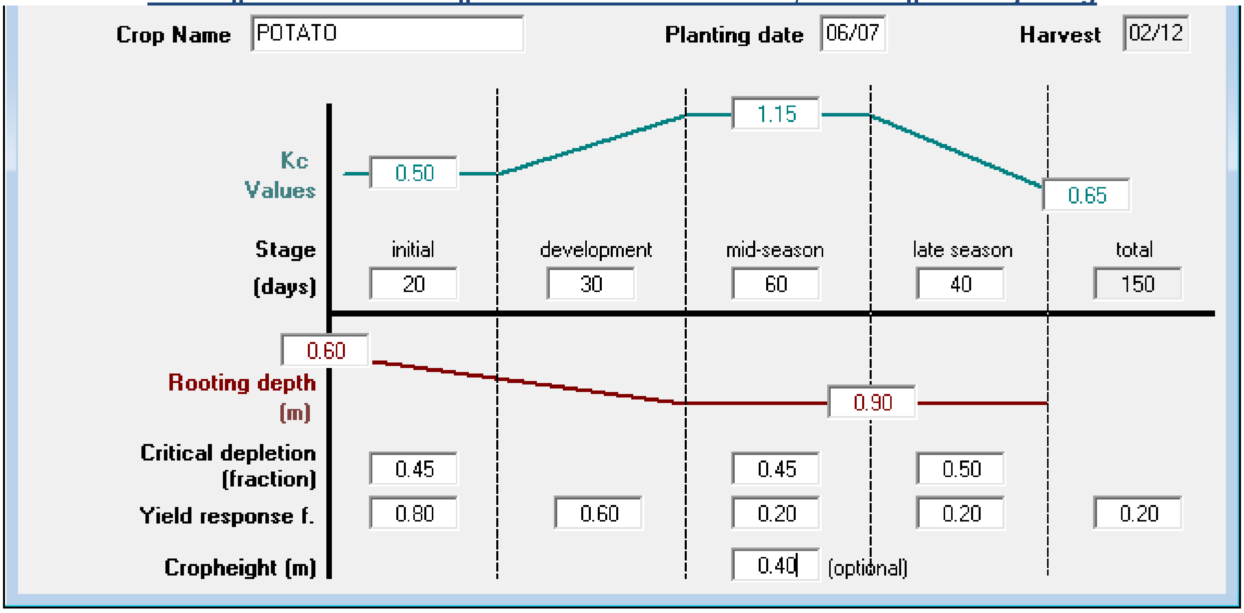


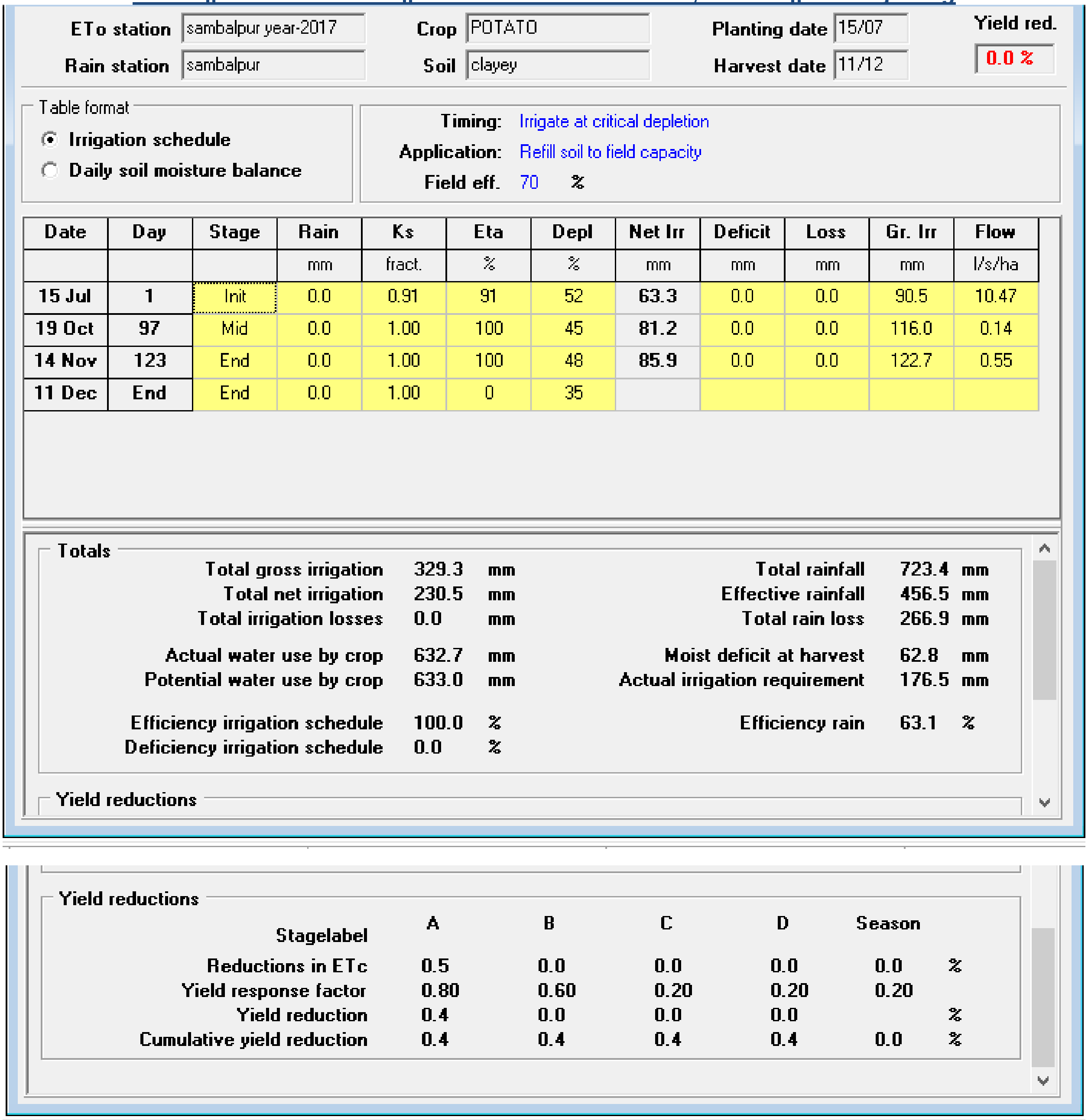
Fig.14. Snapshot of CROPWAT application for POTATO

ETo station: sambalpur year-2017 | Crop: POTATO

Rain station: sambalpur | Planting date: 14/07

Month	Decade	Stage	Kc	ETc	ETc	Eff rain	Irr. Req.
			coeff	mm/day	mm/dec	mm/dec	mm/dec
Jul	2	Init	0.50	3.00	21.0	79.7	0.0
Jul	3	Init	0.50	2.95	32.4	98.8	0.0
Aug	1	Deve	0.57	3.32	33.2	78.5	0.0
Aug	2	Deve	0.77	4.40	44.0	65.5	0.0
Aug	3	Deve	0.99	5.55	61.1	61.6	0.0
Sep	1	Mid	1.11	6.17	61.7	60.7	1.0
Sep	2	Mid	1.11	6.10	61.0	56.9	4.2
Sep	3	Mid	1.11	5.73	57.3	43.5	13.9
Oct	1	Mid	1.11	5.36	53.6	26.8	26.7
Oct	2	Mid	1.11	4.98	49.8	13.4	36.4
Oct	3	Mid	1.11	4.52	49.7	9.6	40.1
Nov	1	Late	1.05	3.82	38.2	5.8	32.3
Nov	2	Late	0.93	3.00	30.0	0.5	29.6
Nov	3	Late	0.81	2.47	24.7	0.3	24.4
Dec	1	Late	0.70	1.98	19.8	0.0	19.8
					637.6	601.6	228.3

Fig.15. Snapshot of CROPWAT application for the ETO Calculation



Date	Day	Stage	Rain	Ks	Eta	Depl	Net Irr	Deficit	Loss	Gr. Irr	Flow
			mm	fract.	%	%	mm	mm	mm	mm	l/s/ha
15 Jul	1	Init	0.0	0.91	91	52	63.3	0.0	0.0	90.5	10.47
19 Oct	97	Mid	0.0	1.00	100	45	81.2	0.0	0.0	116.0	0.14
14 Nov	123	End	0.0	1.00	100	48	85.9	0.0	0.0	122.7	0.55
11 Dec	End	End	0.0	1.00	0	35					

Totals

Total gross irrigation	329.3	mm	Total rainfall	723.4	mm
Total net irrigation	230.5	mm	Effective rainfall	456.5	mm
Total irrigation losses	0.0	mm	Total rain loss	266.9	mm
Actual water use by crop	632.7	mm	Moist deficit at harvest	62.8	mm
Potential water use by crop	633.0	mm	Actual irrigation requirement	176.5	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	63.1	%
Deficiency irrigation schedule	0.0	%			

Yield reductions

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.5	0.0	0.0	0.0	0.0	%
Yield response factor	0.80	0.60	0.20	0.20	0.20	
Yield reduction	0.4	0.0	0.0	0.0		%
Cumulative yield reduction	0.4	0.4	0.4	0.4	0.0	%

Fig.16.Snapshot of CROPWAT application for the schedule (POTATO).

The climatic data of the study area are presented in Fig.16 to 17

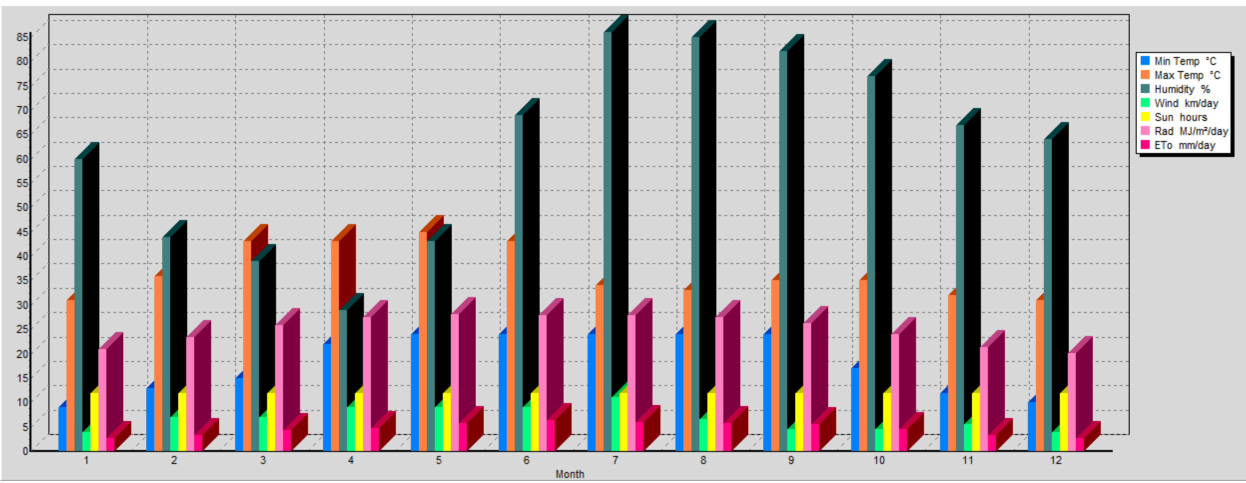


Fig.17.Intensity duration and frequency of the Sambalpur stations for the year 2017.

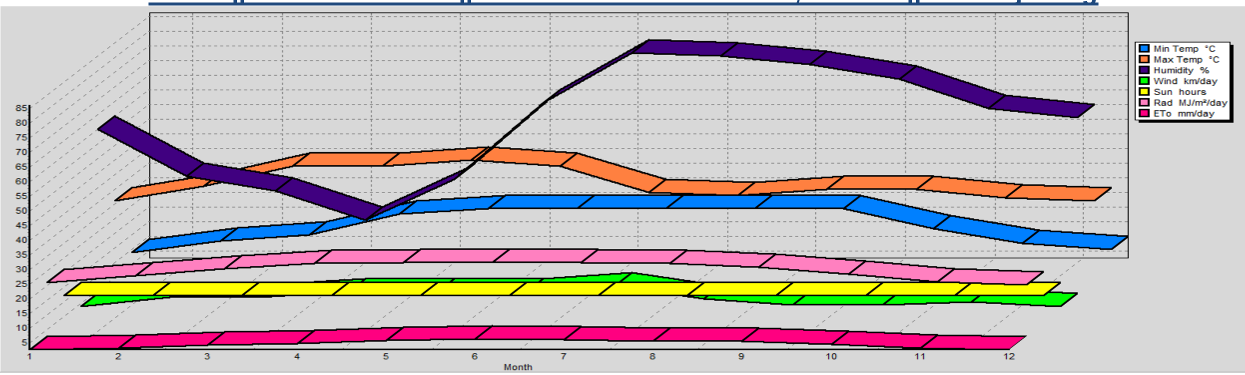


Fig .18. Various climatic data for the study area.

VI. CONCLUSION

It is observed that August month gets the highest amount of rainfall compared to other months. About 55 % of the month, august month gets the highest rainfall. Then, July is around 35 % and 10% in September month.

The management of irrigation systems has gained importance over the last five decades due to a tremendous increase in irrigated areas in India, primarily as a result of massive investments in new and existing surface irrigation projects. There has been a growing realization of possible improvements in water management for more efficient use of available water resources. The potential of information technology applications for improved irrigation system management was realized long ago, but concerted efforts on this front have only been made in the last ten years. The use of computers, communication, and information to control irrigation systems will yield many benefits, resulting in obvious economic savings and in intangible benefits whose value cannot be measured in monetary terms.

Water is no longer defined as a natural resource but as a commodity, the value of which has been recognized both at the administrative and farm levels. Unless reliability in irrigation is achieved, all other efforts to boost the irrigated agricultural sector will not reach the required goal. With limited water resources, it is now the responsibility of the engineers to create water that can be used on-farm by reducing the operational and conveyance losses in the system. Inadequate water in quantity, time, and space is the primary constraint on agricultural production. However, when water reaches an outlet in an irrigation system, we cannot afford to remain despondent or indifferent to its proper distribution. Inefficient water management below outlets not only results in a lag of use but also leads to serious legal complications due to inequity in water distribution. Normally, tail-end users are those who do not get their legitimate share of water. Furthermore, the farmers generally irrigate their farms with as much water as possible and as frequently as possible whenever water is available. This practice cannot be continued when water for irrigation is insufficient. The application of more water to crops does not necessarily mean better yields; on the contrary, it may lead to problems of waterlogging and thereby adversely affect crop yields. Based on the results of the present study the following conclusions have arrived

Production in the HIRAKUD Irrigation system has decreased due to losses of canal water, waterlogging, and seepage. The agronomic side includes the review of current cropping patterns, scientific assessment of crop water requirements to upgrade the system to meet the new demand, adoption of high-yielding varieties, and propagation of proper cultural practices. The administrative side includes the consolidation of land, the volumetric supply of irrigation water, changes in water rate policy, and the like. This can be achieved by improved water management at the farm level, keeping in mind the existing constraints of the physical system and its operational constraints. There is considerable interest among farmers in technologically and economically advanced countries in the use of personal computers to implement their irrigation Scheduling programs. Data collection equipment gathers necessary details about Evapotranspiration, rainfall, and irrigation. The irrigator selects the parameters of allowable soil water depletion and application depth. Irrigation scheduling forecasts the date and amount of the next irrigation, to increase the efficiency of the systems.

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