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Mapping and Analysis of Smart Irrigation System for Arecanut plantation in the region of Mangaluru Taluk

Raksha K S¹, Thanushree Hegde², Thangamani R³

P.G. Student, Department of Civil Engineering, NMAMIT, NITTE, Karnataka, India¹

Assistant Professor, Department of Civil Engineering, NMAMIT, NITTE, Karnataka, India²

Assistant Professor, Department of Civil Engineering, NMAMIT, NITTE, Karnataka, India³

ABSTRACT: India is an agricultural country, wherein about 70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable fruits and vegetables crops. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. It not only provides comfort but also reduce energy consumption, increase efficiency and time saving. Now the industries are using automation and control machine which are expensive and not suitable for using in a farm land. So here we analyze a smart irrigation system in low cost which can be utilized by Indian farmers. Arecanut plantation selected for the study is located in Mangaluru Taluk, Dakshina Kannada district of Karnataka state, India. Variations in its growth and production of Crop water requirement of Arecanut plant are analyzed. Meteorological data for past 10 years is collected to compute crop evapotranspiration to assess crop water requirement..

KEYWORDS: Analysis, arecanut Plantation, crop water requirement, crop evapotranspiration.

I. INTRODUCTION

The crop's productivity is determined by its age; it starts producing 5-7 years after sowing and can continue producing until 50 years. When regulating crop water and estimating basic production, the age of the arecanut plant is crucial. Small-scale marketing groups, which are in charge of export and rate stabilization, rely heavily on the production of arecanut crops. Conventional methods require a lot of time and work to estimate an area under different ages.

Enhancing irrigation effectiveness can significantly lower production costs, increasing industry sustainability and competitiveness. Average crop yields can be maintained (or even enhanced) while reducing environmental effects from excess applied water and subsequent agrichemical leaching with effective irrigation. Arecanut plantations of all ages make up the vast majority of the study area. One of the key determinants of crop water need (CWR), which in turn affects irrigation planning and scheduling, is growth stage. To estimate CWR, it is crucial to make accurate estimates of the crop area, the area occupied by various age groups, and the region under stress. With the development of multispectral remote sensing, it is now possible to distinguish between within-crop differences more reliably and precisely. Crop coefficients are determined using an NDVI-based method, and CWR is evaluated using reference crop evapotranspiration calculated using the Hargreaves and Samani equation.

Agriculture uses for remote sensing are well documented in the literature. In the past, data from sensors with high to intermediate spatial resolution, like ASTER, SPOT, IRS, and Landsat, were frequently employed for extensive mapping. Using these data to map from a regional to a global level is always challenging due to the significant time and resource requirements. The accuracy of the mapping is also impacted by other variables such crop rotation, sowing time variance, and natural calamities. However, a continuous temporal growth pattern that can be recovered from data with a coarse spatial resolution is useful for capturing both the speed and timing of growth.

II. RELATED WORK

2.1 About Study Area:

Arecanut palms are of heights 12 to 30 meters with a diameter of roughly 30 to 45 cm. They normally have unbranched stems. The Arecanut palms can survive with as little as 30 to 60 inches of rainfall if the negative

impacts of low rainfall are offset by generous irrigation in the summer. They do best in areas with heavy rainfall (200 inches or more).

Arecanut palms can grow in a variety of soil types, with textures ranging from loamy to laterite, even though the type of soil in which the palms are grown is essential for the crop's best performance. Despite the fact that palms often don't fare well in laterite soils unless a lot of manuring is used to make up for it, the largest areas of arecanut farming in India are found in the laterite soils of Mysore and Kerala. The arecanut palm has a fibrous root structure. A mass of thick adventitious roots with an average diameter of 0.60-1.25 cm appear about 30-45 cm below the surface of the earth. The smaller branches that emerge from these roots later ramify in all directions. A tuft that ejects above the ground at the base of the stem is how some people perceive the root mass. The arecanut root's structure was created for development in highly moist environments.

2.2 Site Selected:

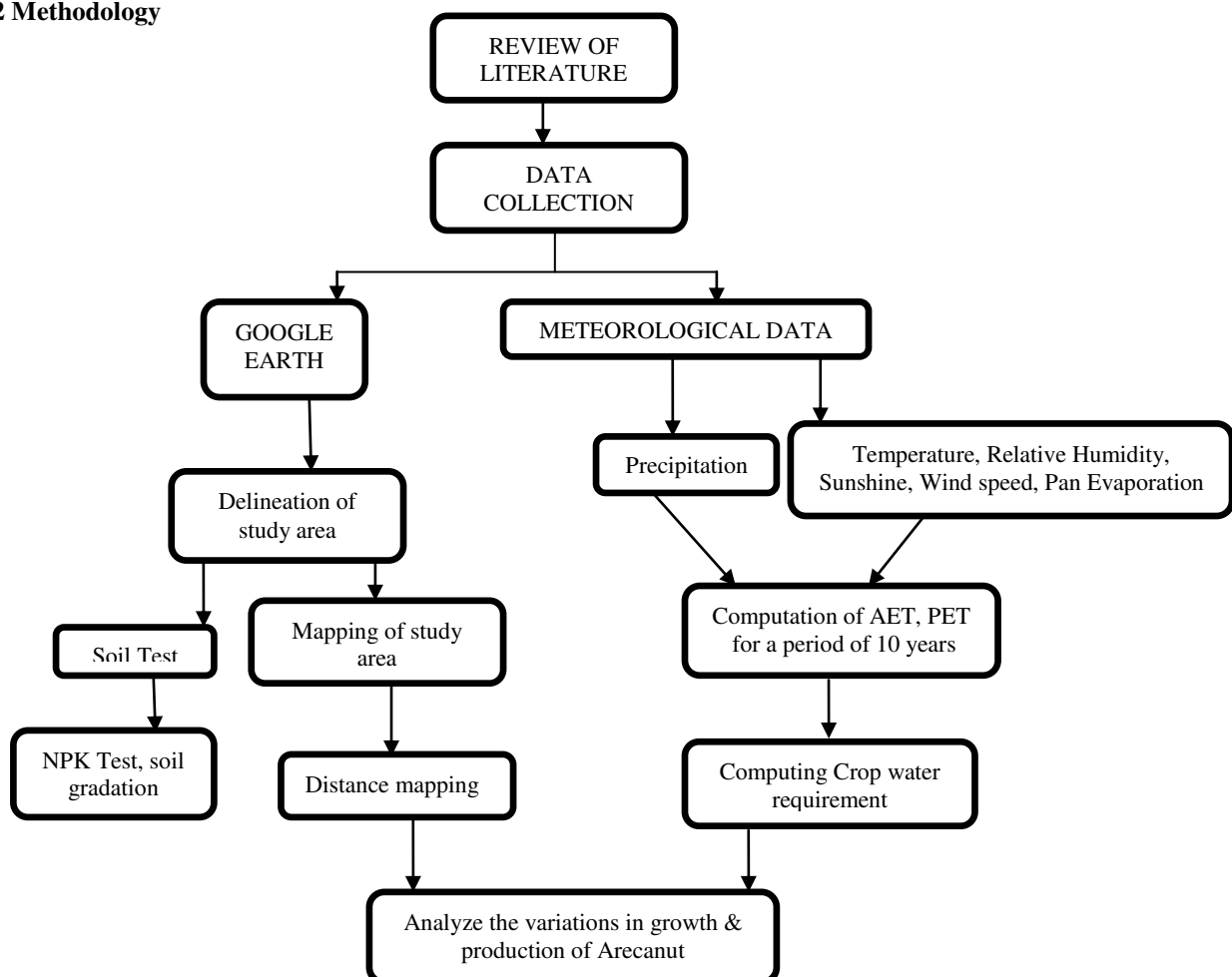
The region selected to conduct the analysis is Badaga Yekkar near Kateel having latitude 74.85°, longitude 13.03°. The region is having an area of 1.5 acres; consists of Arecanut plantation consisting of 250 arecanut plants of age 6 years. The type of soil that is present in the region of study is Sandy Clay Loam.

III. METHODOLOGY

3.1 Objectives

- To obtain the crop water requirement for Arecanut plantation in the region of Mangaluru Taluk.
- To compare the crop water requirement of Arecanut plant with the previous year and analyze the variations in its growth and production.

3.2 Methodology



3.2.1 Data Collection

Daily meteorological data for 10 years (2012-2021) were collected from Surathkal meteorological station. The main meteorological variables include Minimum-Maximum temperatures, Relative Humidity, Sunshine (hours), Windspeed and Pan evapotranspiration data. Rainfall data was collected from Rain gauge station, Surathkal. Soil data was collected through literature review and soil map. Crop details were collected from the agriculturalist.

3.2.2 Delineation of study area

The study area was selected for the study lies in the region of Badaga Yekkar in Kateel and is marked to its boundaries using Google earth. Shapefile of the study area was created using google earth.

3.2.3 Soil Testing

Soil samples were collected from the selected site and tested for NPK contents. Soil gradation test was carried out to know the quantity of sand, clay and silt present in the soil. The type of soil that is present in the region of study is Sandy Clay Loam. Figure 4 shows the soil map of Dakshina Kannada district.

3.2.4 Mapping of Study Area

Agricultural field mapping is a crucial tool for coordinating future activities and monitoring land. It helps you interpret and map many types of data, such as details on slopes, water, irrigation systems, and the nutrient and health of the soil. When done properly, it gives you the opportunity to practice a variety of methods on your property that are meant to optimize land usage, increase productivity, make better use of resources, and reduce potentially dangerous behaviours. Using Q-GIS, the study area is mapped.

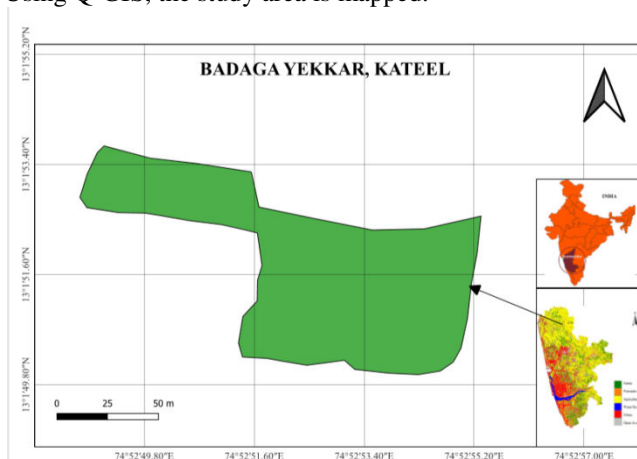


Fig.1 Study Area map

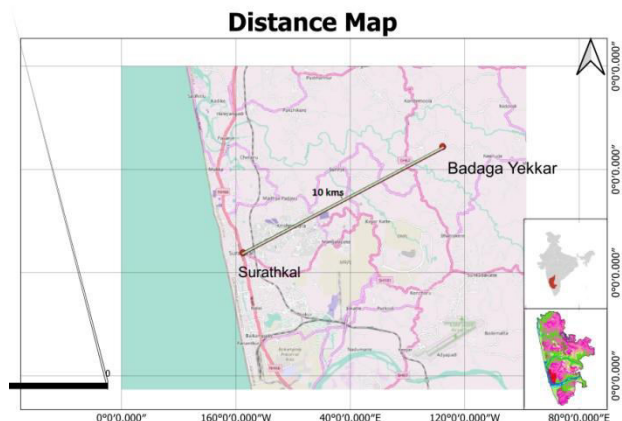


Fig.2 Distance map

IV. EXPERIMENTAL RESULTS

4.1 Soil test Results

NPK test results:

Nitrogen Content

Sample	Latitude	Longitude	Test value In (kg/ha)	Test value In (mg/l)	Rating
1	13°01'51.9"N	74°52'55.08"E	254	127	Low
2	13°01'50.44"N	74°52'53.95"E	366	183	Medium
3	13°01'50.72"N	74°52'53.08"E	329	164.5	Medium

Phosphorus Content

Sample	Latitude	Longitude	Test value in (kg/ha)	Test value in (mg/l)	Rating
1	13°01'51.9"N	74°52'55.08"E	8.65	4.325	Low
2	13°01'50.44"N	74°52'53.95"E	5.14	2.57	Low
3	13°01'50.72"N	74°52'53.08"E	2.7	1.35	Low

Potassium Content

Sample	Latitude	Longitude	Test value in (kg/ha)	Test value in (mg/l)	Rating
1	13°01'51.9"N	74°52'55.08"E	187	93.5	Medium
2	13°01'50.44"N	74°52'53.95"E	231.95	115.975	Medium
3	13°01'50.72"N	74°52'53.08"E	278.99	139.495	Medium

4.1 Analysis of rainfall data for past 10 years (2012-2021)

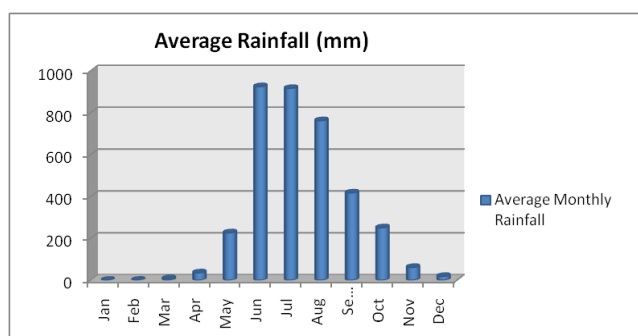


Fig.3 Rainfall graph

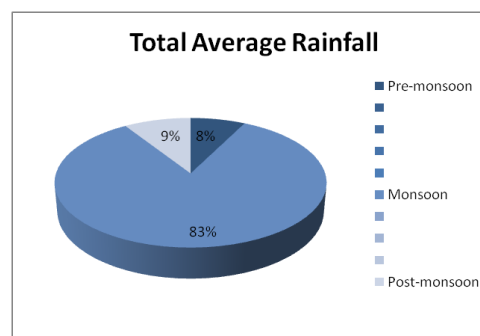


Fig.4 Distance map

4.2 Analysis of Temperature data for past 10 years (2012-2021)

Minimum & Maximum temperature data is collected for a period of 10 years from Surathkal station, Mangaluru Taluk. Monthly average Mean Temperature of 10 years is calculated using the collected data. A graph is plotted to show the variations in the temperature in the region of study.

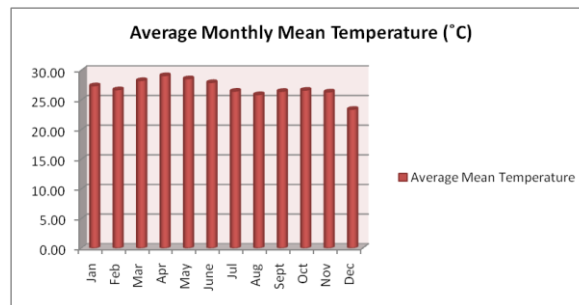


Fig.5 Avg. Temperature Graph

4.3 Analysis of Humidity data for past 10 years (2012-2021)

Relative Humidity (RH) data is collected for a period of 10 years from Surathkal station, Mangaluru Taluk. Monthly Average Relative Humidity of 10 years is calculated using the collected data. A graph is plotted to show the variations in the RH in the region of study.

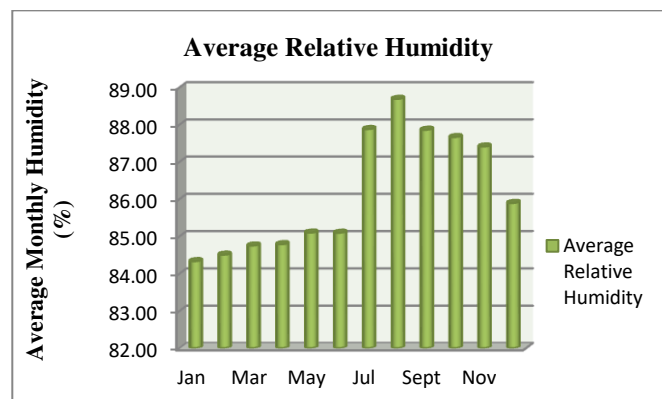


Fig.6 Relative Humidity graph

5.4 Analysis of Sunshine data for past 10 years (2012-2021)

Sunshine data is collected for a period of 10 years from Surathkal station, Mangaluru Taluk. Monthly Average Sunshine (Hours) of 10 years is calculated using the collected data. A graph is plotted to show the variations in the sunshine in the region of study.

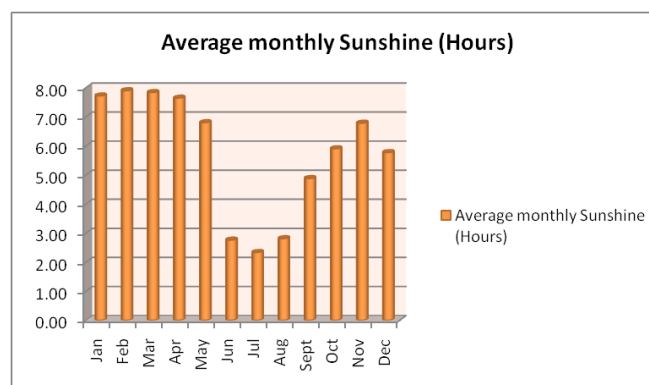


Fig.7 Average sunshine graph

5.5 Analysis of Windspeed data for past 10 years (2012-2021)

Windspeed data is collected for a period of 10 years from Surathkal station, Mangaluru Taluk. Monthly Average Sunshine (Hours) of 10 years is calculated using the collected data. A graph is plotted to show the variations in the windspeed of the selected region.

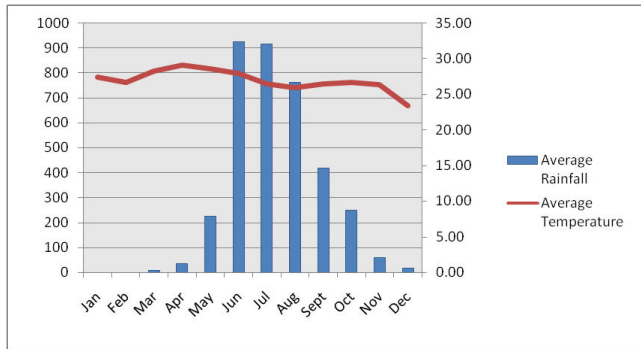


Fig.8 Variations in Total Average Monthly rainfall & Average Mean Temperature from 2012-2021

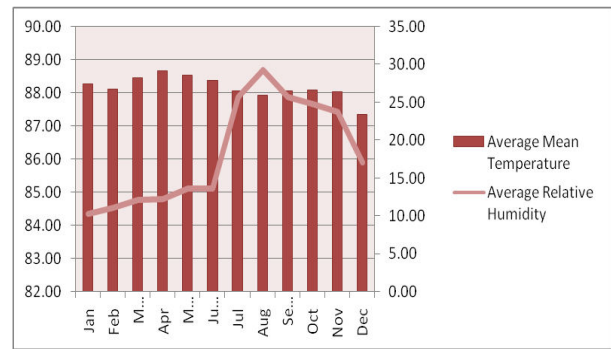


Fig.9 Variations in Average Mean Temperature & Average Relative Humidity from 2012-2021

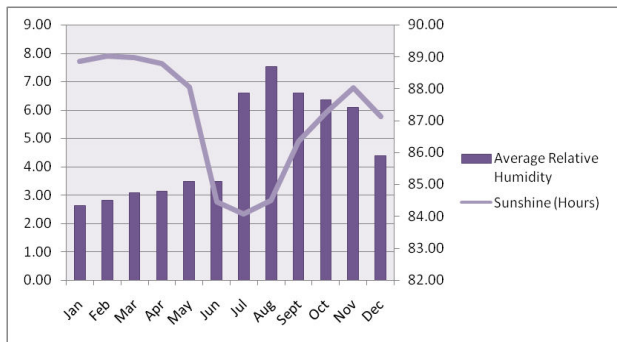


Fig.10 Variations in Avg. Sunshine (Hours) & Avg Relative Humidity from 2012-2021

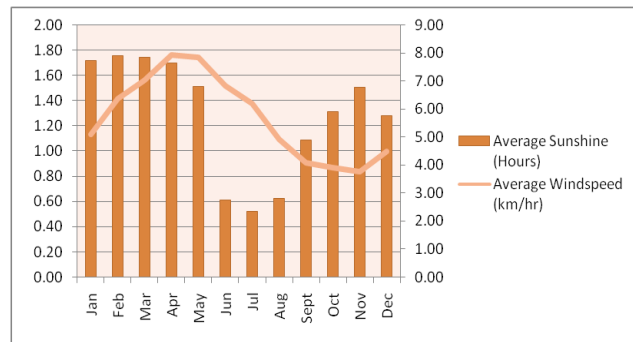


Fig.11 Variations in Avg. Sunshine (Hours) & Avg Windspeed (km/hr) from 2012-2021

5.6 Analysis of Evapotranspiration

One of the major parameter which affects the growth of Arecanut is Evapotranspiration. Variations the rate of evapotranspiration affects the crop water requirement. So it is very essential to consider this parameter for the study. A comparative study on Evapotranspiration is done using two methods; i.e., using Blaney- Criddle Method and Thornthwaite method.

Blaney- Criddle Method:

Potential Evapotranspiration (PET) calculated using Blaney- Criddle formula

$$PET, (ET_0) = p \cdot (0.46T + 8.128)$$

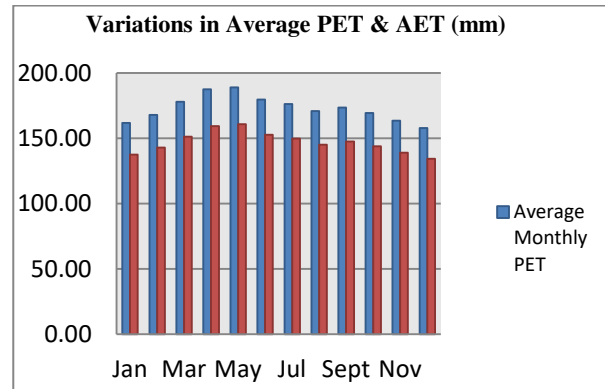
Where P is mean daily percentage of annual daytime hours, T is mean temperature, $T_{mean} = (T_{max} + T_{min}) / 2$

Actual evapotranspiration (AET) is calculated using the equation,

$$Etc = k_c \cdot ET_0$$

Where k_c is crop coefficient.

Months	Average Potential Evapotranspiration	Average Actual Evapotranspiration
<i>Jan</i>	161.70	137.44
<i>Feb</i>	168.01	142.81
<i>Mar</i>	177.92	151.23
<i>Apr</i>	187.55	159.41
<i>May</i>	189.10	160.73
<i>Jun</i>	179.78	152.81
<i>Jul</i>	176.22	149.79
<i>Aug</i>	170.84	145.22
<i>Sept</i>	173.52	147.49
<i>Oct</i>	169.39	143.98
<i>Nov</i>	163.64	139.09
<i>Dec</i>	157.92	134.23



5.6.2 THORTHWAITE METHOD

The Monthly Thornthwaite Heat Index I calculation is necessary in order to compute Potential Evapotranspiration (PET) using the Thornthwaite method.

$$i = \left(\frac{t}{5} \right)^{1.514}$$

the mean monthly temperature is represented by t .

The sum of the monthly heat indices I is used to determine the annual heat index (I) as follows:

$$I = \sum_{i=1}^{12} i$$

Applying the following equation and taking into account that a month has 30 days and that there are 12 hours of theoretical sunshine per day, a potential evapotranspiration (PET) estimation is produced for each month:

$$PET_{non\ corrected} = 16 \cdot \left(\frac{10 \cdot t}{I} \right)^{\alpha}$$

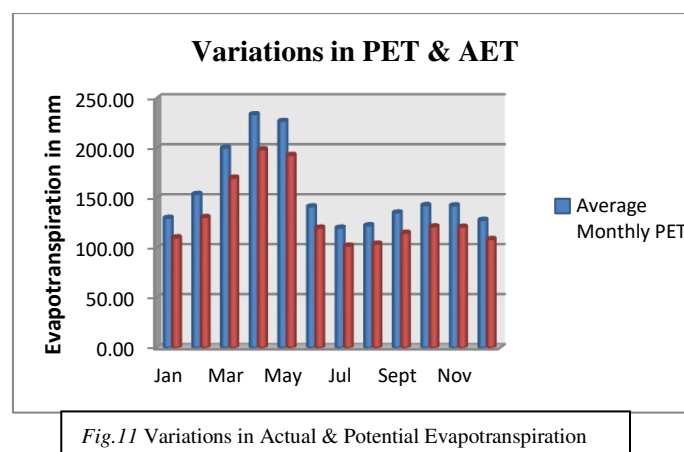
Where α is $\alpha = 675 \cdot 10^{-9} \cdot II_3 - 771 \cdot 10^{-7} \cdot II_2 + 1792 \cdot 10^{-5} \cdot II + 0.49239$

The values obtained are then rectified using the following calculation based on the actual length of the month and the estimated number of hours of sunshine at the desired latitude:

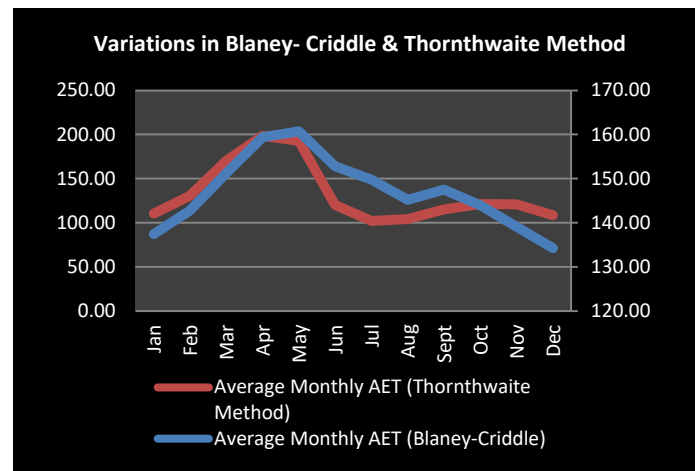
$$PET = PET_{non\ corrected} \cdot \frac{N}{12} \cdot \frac{d}{30}$$

Where N is total amount of days in a month.

Months	Average Potential Evapotranspiration	Average Actual Evapotranspiration
Jan	129.95	110.45
Feb	153.85	130.77
Mar	200.14	170.12
Apr	233.60	198.56
May	226.86	192.83
Jun	141.36	120.16
Jul	120.14	102.12
Aug	122.50	104.12
Sept	135.29	115.00
Oct	142.73	121.32
Nov	142.39	121.03
Dec	127.91	108.72



Below graph shows the variations in Actual evapotranspiration calculated using Blaney-Criddle method and Thornthwaite method.



4.7 Crop water requirement for Arecanut plantation:

Crop water requirements (CWR) are the amount of water [mm] needed to satisfy the evapotranspiration (ET_c) of a crop that is free of illness, growing in large fields under non-restrictive soil conditions, such as soil moisture and fertility, and reaching its full production potential in the given growing environment. The CWR is the total of "crop evapotranspiration" (ET_c), which is defined as the rate of evapotranspiration (millimetres per day) of a certain crop as impacted by its growth phases, environmental circumstances, and crop management to attain the potential crop production. When management or environmental variables deviate from the ideal, actual crop evapotranspiration is the rate of evapotranspiration that must be adjusted to the prevailing conditions (ET_a). Crop water requirement is calculated using equation

$$ET_c = k_c * ET_o$$

Where ET_o = p(0.46Ta+8) according to Blaney- Criddle formula

The concept of crop water requirement (CWR) for irrigated crops must be supplemented by the idea of irrigation water requirement, which is the net depth of water (mm) that must be administered to a crop in order to fully achieve its specific crop water demand. The IWR is the portion of the CWR which is not satisfied by precipitation, soil water storage, or groundwater contribution. When adding a leaching fraction is necessary to achieve proper salt leaching in the soil profile, this water depth is also taken into account by IWR. IWR must be converted into gross irrigation requirements in order to take the efficiency of the irrigation systems into consideration. From the above analysis, the crop water requirement for Arecanut is obtained is shown in below table.

Months	Crop water requirement (CWR in mm)
Jan	137.44
Feb	142.81
Mar	151.23
Apr	159.41
May	160.73
Jun	152.81
Jul	149.79
Aug	145.22
Sept	147.49
Oct	143.98

<i>Nov</i>	139.09
<i>Dec</i>	134.23

Irrigation water need is calculated using the formula,

$$IN = ET_{\text{crop}} - Pe$$

Where ET_{crop} is crop water need and Pe is effective rainfall.

Months	Irrigation Need (IN in mm)
<i>Jan</i>	138.35
<i>Feb</i>	143.52
<i>Mar</i>	151.50
<i>Apr</i>	146.67
<i>May</i>	3.08
<i>Jun</i>	-562.14
<i>Jul</i>	-558.46
<i>Aug</i>	-439.86
<i>Sept</i>	-161.40
<i>Oct</i>	-31.88
<i>Nov</i>	107.48
<i>Dec</i>	130.88

From the analysis carried out for 10 years duration considering all the parameters, it is seen that crop water requirement is more during pre-monsoon season i.e., during the month of January-May. CWR decreases gradually during monsoon and post monsoon. Crop water requirement for past 10 years is calculated using Blaney- Criddle method. On an average the production of Arecanut in the region is 8 quintal.

The 10-year study indicated that there is in the Arecanut plants starts to produce yield at the age of 3-5 years. In the beginning of the yield i.e., 5-8 years plant produces 100-150 kg Arecanut per year. When the plants reach 12 years of age it produces 8 quintal Arecanut per year. Fully grown Arecanut process 12 quintal Arecanut. There is substantial increase in the Arecanut production A rise in productivity assures that the two most important inputs, namely water and nutrients, are used more effectively in the production of crops.

The fluctuations in arecanut yield caused by climatic changes and the amount of nutrients in the soil show that appropriate supplies of nutrients and water are required to overcome soil and climatic limitations in laterite soils. The analysis clearly illustrates that arecanut farmers can benefit from adopting drip fertigation technique to provide nutrients, sprinkler system or drip irrigation system to water the farm, leading to improved yields, resource usage efficiency and profitability.

V. CONCLUSIONS

- In this study, variations in the Arecanut growth in the region of Badaga Yekkar, Kateel in past 10 years were analyzed.
- NPK test was carried out to determine nutrient content in the soil. It is found that Nitrogen (158.167mg/l) and Potassium contents (2.74mg/l) are present in sufficient amount while Phosphorus content (116.32mg/l) is low.
- In addition, two different methods to find evapotranspiration were carried out in order to find the crop water requirement for the Arecanut plantation in the selected region.

- Crop water requirement for past 10 years is calculated using Blaney- Criddle method, as it is more appropriate method when compared to Thornthwaite method.
- It is found that water requirement for Arecanut is 150.324 mm during the summer when compared to monsoon and post monsoon whose requirements are 149.27mm & 139mm respectively.

REFERENCES

- [1] Boutaina Sebbah, Otmane Yazidi Alaoui, Miriam Wahbi, Mustapha Ma'atouk, Nizar Ben Achhab, "QGIS-Landsat Indices plugin (Q-LIP): Tool for environmental indices computing using Landsat data", Elsevier 2021.
- [2] Devaki Nandan Sharma, Vinod Tare, "Assessment of irrigation requirement and scheduling under canal command area of Upper Ganga Canal using CropWat model", Springer 2021.
- [3] Revati P. Potdar, Mandar M. Shirolkar, Alok J. Verma, Pravin S. More & Atul Kulkarni "Determination of soil nutrients (NPK) using optical methods: a mini review", Taylor & Francis 2021.
- [4] Keyu Xiang, Yi Li, Robert Hortond, Hao Fenge, "Similarity and difference of potential evapotranspiration and reference crop evapotranspiration – a review", Elsevier 2020.
- [5] Mohamed Elsayed Gabr, Ehab Mostafa Fattouh, "Assessment of irrigation management practices using FAO-CROPWAT 8, case studies: Tina Plain and East South El-Kantara, Sinai, Egypt". Elsevier 2020.
- [6] Rodney L. Gondwe, Rintaro Kinoshita, Tsutomu Suminoe, Daigo Aiuchi, Jiwan P. Palta & Masayuki Tani, "Available Soil Nutrients and NPK Application Impacts on Yield, Quality, and Nutrient Composition of Potatoes Growing during the Main Season in Japan", Springer 2020.
- [7] Youssef Lebrini, Abdelghani Boudhar, Abdelaziz Htitiou, Rachid Hadria, Hayat Lionboui, Lahouari Bounoua & Tarik Benabdelouahab, "Remote monitoring of agricultural systems using NDVI time series and machine learning methods: a tool for an adaptive agricultural policy", Elsevier 2020.
- [8] Vaibhav Bhatnagar & Ramesh C. Poonia, "A prototype model for decision support system of NPK fertilization", Taylor & Francis 2018.
- [9] Bhojaraja B. E.,* Gaurav Hegde, Pruthviraj U., Amba Shetty, Nagaraj M. K, "Mapping Agewise Discrimination of Arecanut Crop Water Requirement using Hyperspectral Remote Sensing", Elsevier 2015.
- [10] Yanjun Shen, Shuo Li, Yaning Chenc, Yongqing Qi, Shuowei Zhang "Estimation of regional irrigation water requirement and water supplyrisk in the arid region of Northwestern China 1989–2010", Elsevier 2013.



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