

“IRRIGATION WATER MANAGEMENT PRACTICE IN NAVSARI DISTRICT”

A PROJECT REPORT

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ABSTRACT

Schedule irrigation of the any crop give the better overall output rather than using randomly (i.e not randomly but with assumption made from past experience)so, we prepared the detailed schedule of the sugarcane and paddy crop for the Eroo district of Navasari using Cropwat software and also we provide the crop water requirements (CWR) ,We used the meteorological data and soil data of the study area all of the data collected from the Navsari agriculture University and some from field (some soil datas are assumption because of the calculation of the that constant is difficult also it's value doesn't effect too much on results, it's give the fairly accurate results).Suggesting the better and cost effective irrigation system the Mango Farm in Eroo area of Navasari district of Gujarat. Existing irrigation system is good enough for limited Mango tree but for large area it's become difficult and requires lots of time and labour and we created the GUI(Graphical user interface) application for the drip irrigation system and calculating the overall cost using python programming language.

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CHAPTER 1: INTRODUCTION

1.1 General

Studies at the Warrington Irrigation Research Farm are aimed at using water to maximize crop yields and improve profits.

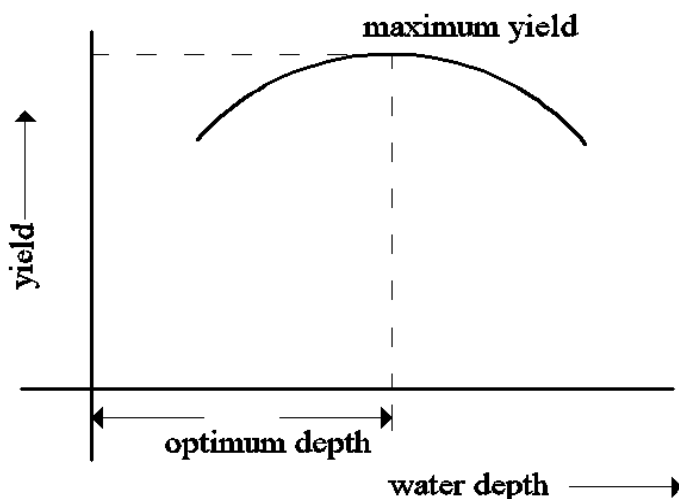
Water is one of the most critical crop needs. By improving water management, farmers can be sure that their crops receive adequate water throughout the growing season. A more efficient irrigation system can save money, energy, and reduce carbon dioxide emissions. In the Mid-Atlantic region, high heat and droughts are likely to become more common as the climate changes. Irrigation is widely used to protect crop yields during these extreme events. More efficient use of water will help growers maintain or increase their crop yields under changing climate conditions and better protect the environment.

- What is irrigation?

Irrigation may be defined as the science of the artificial application of water to the land in order to fulfill the water requirements of the crops throughout the crop period.

- Crop period: -

The time period between the instant of sowing seeds to the instant of harvesting the plants is called crop period.



- Irrigation water should be supplied as soon as the moisture falls up to the optimum level. The quantity of water that produces the maximum yield of the crops is termed as optimum water level. More or less than the optimum level results in the reduction of the yield.
- Soil moisture content: - The amount of water present in a soil moisture content. It is expressed as 'mm' of water depth present in 1 m depth of soil.

- **Saturation capacity:** - It is the amount of water required to fill all the pore spaces between soil particles by replacing all air held in pore spaces. It is also known as maximum moisture holding capacity.
- **Field Capacity:** -
The amount of soil moisture or water content held in the soil after excess water has drained away and the rate of downward movement has decreased. This usually takes place 2–3 days after rain or irrigation in pervious soils of uniform structure and texture.
- **Permanent wilting point:** -
It is defined as the minimum amount of water in the soil that the plant requires not to wilt. If the soil water content decreases to this or any lower point a plant wilts and can no longer recover.
- **Available Water Capacity:** -
The available water (holding) capacity is the portion of water that can be absorbed by plant roots. By definition it is the amount of water available, stored, or released between field capacity and the permanent wilting point water contents.

1.2 Methods of irrigation :-

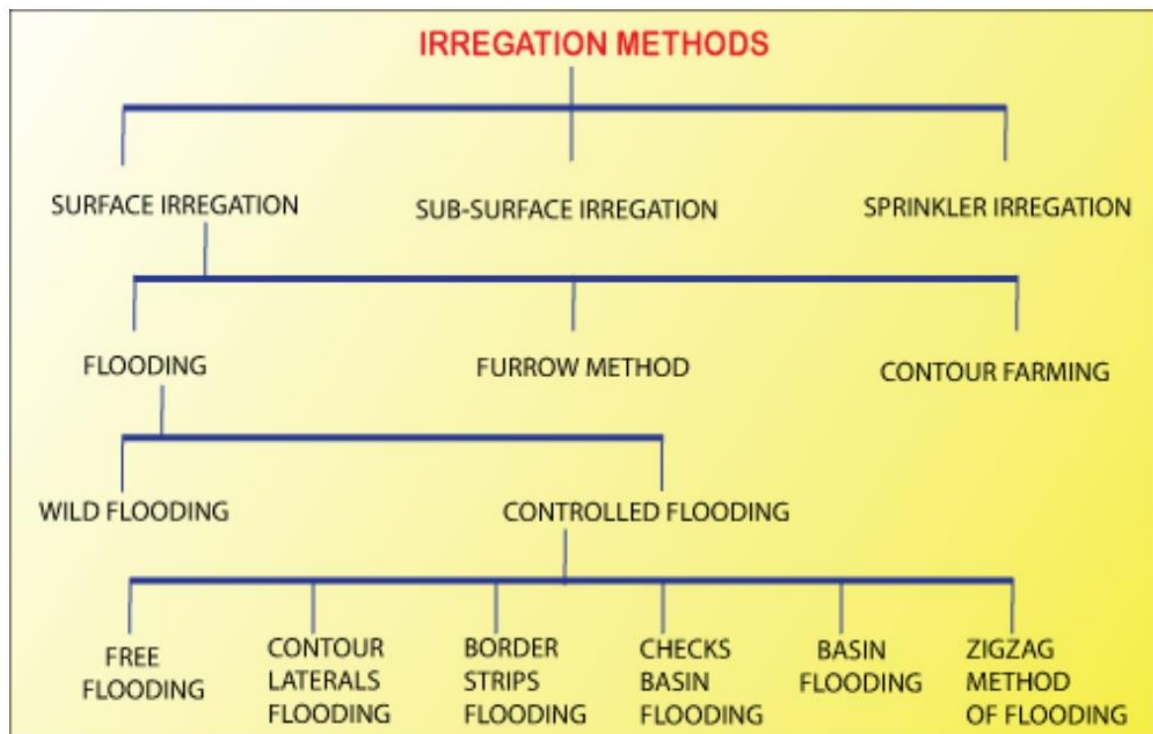


Fig 1.1 Methods of irrigation

1.2.1 Surface Irrigation

In this technique water flows and spreads over the surface of the land. Varied quantities of water are allowed on the fields at different times. Therefore, flow of water under surface irrigation comes under wobbly flow

- If the surface irrigation method is perfectly selected, it fulfils following requirements:
 1. It assists in storing required amount of water in the root-zone-depth.
 2. It reduces the wastage of irrigation water from the field in the form of run-off water.
 3. It reduces the soil erosion to minimum.
 4. It helps applying uniform application of water to the fields.
 5. Amount of manual labour required is less.
 6. It is suitable to the size of the field and at the same time it uses minimum land for making ditches, furrows, strips, etc.

Free Flooding

This flooding system of irrigation is used from ancient times. Flooding method consists in applying the water by flooding the land of rather smooth and flat topography. In current irrigation practice, several flooding methods have been developed. In free flooding method, water is applied to the land from field ditches without any check or guidance to the flow. The land is divided into plots or kiaries of suitable size depending on porosity of soil. Water is spread over the field from watercourse. The irrigation operation begins at the higher area and proceeds towards the lower levels.

Border Strip Method

In this technique of irrigation, a field is divided into number of strips. The width of strip varies from 10 to 15 metres and length varies from 90 m to 400 m. Strips are separated by low embankments or levees. The water is diverted from the field channel into the strips. The water flows gradually towards lower end, wetting the soil as it advances. The surface between two embankments should essentially be level. It assists in covering the entire width of the strip. There is a general surface slope from opening to the lower end. The surface slope from 2 to 4 m/1000 m is best suited. When the slope is steeper, special arrangement is made to prevent erosion of soil.

Furrow irrigation

Furrow irrigation is conducted by creating small parallel channels along the field length in the direction of predominant slope. Water is applied to the top end of each furrow and flows down the field under the influence of gravity. Water may be supplied using gated pipe, siphon and head ditch, or bankless systems. The speed of water movement is determined by many factors such as slope, surface roughness and furrow shape but most importantly by the inflow rate and soil infiltration rate. The spacing between adjacent furrows is governed by the crop species,

common spacing typically range from 0.75 to 2 metres. The crop is planted on the ridge between furrows which may contain a single row of plants or several rows in the case of a bed type system. Furrows may range anywhere from less than 100 m to 2000 m long depending on the soil type, location and crop type.

1.2.2 Subsurface irrigation

Subsurface irrigation uses a network of polyethylene pipes located just under the ground's surface to apply disinfected effluent in the root zone of plants, preventing airborne drift and minimising runoff.

Subsurface irrigation requires less maintenance than surface irrigation, and there is also less chance of surface saturation and effluent runoff. By reducing the chance of human contact

1.2.3. Sprinkler Irrigation

In the sprinkler technique of irrigation, water is sprinkled into the air and allowed to fall on the ground surface just like rainfall. The spray is done by the flow of water under pressure through small orifices or nozzles. The pressure is generally obtained by pumping. Through proper selection of nozzle sizes, operating pressure and sprinkler spacing the amount of irrigation water required to refill the crop root zone can be applied almost uniform at the rate to suit the infiltration rate of soil. In agriculture, almost all crops are suitable for sprinkler irrigation system except crops such as paddy and jute. The dry crops, vegetables, flowering crops, orchards, plantation crops like tea, coffee are all suitable and can be irrigated through sprinklers techniques of irrigation.

1.2.4. Drip irrigation

In the area of irrigation process, drip irrigation is modern technique. It is also called trickle irrigation.

In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface. The soil moisture is kept at an optimum level with frequent irrigations. In this method irrigation water is conveyed on the surface in 12 to 16 mm diameter tubing's fed from large feeder pipes. The water is allowed to drip or trickle slowly through the nozzle or orifices at practically zero pressure. In this way the soil in the root-zone of crops is constantly kept wet. Drip irrigation results in a very high water application efficiency of about 90-95 per cent.

One of the main purposes of drip irrigation is to decrease the water consumption by reducing the leaching factor.

- The advantages of drip irrigation are under:
 1. Possibility of using soluble fertilizers and chemicals.
 2. Fertilizer and nutrient loss is minimized due to localized application and reduced leaching.
 3. Water application efficiency is high.
 4. Field levelling is not necessary. Fields with irregular shapes are easily accommodated.

5. Recycled non-potable water can be safely used.
6. Soil type plays less important role in frequency of irrigation.
7. Soil erosion is lessened.
8. Weed growth is lessened.
9. Water distribution is highly uniform, controlled by output of each nozzle.
10. Labour cost is less than other irrigation methods.
11. Variation in supply can be regulated by regulating the valves and drippers.

1.4 Introduction of CROPWAT: -

- CROPWAT is a decision support tool developed by the land and water development division of FAO. CROPWAT 8.0 for Windows is a computer program for the calculation of crop water requirements and irrigation requirements based on soil, climate and crop data.

Function of CROPWAT: -

- To calculate reference evapotranspiration, crop water requirements, crop irrigation requirements.
- To develop irrigation schedules under various management conditions, Scheme water supply.

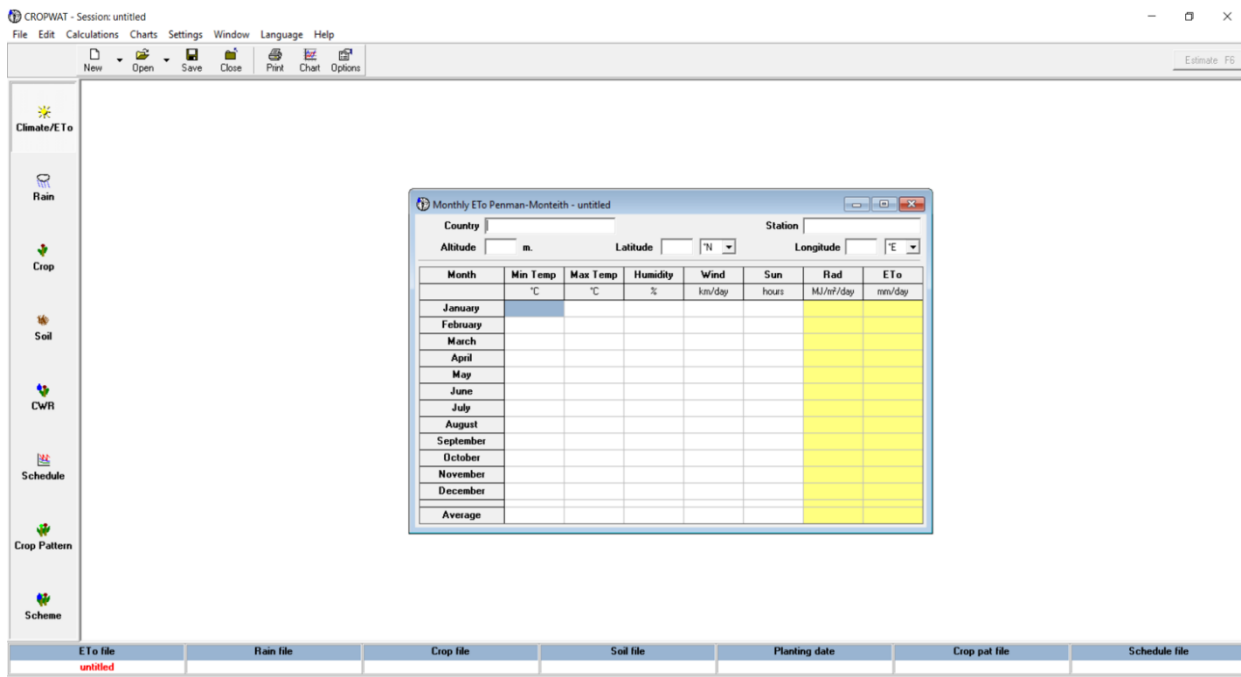


Fig 1.2 (CROPWAT software)

1.5 Aim: -

- To improve the overall production of the crop by doing irrigation water management with the help of CROPWAT software.
- Study area details: -
 - Area near Navsari Agriculture university (Eroo & Bhutsad)

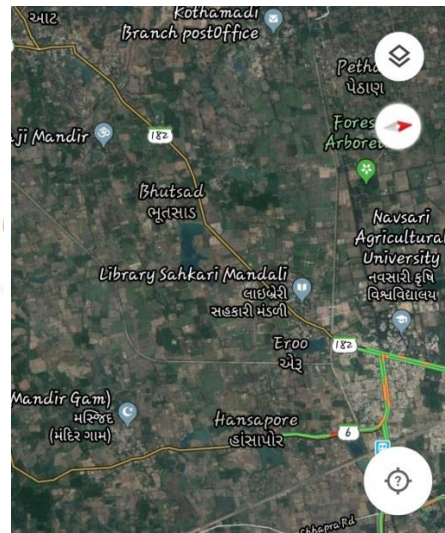
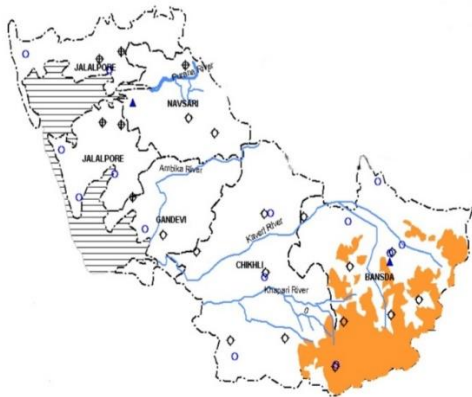


Fig 1.3
(Study area map)

1.6 Scope: -

- By the use of CROPWAT software, with the help of an actual data set, crop water requirement and irrigation scheduling are calculated.
- Prepare the design of drip irrigation system.

Chapter 2: Identification of the problem

2.1 Literature Review: -

Review paper 1

- **Title:** -Irrigation water management strategies for wheat under sodic environment
- **Author:** - Atul Kumar Singh, Sanjay Arora.
- **Publication:** - Journal of Soil and Water Conservation · July 2016
- **Outcomes:** -

Wheat is a moderately salt-tolerant crop as well as susceptible to excess application of irrigation water. In turn, the irrigation water productivity of sprinkling methods just doubled than the surface method of irrigation and also saving of water in the range of 30 to 40% by sprinkling methods over surface methods of irrigation. Energy productivity of surface and sprinkler methods is nearly same; this is, due to higher operating pressure requirement of sprinkler nozzles used during the experimentation. It is suggested to use sprinkler nozzles requiring low operating pressure to achieve higher energy productivity. Overall, it is observed that there is substantial saving of water while practicing irrigation through sprinkling methods over surface method of irrigation.

Review paper 2

- **Title:** - Water Management Strategies Under Deficit Irrigation
- **Author:** - Antonina Capra, Simona Consoli, Baldassare Scicolone
- **Publication:** -Journal of Agricultural Engineering- Riv. di Ing. Agr. (2008)
- **Outcomes:** -

The review of the experimental research shows quite positive effects from Deficit irrigation applications. The positive effects are mostly evidenced when the economics of Deficit irrigation is included in the research approach. The applications present a wide survey of the agronomic effects of Deficit irrigation. Generally, total fresh mass and total production are reduced under Deficit irrigation, whereas the effects on dry matter and product quality are positive, mainly in crops for which excessive soil water availability significantly influences the size, color or composition of fruit (grape, tomato, mango, etc.). The economic convenience of Deficit irrigation therefore also depends on the type of crop.

Review paper 3

- Title: - Modelling the crop water requirement using FAO-CROPWAT and assessment of water resources for sustainable water resource management: A case study in Palakkad district of humid tropical Kerala, India
- Author: - U. Surendran, C.M.Sushanth, George Mammen, and E.J.Joseph
- Publication: - International Conference on Water Resources, Coastal and Ocean Engineering (Icwrcoe 2015)
- Outcomes: -

An attempt has been made to compute the crop water requirements of major crops in different agro-ecological zones of Palakkad using CROPWAT 8.0 model of FAO and comparing the same with the available water resources of the district. The major cultivated crops are rice, coconut, banana, vegetables, pulses, rubber, tea, coffee, cotton etc. The total water requirement for these crops in various agro-ecological zones has been computed. Using the evapotranspiration (ET₀) and effective rainfall in each agro-ecological unit (AEU), a climatic water balance has been worked out. However, the secondary data showed that utilizable water resources of Palakkad district is less and will create a deficit scenario. This deficit indicates that if the total area is brought under irrigation there will be deficit years and during such period's deficit irrigation or reduction in command area may have to be adopted.

Review paper 4

- Title: -Irrigation Water Use Efficiency: Review
- Author: - Gashaw Tenna Alemu, Zewdu Berhanie, Asegdew Gashaw
- Publication: -Radix International Journal of Research in Social Science, Volume 6, Issue 4 (April, 2017), issn: 2250 – 3994
- Outcomes: -

Water needs to be properly managed and used productively and efficiently. There is a quantitative reduction of water resource and increasing conflict of use due to environmental problem, increasing population, urbanization, land scarcity, etc. Hence, there is a need for improvements in the efficiency of existing irrigation production activity and a need for reducing the wastes of the resource. Pricing and valuing water must be seen as tools necessary to operationalize the concept of irrigation water use efficiency as it does away with the notion of 'free' water, which is common at the local level. In many literatures' irrigation water use efficiency, i.e. the amount of water actually utilized.

Review paper 5

- Title: - Efficient Water Saving Technique for Green Farming using IOT
- Author: - Nurjaha Bagwan, Pradnya Kushire, Manasi Deshpande, Priyanka Singh, Prof. Shyam Gupta.

➤ Publication: - International Journal of Scientific Research in Computer Science,2017
IJSRCSEIT | Volume 2

➤ Outcomes:-

The need for systems that make agriculture easier and more sustainable has increased within the past few years. The ability to conserve two of the most important resources of a farmer, water and time, has been the latest challenge. A system that provides this ability - through the use of efficient and reliable methods such as wireless sensor networking, sprinkler irrigation, GSM, SMS technologies and readily available mobile phone devices is certain to help the farmers get a better yield and on a larger scale, help the agricultural and economic growth of the country.

Review paper 6

➤ Title :- AN EMPIRICAL STUDY ON DRIP IRRIGATION

➤ Author :- E.Sathyapriya1* M.R.Naveenkumar2 and V.Dhivya3

➤ Publication :- 1&2 Ph.D. Scholars, Department of Agricultural Extension and Rural Sociology, 3 Ph.D. Scholars, Department of Agricultural Entomology, TNAU, Coimbatore.

➤ Outcomes :-

The Benefits encountered by the farmers are saving of water, uniform application and easy method of irrigation and the constraints are problem of non-availability of quality material and no follow up services by drip agencies. It is clear from the study that the drip irrigation agencies, financing institutions and others to supply adequate standard spare parts and other appropriate measures to ensure the satisfactory situation for proper adoption of drip irrigation method.

Review paper 7

➤ Title :- Effect of Sprinkler Irrigation Systems and Irrigation Frequency on Water Use Efficiency and Economical Parameters for Wheat Production

➤ Author :- Abdelraouf Ramadan Eid1*, Ahmed Mohamed El-Farouk2, Bakry Ahmed Bakry3 , M. KH. Elbegawy

➤ Publication :- International Journal of Scientific Research in Agricultural Sciences, 1(4), pp. 56-66, 2014

➤ Outcomes :-

Under solid set sprinkler irrigation system and irrigation frequency three times per week (IF3) occurred best result of technical side and occurred also, maximum value of net return and there are significant differences. Applying any technique depending on two

sides, technical side and the other is economical side. Total costs, total income and net return were studied as a evaluation parameters to the effect of sprinkler irrigation systems and irrigation frequency.

Review paper 8

- Title :- AUTOMATIC IRRIGATION SYSTEM FOR AGRICULTURE FIELD USING WIRELESS SENSOR NETWORK (WSN)
- Author :- Prof. Rashmi Jain, Shaunak Kulkarni, Ahtesham Shaikh, Akash Sood.
- Publication :- International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 04 | Apr-2016.
- Outcomes :-

The greenhouse based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are precisely controlled. The main objective of the present paper is to develop a smart wireless sensor network (WSN) for an agricultural environment. Monitoring agricultural environment for various factors such as soil moisture, temperature and humidity along with other factors can be of significance. A traditional approach to measure these factors in an agricultural environment meant individuals manually taking measurements and checking them at various times. This paper investigates a remote monitoring system using RF module. These nodes send data wirelessly to a central server, which collects the data, stores it and will allow it to be analyzed then displayed as needed and can also be sent to the client mobile. we can improve the traditional way of agriculture irrigation system in different region of India.

2.2 Objectives

- To provide solution for improvement and regulation of existing water management facilities.
- Evapotranspiration estimation using CROPWAT, study of methods of irrigation and water management practices in Navsari district.
- Prepare the design of drip irrigation system of our study area.

CHAPTER 3 METHODOLOGY

3.1 Project procedure

Every project has one type of procedure to complete it regularly and easily. In this project we cover to aspects of the irrigation schedule for the paddy and sugarcane using CROPWAT software and drip irrigation system design for the Mango farm.

3.1.1 Procedure for CROPWAT irrigation schedule and Crop water requirements (CWR)

1. Data collection
2. Feeding the data into software
3. Final result from software
4. Conclusion based on result

3.1.1.1 Data collection

- First of all, we collected metrological data from the agricultural university of Navsari.
 - We meet the professor of metrological department of Navsari agricultural university and collect the metrological data last 20 years.
 - From this data, by using CROPWAT software different data about Crop water requirement (CWR) and Scheduling of irrigation is calculated for that area.
-
- We first visit of Navsari agriculture university for information about data collection.
 - Second visit we collected metrological data for the Navsari station.
 - Third visit we show the different type of the crop farm near eroo area. We show the method of irrigation farmer used.

Fig 3.1 - Flowchart

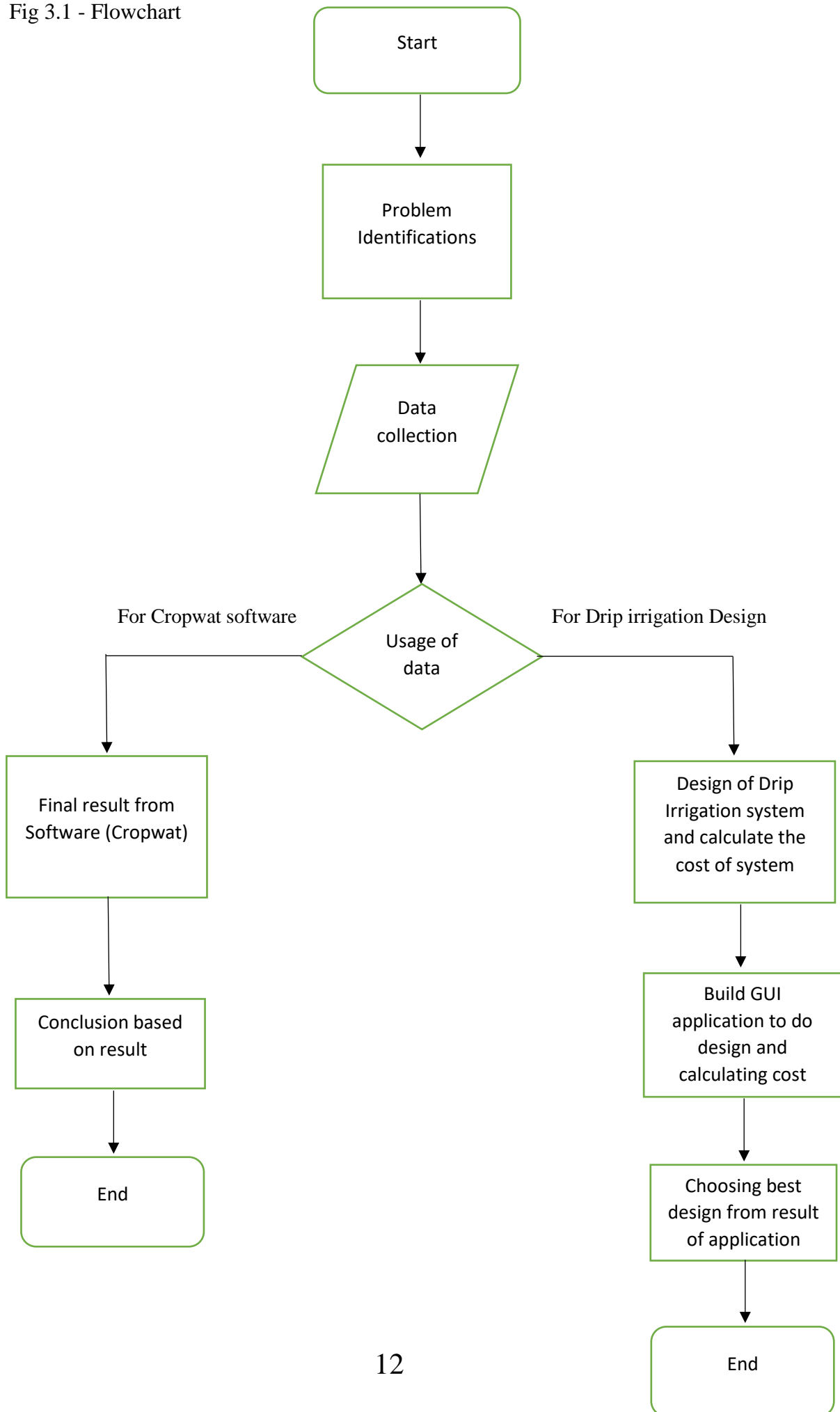




Fig 3.2 & 3.3 : different type of the crop

- We meet the different farmers and collect information about which type of crop take in different season.
- We show the one mango farm in this farm we show the drip irrigation system and collect details about this crop.



Fig 3.4 drip irrigation in mango farm

- We visit one another mango farm but this farm not used drip irrigation system.



Fig 3.5 Mango farm without drip irrigation

➤ **Questionnaire survey: -**

- we meet the farmers and done the questionnaire survey. We use the questions for this survey is below,

Questions
1. Name of Farmer?
2. Size of Farm?
3. What is name of crop?
4. Season of the crop?
5. Time period of the crop?
6. Type of irrigation system used?
7. Which irrigation method use?
8. Detail about irrigation system?
9. Type of Fertilizer and How much used?
10. Cost of the fertilizer?
11. Cost of the seeds?
12. Cost about labours in different works?
13. Cost of the electricity?
14. Estimated Product?
15. Estimate price and Profit of product?

3.1.1.2 Feeding the data into software: -

We collect the raw data from the farm through Questionnaire survey and data from the Navsari agriculture University, after collecting raw data we sorted the data according to use. After sorted data were feed into the software.

Following data is sorted according to need: -

1. Minimum temperature, Maximum temperature, wind speed, humidity, sun hours for calculating evapotranspiration.
2. Rainfall data
3. Soil data

❖ For the last 20 years metrological data collected we plot the graphs of tmax tmin, humidity, wind speed.

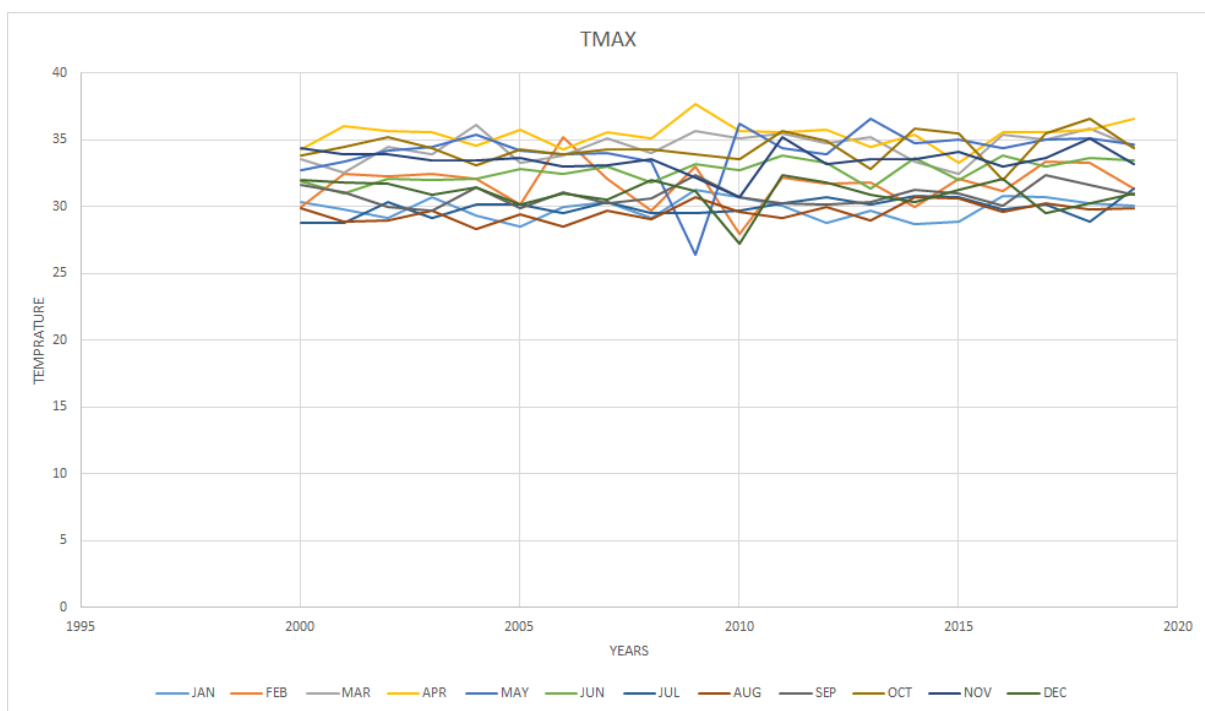


Fig 3.6 : Graph of Tmax vs time (years)

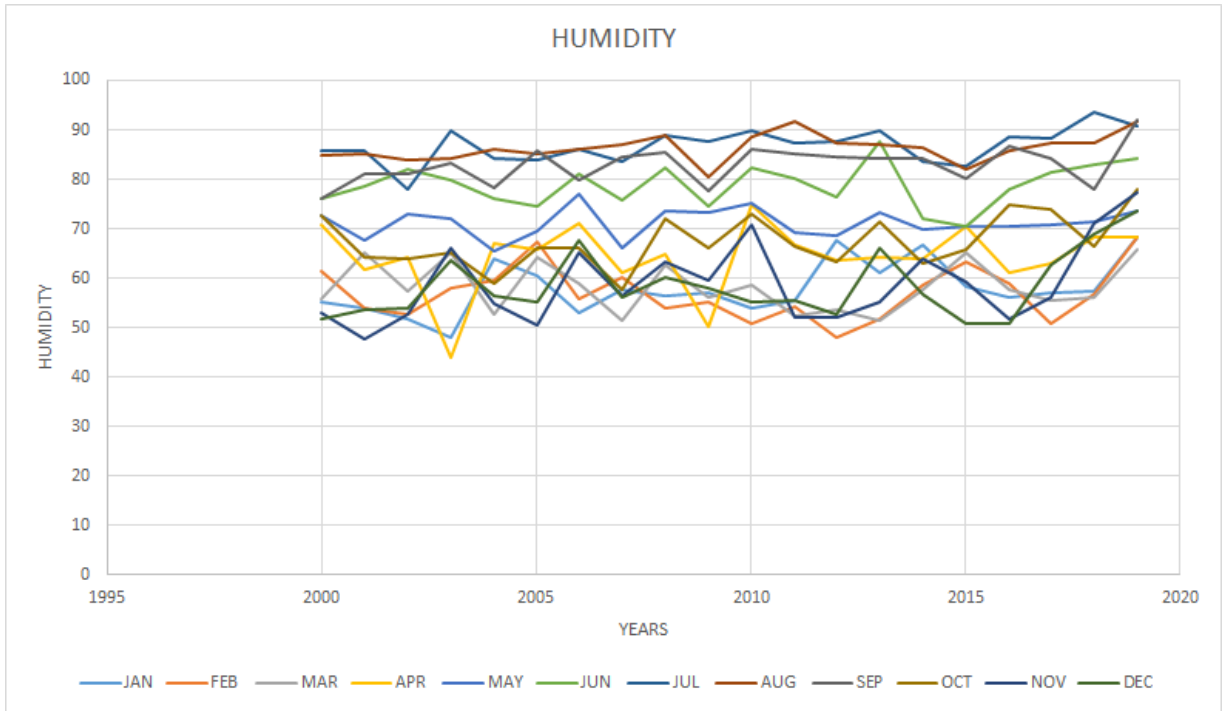


Fig 3.7 : Graph of Humidity vs time (years)

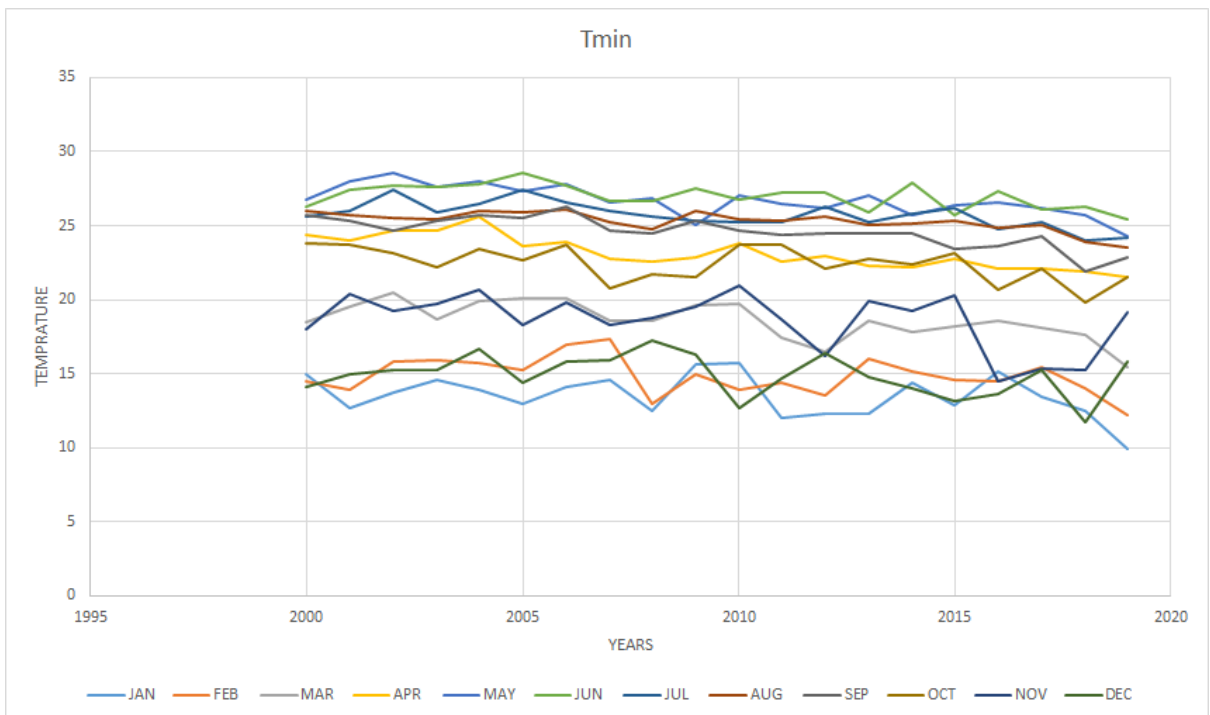


Fig 3.8 : Graph of Tmin vs time (years)

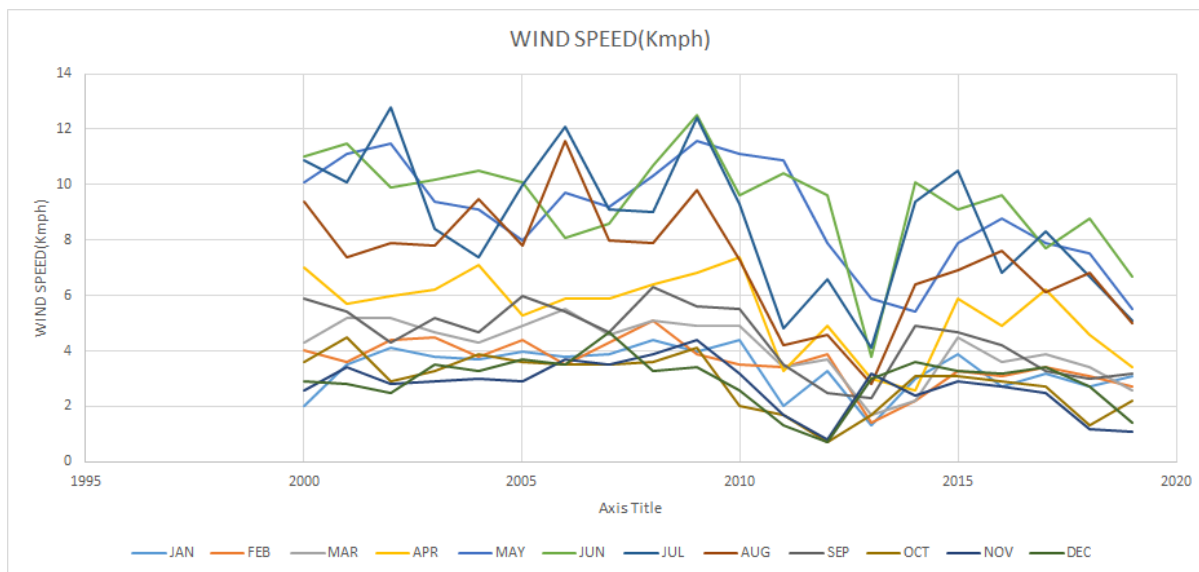


Fig 3.9 : Graph of wind speed (kmph) vs time (years)

We feed the worst year data of the Minimum temperature, maximum temperature, wind speed, humidity of the last 20 years to the software for the replicate the worst year scenario to estimate the best solution for the any situation.

➤ Below figure shows the data entry in CROPWAT software

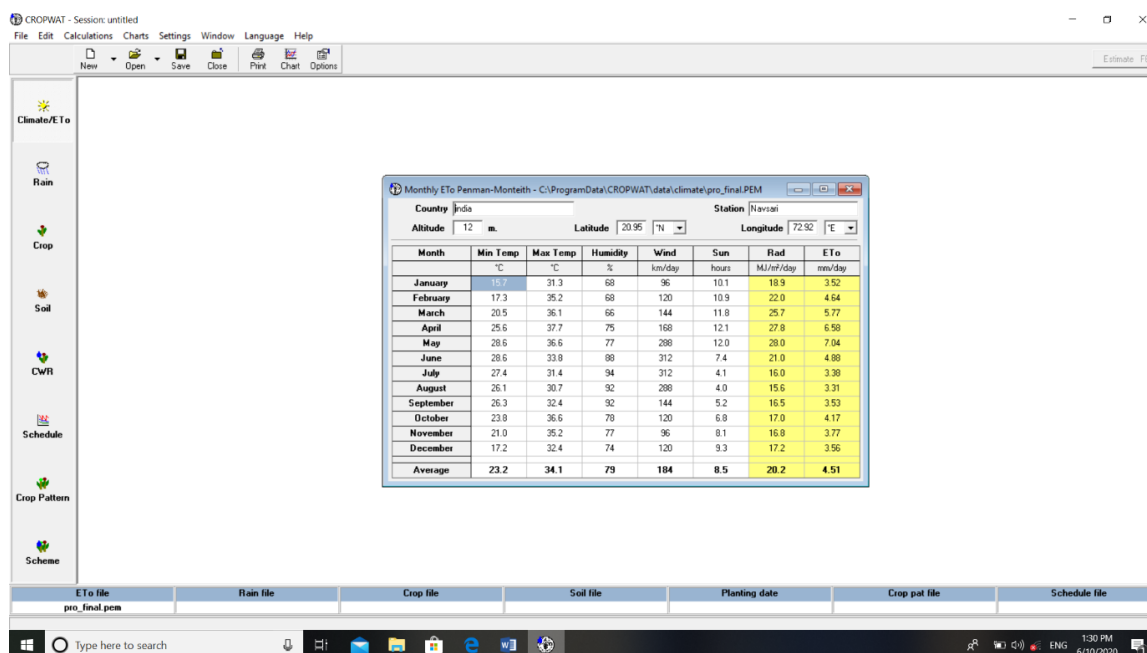


Fig 3.10 : Data entry in CROPWAT (ET)

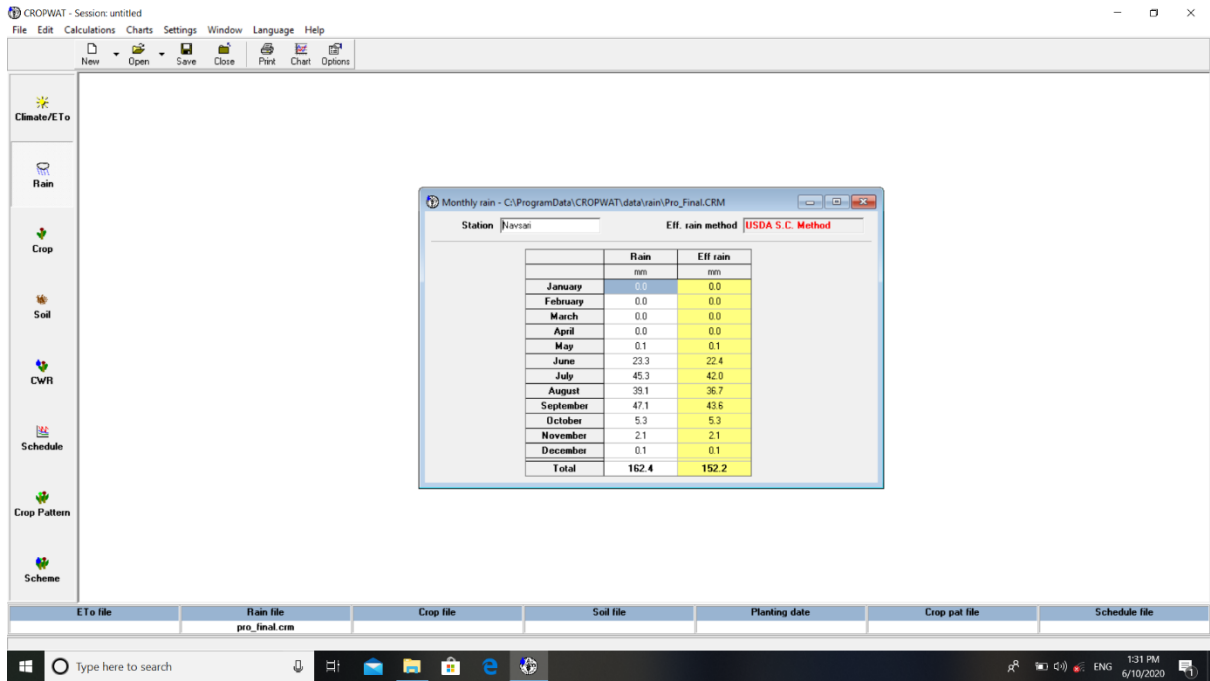


Fig 3.11 : Data entry in CROPWAT (Rainfall)

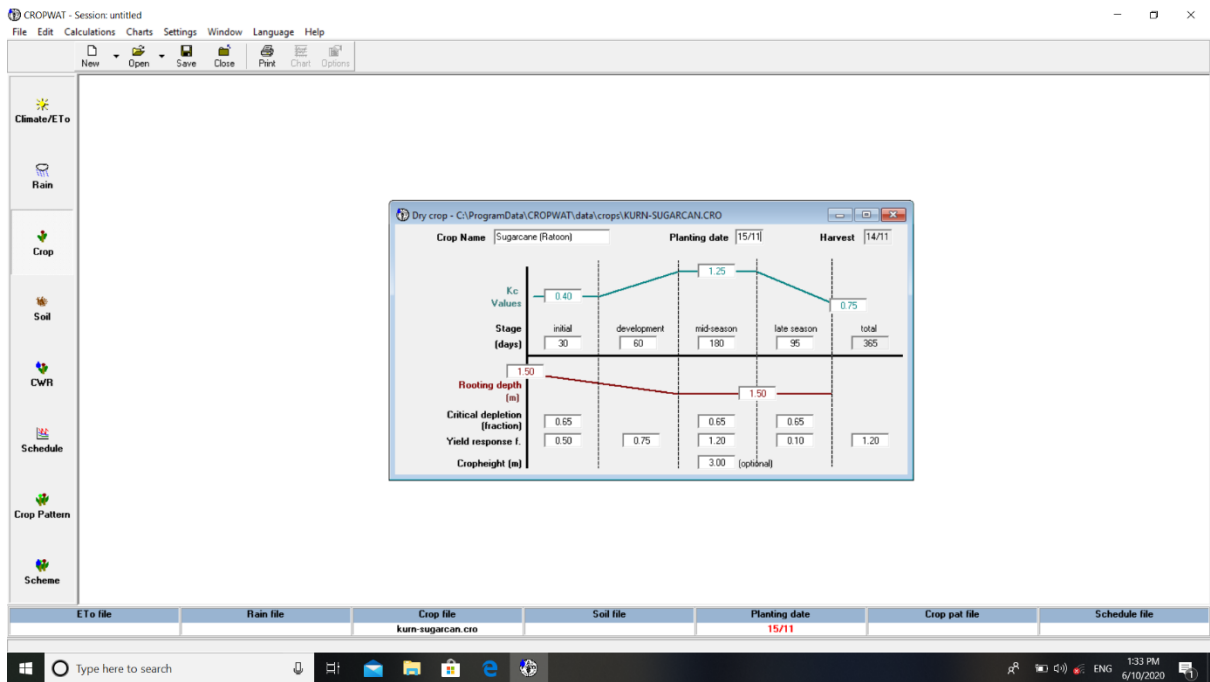


Fig 3.12 : Data entry in CROPWAT (crop)

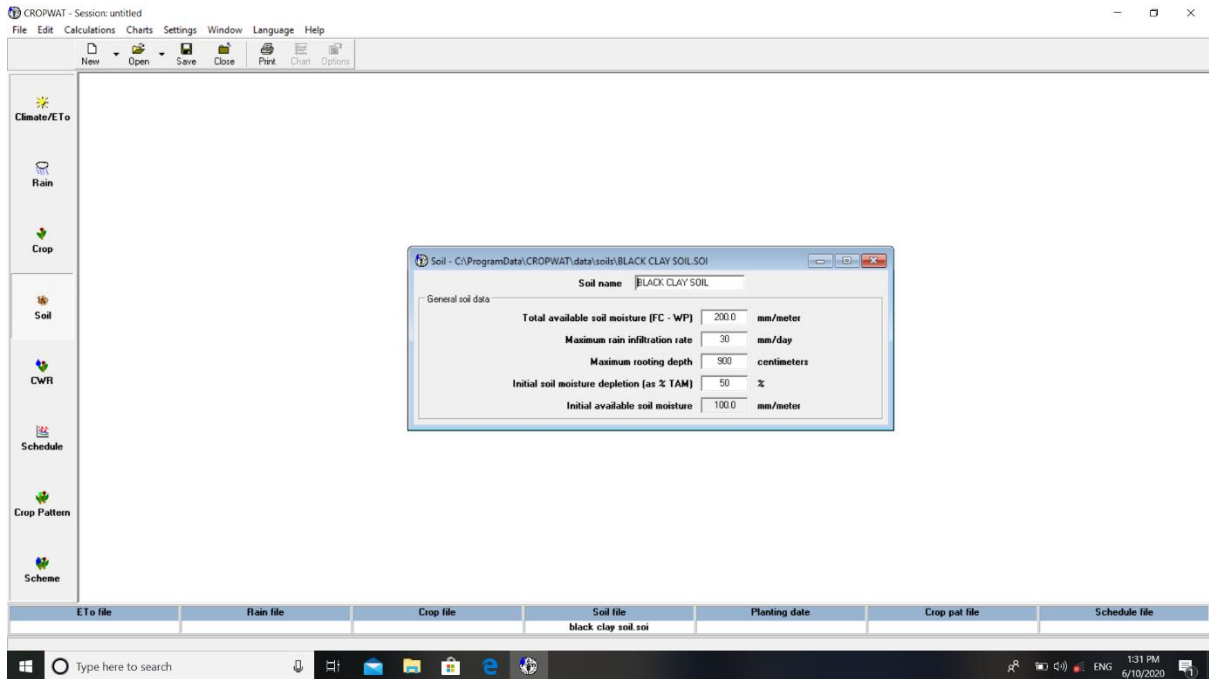


Fig 3.13 : Data entry in CROPWAT (soil)

3.1.2 Procedure for Drip irrigation design

1. Data collection from farm and identification of problem
2. Design of drip irrigation system
3. Cost estimation of drip irrigation
4. Write a program for calculating step 2 and 3 and give results.
5. Choosing cost effective and best performance drip irrigation system from results.

3.1.2.1 Data collection and identification of problem

- We visited the Eroo village of Navsari district and we collected the data of Mango Farm. We identified the problem during irrigation of Mango plants they use traditional method of irrigation like through pipe or any other method.
- We suggest the cost effective and more effective method of irrigation system.
- Drip irrigation method is far more supervisor than any other methods because it's given the more yield of the crop without using excessive resources.
- Data about this farm is below,

1. Size of farm: - 50 * 65 m

2. Spacing: - 4 * 3 m
3. Pan coefficient (Kp): - 0.7
4. Crop coefficient (Kc): - 0.8
5. Maximum pan evaporation (Ep): - 7.5 mm/day (from data collection)
6. Effective root zone depth: - 1.2 m
7. Wetting percentage(W): - 60 %
8. Area: - 3250 m²

3.1.2.2 Drip irrigation design of Mango Farm: -

➤ Step 1: - Estimation of water requirement

Evapotranspiration: -

$$\begin{aligned} \text{Eva} &= \text{Ep} \times \text{kp} \times \text{kc} \\ &= 4.31 \text{ mm/day} \end{aligned}$$

Volume of water to be applied = area covered by the plant * wetting fraction *
Evapotranspiration of crop

$$\begin{aligned} V &= A \times W \times \text{Eva} \\ &= 31.03 \text{ m}^3 \end{aligned}$$

➤ Step 2: - Emitter selection and irrigation time

$$\begin{aligned} Q_e &= 3 * E_m \\ \text{Time} &= V / Q_e \\ &= 3.45 \text{ hrs.} \end{aligned}$$

➤ Step 3: - Discharge through each lateral

Length of the main line (size_m): - 35 m

Length of sub-main line(size_s): -48.5 m

Length of lateral (size_l): - 30 .5 m

$$\begin{aligned} 1. \text{No}_l &= \text{length of farm} * 2 / \text{spacing of laterals} \\ &= \frac{50 \times 2}{3} \\ &= 34 \text{ Nos.} \end{aligned}$$

$$\begin{aligned} 2. \text{Discharge carry by each laterals (Ql)} &= \text{No}_l \times Q_e \\ &= 72.0 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} 3. \text{Total discharge by the all laterals (Ql}_t) &= \text{No}_l \times Q_l \\ &= 2304.0 \text{ m}^3 \end{aligned}$$

$$4. \text{Nos_Em} = \text{No_I} \times \text{No_T} \times 3$$

$$= 768 \text{ Nos.}$$

➤ **Step 4: - Determine the numbers of Manifolds: -**

Assuming the pump 2.5 lit/hr

$$\text{PUMP} = 2.5 \times 60 \times 60$$

$$\text{Number of laterals that can be operated by each manifold} = \frac{\text{PUMP}}{Q_l}$$

$$= 75 \text{ Nos.}$$

So, here one manifolds can supply the water to all of the laterals.

➤ **Step 5: - Size of laterals**

Once the discharge carried by each lateral is known then size of laterals can be determined by using Hazen-William's equation.

$$m = 1.852$$

$$N1 = 3 \times \text{No_T}$$

$$F = \frac{1}{m+1} + \frac{1}{2 N1} + \sqrt{\frac{m^2 - 1}{6N1^2}}$$

$$k = 1.22 \times 10^{12}$$

C = 140 (value of hazen-Willams constant for pipe material)

Material	C	Material	C
Asbestos Cement	140	Copper	130-140
Brass	130-140	Galvanized iron	120
Brick sewer	100	Glass	140
<i>Cast-Iron:</i>		Lead	130-140
New, unlined	130	Plastic	140-150
10 yr. old	107-113	<i>Steel:</i>	
20 yr. old	89-100	Coal-tar enamel lined	145-150
30 yr. old	75-90	New unlined	140-150
40 yr. old	64-83	Riveted	110
<i>Concrete/Concrete-lined:</i>			
Steel forms	140	Tin	130
Wooden forms	120	Vitrif. clay (good condition)	110-140
Centrifugally spun	135	Wood stave (avg. condition)	120

Fig 3.14 : Hazen-willams Coefficient

$$\text{head loss @ lateral (hl)} = \frac{k \times F \times \left(\frac{Ql}{3600}\right)^m \times \text{size}_m}{100 \times (C^m) \times (L^{4.877})}$$

$$= 0.0571 \text{ m}$$

The permissible head loss due to friction is 10% of head of 10m is 1m, therefore 12 mm diameter lateral selected.

➤ **Step 6: -Size of sub main**

$$Q_s = Ql \times N_o_1$$

$$N_2 = N_o_1$$

$$F_1 = \frac{1}{m+1} + \frac{1}{2N_2} + \sqrt{\frac{m^2 - 1}{6N_2^2}}$$

C = 140 (value of hazen-Willams constant for pipe material)

- Head loss @ submain (hs) = $\frac{k \times F_1 \times \left(\frac{Q_s}{3600}\right)^m \times \text{size}_s}{100 \times (C^m) \times (S^{4.877})}$ (using Hazen-William Eq.)

$$= 1.5306 \text{ m}$$

Head loss at inlet section of submain (hi) = Head require to run emitter(10m) + Head loss at laterals + head loss at sub-main

$$= 11.5877 \text{ m}$$

Pressure head variation = (hi – hl + 10) x 100/hi

$$= 13.209 \%$$

Variance in the pressure is permissible up to 20% if it exceeds than we need to try another combination of lateral pipe and submain pipe.

So, it's okay to use 25 mm sub-main pipe.

➤ **Step 7: - Size of main pipe**

C = 140 (value of hazen-Willams constant for pipe material)

$$\text{Head loss @ main (hm)} = \frac{k \times F_1 \times \left(\frac{Q_s}{3600}\right)^m \times \text{size}_m}{100 \times (C^m) \times (S^{4.877})} \text{ (using Hazen-William Eq.)}$$

$$= 0.3045$$

Total dynamic head: -

$$TD = hl + hs + hm + 10 + 1.28 \times \frac{hl + hs + hm}{10}$$

$$= 24.361 \text{ m}$$

➤ Horse Power: -

$$HP = \frac{TD \times Qs}{3600 \times 0.60 \times 75}$$

$$= 0.3465 \text{ hp}$$

$$\approx 0.5 \text{ hp}$$

3.1.2.3 Estimation of overall cost: -

- Total_fit = Nos_Em + No_l x 2 + 2 + 2 + 1
 - P_fit = 20 (it's contained price of valves and extension line connector at fitting point.)
 - overall_fit = 1 (rupees per meter for labour work)
 - Price of valve(P_valve) = 250
 - Price of filter(P_filter) = 3500
 - P_manif = 500
- $s1 = Pe \times No_Em + Pl \times No_l \times size_l + Ps \times size_s + Pm \times size_m +$
 Total_fit x P_fit + overall_fit x to_s + P_manif x No_Manifols
- $s1 = s1 + s1 \times 10/100$ (adding contingencies cost)
- Overall cost (without pump) = s1
 = 40396.4 Rs.
- Overall Cost including Pump \approx 50000 Rs. (approximate)
- **After design of drip irrigation system, we calculated bellow parameters**
1. Evapotranspiration: - 4.31 mm/day
 2. Volume of water to be applied 31.03 m³
 3. Irrigation time require: - 3.45 hrs.
 4. Total Discharge in one lateral pipe: - 72.0
 5. Total Discharge in Sub-Main pipe: -2304.0
 6. Head loss in lateral pipe: -0.0571
 7. Head loss in Sub-Main pipe: - 1.5306
 8. Pressure variance (13.209) is less than 20.so, it is okay.
 9. Head loss at Inlet-section of sub-main pipe: - 11.5877
 10. Head loss in main pipe: - 0.3045
 11. Total Dynamic Head: - 24.361
 12. Horse power require: - 0.3465
 13. Overall Cost (without PUMP): - 40396.4

14. Overall Cost including Pump \approx 50000 Rs. (approximate)

3.1.2.4 Write a program for calculating step 2 and 3 and give results.

We write the python program for computing the step 2 and 3 for the multiple time. (Detailed program of the Drip irrigation design is at the Annexure- B)

Program gives the GUI (Graphical user interface) for calculating the step 2 and 3
Snapshot of the Program GUI: -

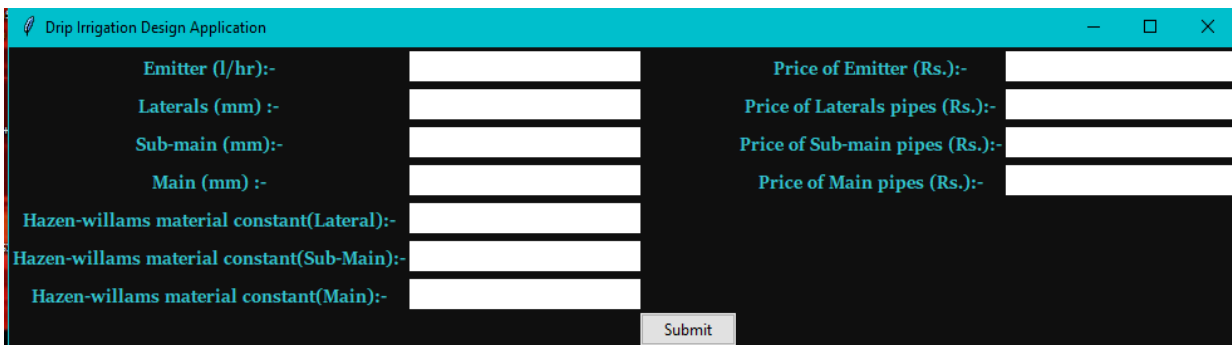


Fig 3.15 : Snapshot of Program GUI

Following GUI application give the result_drip.txt file which store the results of past entry, with using this store results we conclude the best possible solution.

Snapshot of the result_drip.txt

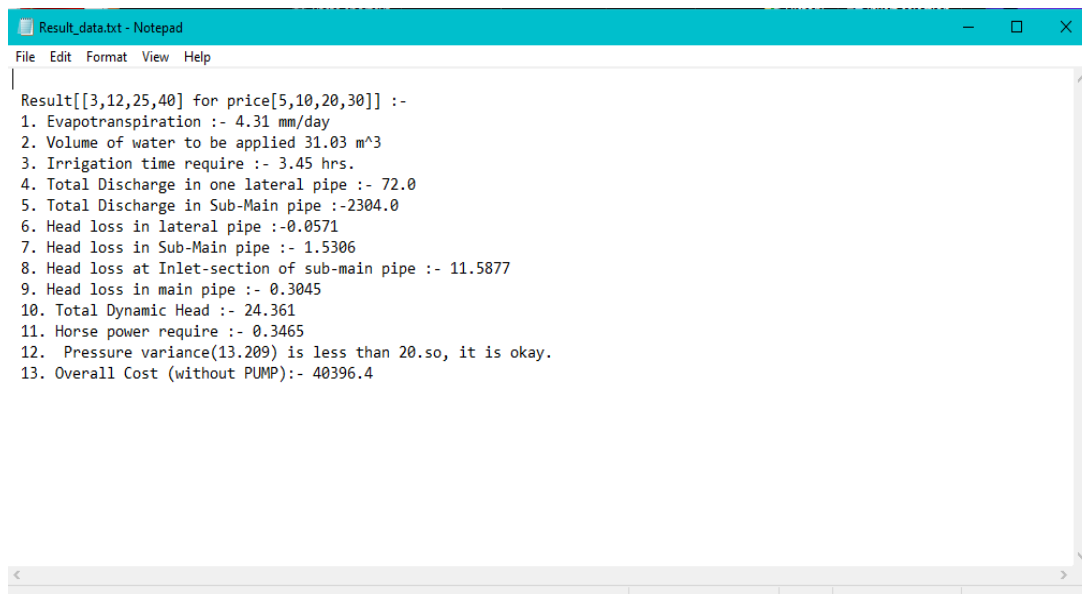


Fig 3.16 Snapshot of Result in GUI

CHAPTER 4: ANALYSIS AND RESULT

4.1 Analysis of data: -

- this data prepares the crop water requirement and irrigation schedule of paddy and sugarcane crop using CROPWAT software.

4.1.1 Crop water requirement of paddy crop: -

CROP WATER REQUIREMENTS							
ETo station: Navsari				Crop: Rice			
Rain station: Navsari				Planting date: 20/01			
Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Dec	3	Nurs/LPr	1.19	0.73	8.0	0.0	98.4
Jan	1	Nurs/LPr	1.06	3.69	36.9	0.0	36.9
Jan	2	Init	1.07	3.66	36.6	0.0	179.9
Jan	3	Init	1.10	4.21	46.3	0.0	46.3
Feb	1	Deve	1.10	4.70	47.0	0.0	47.0
Feb	2	Deve	1.12	5.22	52.2	0.0	52.2
Feb	3	Deve	1.15	5.78	46.3	0.0	46.3
Mar	1	Deve	1.18	6.37	63.7	0.0	63.7
Mar	2	Mid	1.19	6.89	68.9	0.0	68.9
Mar	3	Mid	1.19	7.22	79.4	0.0	79.4
Apr	1	Mid	1.19	7.54	75.4	0.0	75.4
Apr	2	Late	1.19	7.86	78.6	0.0	78.6
Apr	3	Late	1.16	7.81	78.1	0.0	78.1
May	1	Late	1.11	7.84	78.4	0.0	78.3
May	2	Late	1.06	7.74	69.7	0.0	69.7
					865.4	0.1	1099.0

Fig 4.1 : CWR of paddy

4.1.2 Irrigation schedule of paddy: -

RICE IRRIGATION SCHEDULE

ETo station: Navsari Crop: Rice Planting date: 20/01
 Rain station: Navsari Soil: BLACK CLAY SOIL Harvest date: 19/05

Yield red.: 0.0 %

Rice scheduling options

Pre puddling:
 Soaking depth on day 1 0.5 m
 Timing Irrigate at 20 % depletion of Field Capacity
 Application Refill soil moisture content to 100 % saturation

Puddling
 Timing Irrigate at 0 mm waterdepth
 Application Refill waterdepth to 50 mm

Growth stages
 Timing Irrigate at 5 mm waterdepth
 Application Refill waterdepth to 100 mm

Field efficiency 70 %

Table format: Irrigation schedule

Date	Day	Stage	Rain mm	Ks fract.	Eta %	Puddl state	Percol. mm	Depl. mm	SMNet mm	Gif mm	Loss mm	Depl.SA mm
31 Dec	-19	PrePu	0.0	0.90	90	Prep	0.0	41	91.2	0.0	40.0	
15 Jan	-4	Puddl	0.0	1.00	100	Prep	0.0	13	90.0	0.0	40.0	
17 Jan	-2	Puddl	0.0	1.00	100	OK	12.1	0	51.4	0.0	1.4	
23 Jan	4	Init	0.0	1.00	100	OK	3.1	0	98.5	0.0	-1.5	
5 Feb	17	Init	0.0	1.00	100	OK	3.1	0	97.6	0.0	-2.4	
17 Feb	29	Dev	0.0	1.00	100	OK	3.1	0	97.3	0.0	-2.7	
28 Feb	40	Dev	0.0	1.00	100	OK	3.1	0	96.1	0.0	-3.9	
11 Mar	51	Mid	0.0	1.00	100	OK	3.1	0	104.7	0.0	4.7	
21 Mar	61	Mid	0.0	1.00	100	OK	3.1	0	100.3	0.0	0.3	
31 Mar	71	Mid	0.0	1.00	100	OK	3.1	0	103.2	0.0	3.2	
9 Apr	80	Mid	0.0	1.00	100	OK	3.1	0	95.8	0.0	-4.2	
18 Apr	89	Mid	0.0	1.00	100	OK	3.1	0	98.4	0.0	-1.6	
27 Apr	98	End	0.0	1.00	100	OK	3.1	0	98.3	0.0	-1.7	
6 May	107	End	0.0	1.00	100	OK	3.1	0	98.4	0.0	-1.6	
15 May	116	End	0.0	1.00	100	OK	3.1	0	98.0	0.0	-2.0	
19 May	End	End	0.0	1.00	0	OK	0.0	0				

Totals:

Total gross irrigation	2027.6 mm	Total rainfall	0.0 mm
Total net irrigation	1419.3 mm	Effective rainfall	0.0 mm
Total irrigation losses	0.0 mm	Total rain loss	0.0 mm
Total percolation losses	458.3 mm		
Actual water use by crop	779.7 mm	Moist deficit at harvest	0.0 mm
Potential water use by crop	779.7 mm	Actual irrigation requirement	779.7 mm
Efficiency irrigation schedule	100.0 %	Efficiency rain	100.0 %
Deficiency irrigation schedule	0.0 %		

Fig 4.2 Irrigation schedule of paddy

4.1.3 crop water requirement of sugarcane: -

CROP WATER REQUIREMENTS

ETo station: Navsari
Rain station: Navsari

Crop: Sugar cane
Planting date: 15/11

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Nov	2	Init	0.69	2.61	15.6	0.4	10.1
Nov	3	Init	0.40	1.48	14.8	0.5	14.3
Dec	1	Init	0.40	1.45	14.5	0.2	14.3
Dec	2	Deve	0.43	1.52	15.2	0.0	15.2
Dec	3	Deve	0.56	2.00	22.0	0.0	22.0
Jan	1	Deve	0.71	2.45	24.5	0.0	24.5
Jan	2	Deve	0.84	2.89	28.9	0.0	28.9
Jan	3	Deve	0.99	3.78	41.6	0.0	41.6
Feb	1	Deve	1.13	4.83	48.3	0.0	48.3
Feb	2	Mid	1.22	5.65	56.5	0.0	56.5
Feb	3	Mid	1.22	6.12	49.0	0.0	49.0
Mar	1	Mid	1.22	6.58	65.8	0.0	65.8
Mar	2	Mid	1.22	7.04	70.4	0.0	70.4
Mar	3	Mid	1.22	7.37	81.0	0.0	81.0
Apr	1	Mid	1.22	7.70	77.0	0.0	77.0
Apr	2	Mid	1.22	8.03	80.3	0.0	80.3
Apr	3	Mid	1.22	8.21	82.1	0.0	82.1
May	1	Mid	1.22	8.64	86.4	0.0	86.3
May	2	Mid	1.22	8.94	89.4	0.0	89.4
May	3	Mid	1.22	7.94	87.4	0.2	87.2
Jun	1	Mid	1.22	6.83	68.3	5.1	63.2
Jun	2	Mid	1.22	5.95	59.5	7.6	51.9
Jun	3	Mid	1.22	5.34	53.4	9.7	43.7
Jul	1	Mid	1.22	4.65	46.5	12.6	33.9
Jul	2	Mid	1.22	4.00	40.0	15.2	24.8
Jul	3	Mid	1.22	4.01	44.1	14.2	29.9
Aug	1	Mid	1.22	4.06	40.6	12.4	28.2
Aug	2	Late	1.19	3.95	39.5	11.7	27.9
Aug	3	Late	1.13	3.84	42.2	12.6	29.6
Sep	1	Late	1.07	3.72	37.2	15.2	22.0
Sep	2	Late	1.02	3.60	36.0	16.6	19.3
Sep	3	Late	0.96	3.60	36.0	11.7	24.4
Oct	1	Late	0.91	3.64	36.4	4.9	31.5
Oct	2	Late	0.85	3.63	36.3	0.1	36.1
Oct	3	Late	0.79	3.24	35.6	0.3	35.3
Nov	1	Late	0.73	2.85	28.5	1.0	27.5
Nov	2	Late	0.69	2.61	10.4	0.3	10.1

Fig 4.3 : CWR of sugarcane

4.1.4 Irrigation schedule of sugarcane: -

CROP IRRIGATION SCHEDULE													
ETo station: Navsari			Crop: Sugar cane			Planting date: 15/11							
Rain station: Navsari			Soil: black clay soil			Harvest date: 14/11							
Yield red.: 0.0 %													
Crop scheduling options													
Timing:			Irrigate at 100 % depletion										
Application:			Refill to 100 % of field capacity										
Field eff.			70 %										
Table format: Irrigation schedule													
Date	Day	Stage	Rain mm	Ks fract.	Eta %	Depl %	Net Irr	IrrDeficit	Loss	Gr. Irr	Flow		
11 Dec	27	Init	0.0	1.00	100	65	195.5	0.0	0.0	279.2	1.20		
13 Feb	91	Mid	0.0	1.00	100	65	195.9	0.0	0.0	279.8	0.51		
16 Mar	122	Mid	0.0	1.00	100	66	196.5	0.0	0.0	280.8	1.05		
12 Apr	149	Mid	0.0	1.00	100	67	202.2	0.0	0.0	288.8	1.24		
6 May	173	Mid	0.0	1.00	100	66	198.1	0.0	0.0	283.0	1.36		
29 May	196	Mid	0.0	1.00	100	65	195.3	0.0	0.0	279.0	1.40		
6 Jul	234	Mid	0.0	1.00	100	65	195.0	0.0	0.0	278.6	0.85		
21 Sep	311	End	0.0	1.00	100	65	196.5	0.0	0.0	280.7	0.42		
14 Nov	End	End	0.0	1.00	0	53							
Totals:													
Total gross irrigation				2250.0 mm		Total rainfall				162.7 mm			
Total net irrigation				1575.0 mm		Effective rainfall				153.2 mm			
Total irrigation losses				0.0 mm		Total rain loss				9.5 mm			
Actual water use by crop				1738.5 mm		Moist deficit at harvest				160.3 mm			
Potential water use by crop				1738.5 mm		Actual irrigation requirement				1585. mm			
Efficiency irrigation schedule						100.0 %		Efficiency rain				94.2 %	
Deficiency irrigation schedule						0.0 %							

Fig 4.4 : Irrigation schedule of sugarcane

4.1.5 Design of drip irrigation: -

The design details of components irrigation system are estimated as,

1. Total number of emitters: - 1056 nos
2. Length of laterals: - 30.5 m
3. No of laterals: - 32 nos
4. Dia of lateral pipe: - 12 mm
5. Length of sub main pipe: - 48.5 m
6. Dia of sub main pipe: - 25 mm
7. No of sub main pipe: - 1 nos
8. Length of main pipe: - 42.5 m
9. Dia of main pipe: - 40 mm
10. Total power required: - 1 hp motor

➤ Area of one plant (A₂) = 3 x 4
= 12 m²

Price of Emitter (P_e) = 5

Price of Laterals pipe (per meter length) (P_l) = 10

Price of Sub-main pipe (per meter length) (P_s) = 20

Price of Main pipe (per meter length) (P_l) = 30

Total cost of this irrigation design = 50000 Rs (approximate)

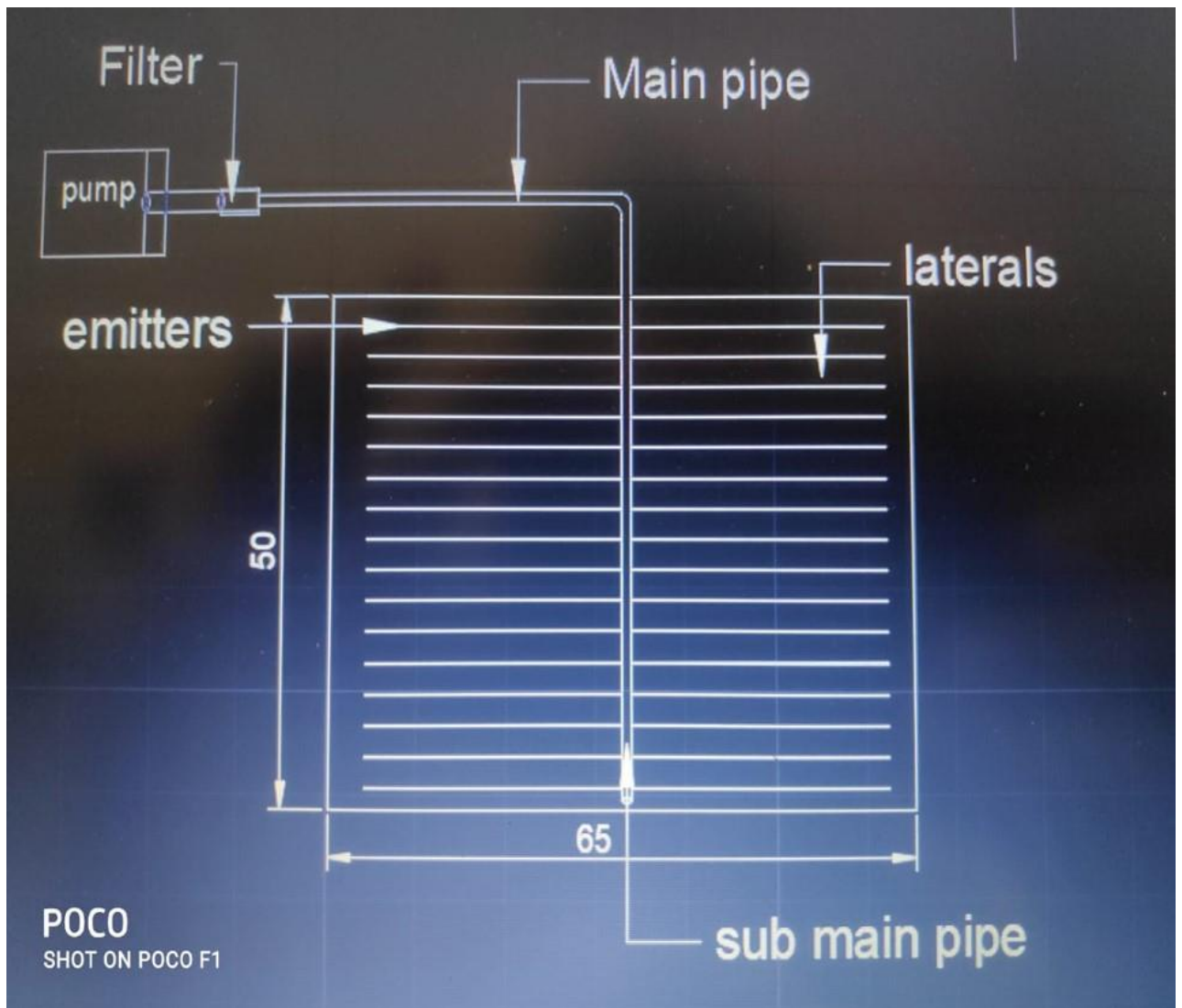


Fig 4.5 : drip irrigation design

4.1.6 GUI application made in Python programming language.

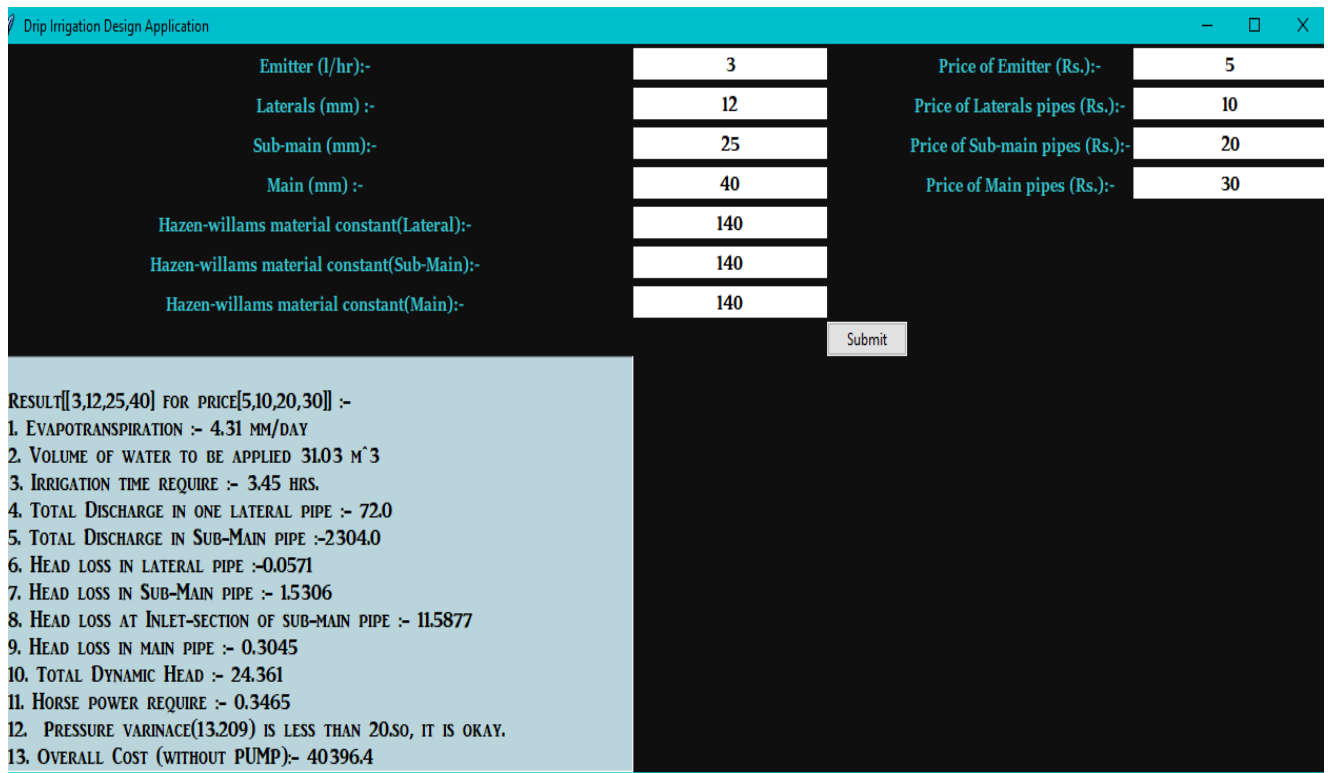


Fig 4.6 : GUI Application Result

This figure shows the GUI (Graphical user interface) of our created application for Drip irrigation Design.

4.2 Result and discussion: -

1. From the cropwat software, we calculate the schedule of paddy crop and how much water requirements for crop. (Detailed schedule and water requirements are shown on fig.)

2. From the cropwat software, we calculate the schedule of sugarcane crop and how much water requirements for crop. (Detailed schedule and water requirements are shown on fig.)
3. Design of DRIP IRRIGATION SYSTEM for Mango farm (size: 50m X 65m) and also, we have created application for designing the DRIP IRRIGATION SYSTEM.
4. From Questionnaire survey, following points are concluded: -
 - cropping pattern of crop like paddy and sugarcane.
 - Type of irrigation system used (surface irrigation, Drip irrigation, sprinkler irrigation)
 - Detailed of irrigation system
 - Total cost of one seasonal Farming of one crop.

CHEPTEP 5: CONCLUSIONS

5.1 Final Solution: -

1. By the result of cropwat software and questionnaire survey, farmers get more economic benefit and good quality if they properly schedule the crop.
2. If drip irrigation system is suitable for the crop, then it will reduce water wastage and increase crop yield.

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❑ LINKS

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- 2 www.imd.geo.in
- 3 www.jains.com
- 4 www.lmnoeng.com/hazenwilliams.php
- 5 <https://docs.python.org/3/library/tkinter.html>
- 6 <https://www.python.org>
- 7 <https://jupyter.org>
- 8 <https://docs.python.org/3/library/math.html>

ANNEXURE A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
						february				march					april					may
	years	tmax	tmin	humidity	wind speed	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum
2000	30.31	15	55.16	2.04	29.96	14.46	61.29	4.02	33.61	18.45	55.62	4.31	34.28	24.37	70.71	7.03	32.74	26.76	72.53	
2001	29.8	12.7	53.75	3.5	32.5	13.9	54	3.6	32.6	19.5	65.25	5.2	36	24	61.85	5.7	33.4	28	67.65	
2002	29.2	13.7	51.75	4.1	32.3	15.8	52.75	4.4	34.5	20.5	57.45	5.2	35.7	24.7	64.2	6	34.2	28.6	73	
2003	30.7	14.6	48	3.8	32.5	15.9	58	4.5	33.9	18.7	65	4.7	35.6	24.7	43.97	6.2	34.5	27.6	72.05	
2004	29.3	13.9	64	3.7	32.1	15.7	59.5	3.8	36.1	19.9	52.65	4.3	34.6	25.6	67	7.1	35.4	28	65.45	
2005	28.5	13	60.55	4	30.2	15.2	67.3	4.4	33.3	20.1	64.35	4.9	35.8	23.6	65.85	5.3	34.2	27.3	69.5	
2006	30	14.1	53	3.8	35.2	17	55.65	3.5	33.8	20.1	59	5.5	34.3	23.9	71	5.9	33.9	27.8	77	
2007	30.4	14.6	57.5	3.9	32.1	17.3	60	4.3	35.1	18.6	51.5	4.6	35.6	22.8	61.1	5.9	34	26.6	66	
2008	29.2	12.5	56.5	4.4	29.7	13	53.9	5.1	34	18.6	62.5	5.1	35.1	22.6	64.85	6.4	33.4	26.9	73.5	
2009	31.3	15.6	57	4	33	15	55.2	3.9	35.7	19.6	56	4.9	37.7	22.9	50.3	6.8	26.4	25	73.4	
2010	30.7	15.7	53.85	4.4	28	13.9	50.65	3.5	35.1	19.7	58.5	4.9	35.7	23.8	74.7	7.4	36.2	27	75.3	
2011	30.1	12.0	55.45	2	32.2	14.4	54.25	3.4	35.5	17.5	52.35	3.4	35.6	22.6	66.7	3.3	34.4	26.5	69.2	
2012	28.8	12.3	67.7	3.3	31.7	13.5	48.05	3.9	34.8	16.5	53.5	3.7	35.8	23	63.6	4.9	33.9	26.2	68.65	
2013	29.7	12.3	61.05	1.3	31.8	16	51.85	1.4	35.2	18.6	51.35	1.7	34.5	22.3	64.1	3	36.6	27	73.2	
2014	28.7	14.4	66.85	3	30	15.1	58.6	2.2	33.4	17.8	57.6	2.2	35.4	22.2	64	2.6	34.8	25.7	69.85	
2015	28.9	12.9	58.15	3.9	32.1	14.6	63.35	3.3	32.5	18.2	65.1	4.5	33.3	22.8	70.4	5.9	35	26.4	70.5	
2016	30.8	15.1	56	2.7	31.2	14.5	58.9	3.1	35.4	18.6	57.65	3.6	35.6	22.1	61.15	4.9	34.4	26.6	70.6	
2017	30.7	13.4	57.1	3.2	33.4	15.4	50.9	3.4	35	18.1	55.4	3.9	35.6	22.1	62.95	6.2	35	26.2	70.75	
2018	30.3	12.5	57.45	2.7	33.3	14	56.8	3.1	35.9	17.6	55.95	3.4	35.8	21.9	68.25	4.6	35.1	25.7	71.4	
2019	30.1	9.9	68.15	3.1	31.4	12.2	68.35	2.7	34.5	15.4	65.9	2.6	36.6	21.5	68.4	3.4	34.7	24.3	73.45	
		31.3	15.7	68.15	4.4	35.2	17.3	68.35	5.1	36.1	20.5	65.9	5.5	37.7	25.6	74.7	7.4	36.6	28.6	77

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	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	
1			june				july				august				sep				oct		
2	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	
3	10.09	31.9	26.3	76	11	28.8	25.6	85.8	10.9	29.9	26	84.7	9.4	31.6	25.7	76.15	5.9	33.8	23.8	72.5	
4	11.1	31	27.4	78.5	11.5	28.8	26	85.65	10.1	28.9	25.7	85.25	7.4	31.1	25.3	81.1	5.4	34.5	23.7	64.25	
5	11.5	32.1	27.7	82	9.9	30.4	27.4	78	12.8	29	25.5	84	7.9	30	24.7	81	4.3	35.2	23.1	64	
6	9.4	32	27.6	79.7	10.2	29.2	25.9	89.85	8.4	29.7	25.4	84.3	7.8	29.7	25.3	83.2	5.2	34.4	22.2	65	
7	9.1	32.1	27.8	76	10.5	30.2	26.5	84.35	7.4	28.3	26	86.15	9.5	31.5	25.7	78.3	4.7	33.1	23.4	58.9	
8	8	32.8	28.6	74.5	10.1	30.2	27.4	84	10	29.4	25.9	85	7.8	29.9	25.5	85.8	6	34.3	22.7	66	
9	9.7	32.5	27.7	81	8.1	29.5	26.6	86	12.1	28.5	26.1	86	11.6	31.1	26.3	79.7	5.4	33.9	23.7	66	
10	9.2	33	26.7	75.85	8.6	30.4	26	83.5	9.1	29.7	25.2	87	8	30.3	24.7	84.45	4.7	34.3	20.8	57.5	
11	10.3	31.8	26.7	82.2	10.7	29.5	25.6	89	9	29.1	24.8	89	7.9	30.6	24.5	85.55	6.3	34.3	21.7	72	
12	11.6	33.2	27.5	74.6	12.5	29.5	25.3	87.5	12.4	30.7	26	80.5	9.8	32.4	25.3	77.7	5.6	33.9	21.5	66	
13	11.1	32.7	26.8	82.3	9.6	29.7	25.2	89.85	9.3	29.6	25.4	88.5	7.3	30.7	24.7	86.1	5.5	33.6	23.7	73	
14	10.9	33.8	27.2	80.25	10.4	30.3	25.25	87.4	4.8	29.2	25.3	91.55	4.2	30.3	24.4	85	3.5	35.7	23.7	66.45	
15	7.9	33.3	27.2	76.25	9.6	30.7	26.3	87.65	6.6	30	25.6	87.45	4.6	30.2	24.5	84.5	2.5	34.9	22.1	63.3	
16	5.9	31.4	25.9	87.7	3.8	30.2	25.2	89.9	4.1	29	25	86.9	2.8	30.4	24.5	84.2	2.3	32.8	22.8	71.3	
17	5.4	33.7	27.9	72.05	10.1	30.8	25.8	83.45	9.4	30.7	25.1	86.3	6.4	31.3	24.5	84.25	4.9	35.9	22.4	63.1	
18	7.9	32	25.7	70.5	9.1	30.7	26.2	82.7	10.5	30.6	25.3	82.15	6.9	31	23.4	80.3	4.7	35.5	23.1	65.7	
19	8.8	33.8	27.3	78.1	9.6	29.8	24.8	88.65	6.8	29.6	24.9	85.9	7.6	30.1	23.6	86.75	4.2	32	20.7	74.85	
20	7.9	33	26.1	81.4	7.7	30.2	25.2	88.15	8.3	30.3	25	87.2	6.1	32.4	24.3	84.35	3.3	35.5	22.1	73.85	
21	7.5	33.7	26.3	83.05	8.8	28.9	24	93.7	6.7	29.8	23.9	87.35	6.8	31.6	21.9	77.85	3	36.6	19.8	66.4	
22	5.5	33.5	25.4	84.25	6.7	31.4	24.2	90.75	5.1	29.9	23.5	91.7	5	30.9	22.9	91.9	3.2	34.4	21.5	78.05	
23	11.6	33.8	28.6	87.7	12.5	31.4	27.4	93.7	12.8	30.7	26.1	91.7	11.6	32.4	26.3	91.9	6.3	36.6	23.8	78.05	
24																					
25																					

sheet 1

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	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA		
1	sep				oct				nov				dec									
2	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws	tmax	tmin	hum	ws						
3	31.6	25.7	76.15	5.9	33.8	23.8	72.5	3.6	34.4	18	53	2.6	32	14.1	51.8	2.9						
4	31.1	25.3	81.1	5.4	34.5	23.7	64.25	4.5	33.9	20.4	47.5	3.4	31.8	15	53.6	2.8						
5	30	24.7	81	4.3	35.2	23.1	64	2.9	33.9	19.2	52.5	2.8	31.7	15.2	54	2.5						
6	29.7	25.3	83.2	5.2	34.4	22.2	65	3.3	33.5	19.7	66.2	2.9	30.9	15.2	63.5	3.5						
7	31.5	25.7	78.3	4.7	33.1	23.4	58.9	3.9	33.5	20.7	54.85	3	31.5	16.7	56.55	3.3						
8	29.9	25.5	85.8	6	34.3	22.7	66	3.6	33.7	18.3	50.5	2.9	30.2	14.4	55	3.7						
9	31.1	26.3	79.7	5.4	33.9	23.7	66	3.5	33	19.8	65	3.7	31	15.8	67.5	3.5						
10	30.3	24.7	84.45	4.7	34.3	20.8	57.5	3.5	33.1	18.3	56.3	3.5	30.5	15.9	56	4.7						
11	30.6	24.5	85.55	6.3	34.3	21.7	72	3.6	33.6	18.8	63.15	3.9	32	17.2	60	3.3						
12	32.4	25.3	77.7	5.6	33.9	21.5	66	4.1	32.2	19.5	59.45	4.4	31.2	16.3	58	3.4						
13	30.7	24.7	86.1	5.5	33.6	23.7	73	2	30.7	21	70.85	3.2	27.2	12.7	55.3	2.6						
14	30.3	24.4	85	3.5	35.7	23.7	66.45	1.7	35.2	18.7	52	1.7	32.4	14.7	55.45	1.3						
15	30.2	24.5	84.5	2.5	34.9	22.1	63.3	0.7	33.2	16.2	52.15	0.8	31.8	16.4	52.75	0.7						
16	30.4	24.5	84.2	2.3	32.8	22.8	71.3	1.7	33.6	19.9	55.05	3.2	30.9	14.8	66.1	3						
17	31.3	24.5	84.25	4.9	35.9	22.4	63.1	3.1	33.6	19.2	64.05	2.4	30.4	14	56.65	3.6						
18	31	23.4	80.3	4.7	35.5	23.1	65.7	3.1	34.1	20.3	59.3	2.9	31.3	13.1	50.7	3.3						
19	30.1	23.6	86.75	4.2	32	20.7	74.85	2.9	33	14.5	51.7	2.7	32.1	13.6	50.85	3.2						
20	32.4	24.3	84.35	3.3	35.5	22.1	73.85	2.7	33.7	15.3	56.05	2.5	29.5	15.2	62.7	3.4						
21	31.6	21.9	77.85	3	36.6	19.8	66.4	1.3	35.1	15.2	71.1	1.2	30.3	11.7	68.9	2.7						
22	30.9	22.9	91.9	3.2	34.4	21.5	78.05	2.2	33.2	19.1	77.4	1.1	31	15.8	73.55	1.4						
23	32.4	26.3	91.9	6.3	36.6	23.8	78.05	4.5	35.2	21	77.4	4.4	32.4	17.2	73.55	4.7						
24																						
25																						

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ANNAXURE B

Jupyter GUI_Drip_Report_version Last Checkpoint: Last Thursday at 4:00 PM (autosaved) Logout

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Run Stop Refresh Code

```
In [2]: 1 import tkinter as tk
2 from tkinter import *
3 from tkinter import ttk
4 import math
5 import tkinter.font as tkFont
6
7 LENGTH_FARM = 50
8 WIDTH_FARM = 65
9 SPACING_L = 3
10 SPACING_B = 4
11 Kp = 0.8
12 Kc = 0.7
13 Ep = 7.7
14 W = 0.60
15 Area_Farm = LENGTH_FARM * WIDTH_FARM
16 Area_Plant = SPACING_B * SPACING_L
17 ROW = round(WIDTH_FARM/SPACING_B)
18 if LENGTH_FARM%SPACING_L == 0:
19     COLM = math.ceil(LENGTH_FARM/SPACING_L)
20 else:
21     COLM = math.ceil(LENGTH_FARM/SPACING_L) - 1
22
23 '''Evapotranspiration:-'''
24 Eva = round(Ep * Kp * Kc,2)
25 #print('Evapotranspiration:- %.2f mm/day'%Eva)
26
27 # Volume of water to be applied :- Area covered by the plant * wetting fraction * Evapotranspiration of crop
28 V = round(Area_Plant * W * Eva,2)
29 #print('Volume of water to be applied %.2f m^3'%round(V))
30
31 #calculating the number of Laterals.
32 No_l = COLM
33 No_l = round(No_l) * 2
34 '''Nos. of tree at each side of the submain'''
35 No_t = round(ROW)/2
36
```

```
37 class Info():
38     global Eva
39     global V
40     global No_l
41     global No_t
42
43     def __init__(self,Em,Lat,SM,M,HW_CO,HW_CO_S,HW_CO_M):
44
45         self.Em = Em
46         self.Lat = Lat
47         self.SM = SM
48         self.M = M
49         self.HW_CO = HW_CO
50         self.HW_CO_S = HW_CO_S
51         self.HW_CO_M = HW_CO_M
52
53         self.size_m = 35
54         self.size_s = 48.5
55         self.size_l = 30.5
56         self.To_s = self.size_l +self.size_m +self.size_s
57         self.Nos_Em = 0
58         self.Nos_Manifold = 0
59
60     def calculation(self):
61         Qe = 3 * self.Em
62         irr_time = round((V/Qe),2)
63         self.Nos_Em = No_l * No_t * 3
64         Ql = No_t * Qe
65         '''Determine the nos of manifolds'''
66         '''Assuming the pump 2.5 lit/hr'''
67         PUMP = 2.5*60*60
68         x4 = PUMP/Ql
69
70         if x4 > No_l:
71             self.Nos_Manifold = 1
72         else:
73             self.Nos_Manifold = 2
74
```

```

74
75     '''step 5'''
76     m = 1.852
77     N1= 3 * No_t
78     F = 1/(m+1) + 1/(2*N1) + math.sqrt(pow(m,2)-1)/(6*pow(N1,2))
79     k = 1.22 * pow(10,12)
80     constant = k * F
81     x = constant /pow(self.Lat,4.877)
82     y = Q1/3600
83     x1 = x*pow(y,m)/pow(self.Hw_Co,m)
84     HL_lat = round(x1*self.size_l/100,4)
85     Q1_t = Q1 * No_1
86     '''Step 6'''
87     Q5 = Q1_t
88     N3 = No_1
89     F1 = 1/(m+1) + 1/(2*N3) + math.sqrt(pow(m,2)-1)/(6*pow(N3,2))
90     constant1 = F1 * k
91     x2 = constant1 /pow(self.SM,4.877)
92     y1 = Q5/3600
93     x3 = x2*pow(y1,m)/pow(self.Hw_Co_S,m)
94     HL_SM = round(x3*self.size_s/100,4)
95     HL_In = HL_lat + HL_SM + 10
96     P_var = (HL_In -10 - HL_lat)*100/HL_In
97     if P_var < 20:
98         P_var_p = ' Pressure variance({}) is less than 20.so, it is okay.'.format(round(P_var,3))
99     else:
100         P_var_p = ' Pressure variance({}) is not less than 20.so, it is not okay.'.format(round(P_var,3))
101
102     '''Step 7'''
103     constant2 = k
104     x5 = constant2 /pow(self.M,4.877)
105     y2 = Q5/3600
106     x6 = x5*pow(y2,m)/pow(self.Hw_Co_M,m)
107     HL_M = round(x6*self.size_m/100,4)
108
109     '''Total Dynamic Head'''
110     D = (HL_lat + HL_SM + HL_M + 10)/10
111     D_head = HL_lat + HL_SM + HL_M + 10 + 10 +1.28 + D
112     HP = round(D_head*Q5/(3600*0.60*75),4)
113     return [Q1,Q5,HL_lat,HL_SM,HL_In,HL_M,round(D_head,3),HP,P_var_p,irr_time]
114
115 def price(self,e,l,sm,m,mani=500):

```

```

109     '''Total Dynamic Head'''
110     D = (HL_lat + HL_SM + HL_M + 10)/10
111     D_head = HL_lat + HL_SM + HL_M + 10 + 10 +1.28 + D
112     HP = round(D_head*Q5/(3600*0.60*75),4)
113     return [Q1,Q5,HL_lat,HL_SM,HL_In,HL_M,round(D_head,3),HP,P_var_p,irr_time]
114
115 def price(self,e,l,sm,m,mani=500):
116     Total_fit = self.Nos_Em + No_l*2 + 2 + 2 + 1
117     P_fit = 20 #it's contain price of valves of extension line connector at fitting point.
118     overall_fit = 1 #rupees per meter for Labour work
119     P_valve = 250
120     P_filter = 3500
121
122     s1 = e*self.Nos_Em + l*No_l*self.size_l + sm*self.size_s + m*self.size_m + Total_fit*P_fit + overall_fit* self.
123     s1 = round(s1)
124     s1 = s1 + s1*10/100 #add 10% contingencies cost
125     return round(s1,10)
126
127 def write_data(x):
128     f = open('Result_data.txt','a',newline= '\r\n' )
129     f.write(x)
130     f.close()
131
132 window = Tk()
133 # window.geometry('400x300')
134 window.title('Drip Irrigation Design Application')
135 window.configure(background = '#0f0f0f')
136 CF = tkFont.Font(family='Sitka Display', size=12,weight='bold')#Berlin Sans FB Demi,AR JULIAN,Sitka Display,Bookman Old
137 CF1 = tkFont.Font(family='AR JULIAN', size=13)
138 CF2 = tkFont.Font(family='AR JULIAN', size=12)
139
140 #window.wm_iconbitmap('Flameia-Rabbit-Xp-Documents.ico')
141
142 Label(window,text = 'Emitter (l/hr):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=0)
143 Label(window,text = 'Laterals (mm) :-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=1)
144 Label(window,text = 'Sub-main (mm):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=2)
145 Label(window,text = 'Main (mm) :-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=3)
146 Label(window,text = 'Hazen-willams material constant(Lateral):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid
147 Label(window,text = 'Price of Emitter (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=0,column=3)
148 Label(window,text = 'Price of Laterals pipes (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=1,colu
149 Label(window,text = 'Price of Sub-main pipes (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=2,colu

```

```

146 Label(window,text = 'Hazen-willams material constant(Lateral):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid
147 Label(window,text = 'Price of Emitter (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=0,column=3)
148 Label(window,text = 'Price of Laterals pipes (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=1,colu
149 Label(window,text = 'Price of Sub-main pipes (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=2,colu
150 Label(window,text = 'Price of Main pipes (Rs.):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(row=3,column=3
151 Label(window,text = 'Hazen-willams material constant(Sub-Main):-',background='#0f0f0f',foreground='#35C5CF',font=CF).gr
152 Label(window,text = 'Hazen-willams material constant(Main):-',background='#0f0f0f',foreground='#35C5CF',font=CF).grid(ro
153
154 e1 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
155 e2 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
156 e3 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
157 e4 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
158 e5 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
159 e6 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
160 e7 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
161 e8 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
162 e9 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
163 e10 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
164 e11 = tk.Entry(window,justify=CENTER,relief = FLAT,font=CF2)
165
166 e1.grid(row = 0 ,column = 1)
167 e2.grid(row = 1 ,column = 1)
168 e3.grid(row = 2 ,column = 1)
169 e4.grid(row = 3 ,column = 1)
170 e5.grid(row = 4 ,column = 1)
171 e6.grid(row = 0 ,column = 4)
172 e7.grid(row = 1 ,column = 4)
173 e8.grid(row = 2 ,column = 4)
174 e9.grid(row = 3 ,column = 4)
175 e10.grid(row = 5 ,column = 1)
176 e11.grid(row = 6 ,column = 1)
177
178
179
180 def display():
181     global Eva
182     global V
183
184     result = Info(int(e1.get()),int(e2.get()),int(e3.get()),int(e4.get()),int(e5.get()),int(e10.get()),int(e11.get()))
185     x = result.calculation()
186     y = result.price(int(e6.get()),int(e7.get()),int(e8.get()),int(e9.get()))

```

```

179
180 def display():
181     global Eva
182     global V
183
184     result = Info(int(e1.get()),int(e2.get()),int(e3.get()),int(e4.get()),int(e5.get()),int(e10.get()),int(e11.get()))
185     x = result.calculation()
186     y = result.price(int(e6.get()),int(e7.get()),int(e8.get()),int(e9.get()))
187     text_area = tk.Text(master=window,height = 15,width = 60,bg = '#b9d4db',font=CF1)#C5CAE9
188     text_area.grid(column=0,row =8)
189     result = '\n Result[[{},{},{},{}] for price[{},{},{},{}]] :- \n \'
190         '1. Evapotranspiration :- { } mm/day \n \'
191         '2. Volume of water to be applied { } m^3 \n \'
192         '3. Irrigation time require :- { } hrs. \n \'
193         '4. Total Discharge in one lateral pipe :- { } \n \'
194         '5. Total Discharge in Sub-Main pipe :-{ } \n \'
195         '6. Head loss in lateral pipe :-{ }\n \'
196         '7. Head loss in Sub-Main pipe :- { } \n \'
197         '8. Head loss at Inlet-section of sub-main pipe :- { }\n \'
198         '9. Head loss in main pipe :- { }\n \'
199         '10. Total Dynamic Head :- { }\n \'
200         '11. Horse power require :- { }\n \'
201         '12. { }\n \'
202         '13. Overall Cost (without PUMP):- { }\n'.format(int(e1.get()),int(e2.get()),int(e3.get()),int(e4.get()),int
203     write_data(result)
204     text_area.insert(tk.END,result)
205
206 button1 = ttk.Button(window,text= 'Submit',command = display)
207 button1.grid(row = 7,column = 2)
208.mainloop()

```

ANNAXURE C

Questions	Answers
1. Name of Farmer?	Maheshbhai D. Patel
2. Size of Farm?	3 vigha
3. What is name of crop?	Paddy, sugarcane (Now Paddy)
4. Season of the crop?	kharif crop
5. Time period of the crop?	4.5 to 5 months
6. Type of irrigation system used?	Motor through (3 phase line)
7. Which irrigation method use?	Simple
8. Detail about irrigation system?	Bore well
9. Type of Fertilizer and How much used?	Urea, potash,sulphate, 12-32-16, 20-20-013 48 packets
10. Cost of the fertilizer?	30600 Rs
11. Cost of the seeds?	2700 Rs
12. Cost about labours in different works?	32000 rs
13. Cost of the electricity ?	10000 rs
14. Estimated Product?	6300 kg
15. Estimate price and Profit of product?	25000 to 30000 profit

Questions	Answers
1. Name of Farmer?	Balubhai N. Mahida
2. Size of Farm?	2 vigha
3. What is name of crop?	Sugarcane
4. Season of the crop?	Yearly
5. Time period of the crop?	1 year
6. type of irrigation system used?	Motor (3 phase)
7. Which irrigation method use?	Furrow method
8. Detail about irrigation system?	Bore well
9. Type of Fertilizer and How much used?	Urea, potash, 20-10-10 40 packets
10. Cost of the fertilizer?	35000 rs
11. Cost of the seeds?	15000 rs
12. Cost about labours in different works?	10000 rs
13. Cost of the electricity ?	8000 rs
14. Estimated Product?	95 tones
15. Estimate price and Profit of product?	3,00,000 rs and profit about 200000 rs

Questions	Answers
1. Name of Farmer?	Jayeshbhai N. Patel
2. Size of Farm?	1 vigha
3. What is name of crop?	Mango
4. Season of the crop?	Summer season
5. Time period of the crop?	1 year
6. Type of irrigation system used?	Motor through
7. Which irrigation method use?	Basin method
8. Detail about irrigation system?	Bore well
9. Type of Fertilizer ?	Sulphate, urea, n.p.k.(10 26 26)
10. Cost of the fertilizer?	12000
11. Cost of the seeds?	150 to 200 rs per plant
12. Cost about labours in different works?	8000 rs
13. Cost of the electricity ?	-
14. Estimated Product?	8400 kg
15. Estimate price and Profit of product?	Near 3 lakhs and profit 2.5 to2.7 lakhs