MID TERM PAPER

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Question No #01 (Part a)

Define "Delta" and Duty and derive their Relationship in MKS and FPS system.

Answer:-

Delta:- A crop needs a certain amount of water at fixed interval through out its base period

Depth of each watering 5cm(2") — 10cm(4")

Defination:- It is the total depth of the water required by a crop during the entire Period the crop is in the field.

It is denoted by "Δ"

Example:- If a crop required about 12 watering at interval of 10 days and a water depth of 10cm. If the area under the Crop is A hectares, the total quantity will be $1.2 \times A = 1.2A$ hectare-mater in Period of 120 days.

Duty :- The term duty means the area of land that can be irrigated with unit volume of irrigation water.

Duty represents the irrigating capacity of a unit.

Defination :- It is the relationship between the area of the crop irrigated and the quantity of irrigation water required during the entire period of the growth of that crop.

OR

The duty of water is the relationship between the volume of water and the area of crop it matures.

Volume of water is generally expressed by a unit discharged flowing for a time of base period of the crop.

Example :- If 3 cumecs of water supply is required for a crop sown in an area of 5100 hectares, the duty of irrigation water will be $\frac{5100}{3} = 1700$ hectares/cumecs.

The discharged of 3 cumecs will be required throughout the base period.

Relation Between Duty and Delta

In MKS System :-

⇒ Let there be a crop of base period "B" days. Let one cumec (m^3/sec) of water be applied to this crop on the field for "B" days.

⇒ Now the volume of water applied to this crop during B days = $V = (24 \times 60 \times 60 \times B)\ m^3$

$$V = 86400\ m^3$$

⇒ By definition of duty, 1 m^3 of water supplied for "B" days matures "D" hectares of land. This quantity of water (V) matures "D" ha of land or $10^4 D\ m^2$ of area.

⇒ Total depth of water applied on this land

$$= \frac{\text{Volume}}{\text{area}} = \frac{86400B}{10^4 D} = 8.64\ B/D\ m$$

By definition, This total depth of water is called Delta "Δ"

Therefore $\Delta = 8.64\ B/D\ m = 864\ B/D\ cm$

where Δ is in cm

B is in days.

In F.P.S System:-

Let Duty = D (Acres/cusecs)

Delta = A feet Base period = B days By definition

⇒ One cusec of water flowing continously for "B" days gives a depth of water "A" over an area of "D" acres

⇒ Volume of water $1 ft^3/sec$ in one day

$= 1 \times 24 \times 60 \times 60 = 86400 ft^3$

⇒ Volume of water $1 ft^3/sec$ in "B" days

$= 1 \times 24 \times 60 \times 60 = 86400 B ft^3 = 86400 ft^2 \cdot ft$

⇒ As 1 Acre $= 43560 ft^2$ or $1 ft^2 = 143560$ Acre

Then

Volume of water $1 ft^3/sec$ in B days

$= 86400 ft^3 = 86400 B \times 143560$ Acre-ft

Volume of water $1 ft^3/sec$ in B days

$= 1.9883$ B Acre ft

⇒ Depth of water required by crop A

= Volume Area = 1.9883 B Acre ft D

Acre A = 1.983 BD ft.

Question 01 (Part b)

If wheat required about 9cm of water after every 35 days and the base period and crop period of wheat is 140 days.

Find out the delta "Δ" for wheat?

GIVEN DATA:-

Water requirment of wheat = 9cm

Days interval = 35 days

Base period = 140 days

Required :- Delta = Δ = ?

Solution :- As we know that

$$\text{Delta} = \Delta = \frac{\text{Water required} \times \text{Base period}}{\text{Day interval}}$$

$$\Delta = \frac{9\text{cm} \times 140\text{ days}}{35\text{ days}}$$

$$\Delta = 36\text{cm}$$

Now

Total depth of water required in 140 days = 36cm

Explain Indus water Treaty.

Indus water Treaty :-

The Indus waters Treaty is a water distribution treaty between India and Pakistan, brokered by the World Bank to use the water available in the Indus system of Rivers located in India. The Indus water Treaty was signed in Karachi on September 19, 1960 by the first prime minister of India Pandit Jawaharlal Nehru and President of Pakistan Ayub Khan

:- Some Features of the Indus water Treaty :-

* The treaty administer how river Indus and its tributaries that flow in both the countries will utilized.
* According to the Treaty, Beas, Ravi and Sutlaj are the to be governed by India, while Indus, Chenab and ~~Jeh~~ Jhelum are to be taken care by Pakistan.
* Since Indus flows from India, the country is allowed to use 20% of its water for irrigation, Power generation and transport purpose.
* The Treaty also provides arbitration mechanism to solve disputes amicably.

Question 01 (Part - D)

Significance of Duty of a Crop :-

⇒ It helps in designing efficient canal irrigation system.

⇒ Knowing the total available water at the head of the main canal and the overall duty for all the crops required to be irrigated in different seasons of the year, the area which can be irrigated can be worked out.

⇒ Inversely if we know the crop area required to be irrigated and their duties, we can workout the discharged required for designing the canal.

Question = 02 (Part-a)

Explain the factors Affecting Consumptive use:

Consumptive use: It is the amount of water required by a crop for its vegetated growth in evapotranspiration and building of plant tissues plus evaporation from soils and intercepted precipitation It is expressed in term of depth of water.

Consumptive use various with Temperature, humidity wind speed, Topography, Sunlight hours, method of irrigation, moisture availability.

Factor Affecting of CU:

① **Temperature:-** The rate of consumptive use of water by crops in any particular locality is Probably affected more by Temperature, which for long-time Periods is good measure of solar radiation, then by any other factor. Abnormally low Temperatures retard plant growth and unusually high Temperatures may Produce dormancy

② **Humidity:-** Evaporation and Transpiration are accelarated on days of low humidity and slowed during periods of high humidity. During periods of low relative humidity, greater rate of use of water by vegetation may be expected.

3) **Velocity of Wind :-**

Evaporation of water from land and plant surface take place more rapidly when there is moving air than under calm air condition. Hot, dry wind and other unusual wind condition during the growthing period will effect the amount of water consumptively used. However, there is a limit in the amount of water that can be utlized.

As soon as the land surface is dry, evaporation particularly slop and transpiration is limitted by the ability of the plants to extract and convey the soil moisture through the plants.

4) **Sun Light :-** The sun is the source of all energy used in crop growth and evaporation of water this longer day may allow plants transpiration to continoue for a longer period each day and to produced an effect similar to that of longthoning the growing season.

5) **Soil Fertility :-** If the soil is made more fertile through the application of manure or by some other means, the field may be expected to increase with an accompanying small increase in use of water.

However, an increase of in fertility of the soil causes a decrease in the amount of water consumed per unit of crop yield

Question = 02 Part-B

Wheat is to be grown at a certain place, the usefall rainfall for the whole season is 10cm and its cumulative consumptive use is 40cm. Determine consumptive irrigation requirment (CIR) and Field irrigation Requirment (FIR) If the water application efficiency is 80%

Given Data:- Useful Rainfall = 10 cm

water application Efficiency $\eta_a = 80\% = 0.8$

Commulative consumptive use $C_u = 40cm$

Required:-

Field Irrigation Requirment FIR = ?

~~Consumptive Consumptive use Cu =~~

Consumptive irrigation Requirment = CIR = ?

Solution:- By Formula

$$CIR = C_u - R_e = 40 - 10$$

$$\boxed{CIR = 30cm}$$

$$FIR = \frac{CIR}{\eta_a} = \frac{30}{0.8}$$

$$\boxed{FIR = 37.5cm}$$

Question = 02 (Part - C)

Class A Pan Evaporation (EP) Measurment :-

Pan Evaporation can be experimentally determined by directly measuring the quantity of water evaporated from this standard class A pan. This pan is 1m in diameter, 25cm deep and bottom is raised 15cm above the ground surface.

The depth of water is to be kept in a fixed range such that the water surface is at least 5cm and never more than 7.5cm below the top of pan.

The pan evaporation (EP) can also determined by using the christiansen formula which states

$$Ep = 0.459\ R.Ct.Cw.Ch.Cs.Ce$$

where

R = Terrestrial radiation in some unit as cm or mm

Ct = Co-efficient for Temperature

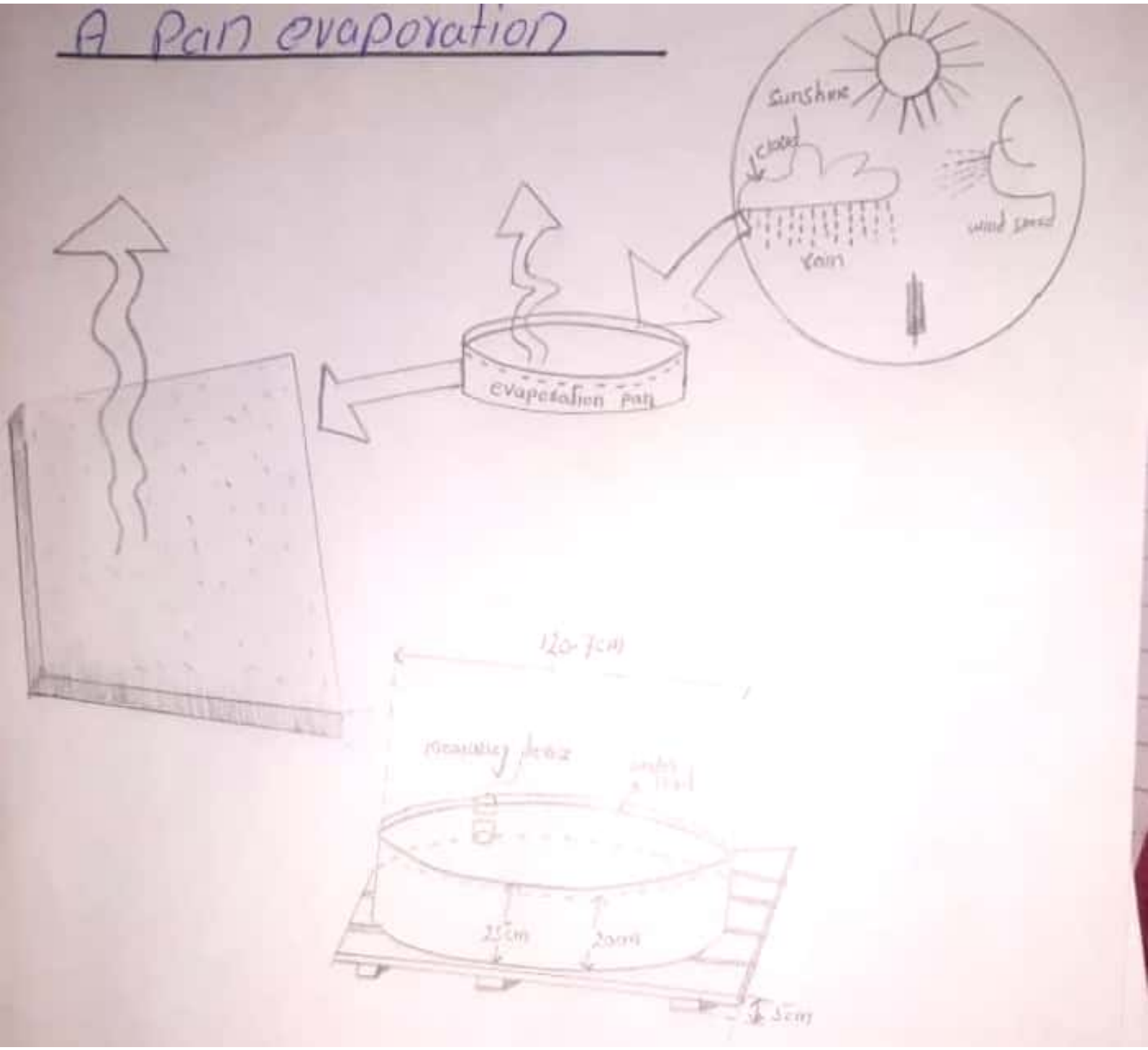
Cw = Co-efficient for wind velocity

Ch = Co-efficient for Humidity

Cs = Co-efficient for %age of possible sunshine

Ce = Co-efficient for elevation

A Pan evaporation



Question 2 (Part - D)

Explain Crop Season (Rabi & Kharif) and Rabi Kharif Ratio

Rabi crops:- Rabi crops are the crops that are sown after the end of the monsoon ie during the winter season.

Major crops:- → wheat, peas, gram, oilseeds barley etc.

Requirment :- → It required warm climate for seed germation and cold climate to grow.

Flowering :- → Require longer day length

Sowing Month :- → October — November.

Harvesting Month :- → March — April.

Kharif Crops :- Kharif crops can be described as the crops which are sown with the beginning of rainy season.

Major crops :- Rice, maize, cotton, groundnut, Jowar, bajra.

Requirment :- It is required huge amount of water and hot weather to grow.

Flowering :- Require shorter day length

Sowing month :- June — July

Harvesting Month :- September — October.

Kharif Rabi Ratio :-

The area to be irrigated for Rabi crops generally more than that for Kharif crops. This Ratio of proposed areas, to be irrigated in Kharif season to that in Rabi ~~season~~ Season is called Kharif Rabi Ratio.

This Ratio is generally 1 : 2

i.e Kharif area is one half of Rabi area

Q3) Define & explain the following terms:-

(a) Field capacity :-

When all gravity water has drained down to water table, a certain amount of water is retained by surface soil. This water which cannot be easily drained under the action of gravity is called Field capacity.

Period of drainage = 2 to 5 days.

Field capacity measured after 2 or 5 days.

i) Capillary water:- water attached to soil by surface tension which can easily be extracted by plants by capillary action.

(ii) Hygroscopic water:- water attached to the soil by chemical bond, which can not be extracted by plants by capillary action

$$\text{Field capacity} = \frac{\text{Weight of water retained volume of Soil}}{\text{weight of some soil}}$$

$$F.C = \frac{\text{wt of water retained volume soil}}{\text{wt of some soil}} \times 100$$

(b) Permanent Wilting Point :-

A plant can extract water from soil till a permanent wilting is reached.

Permanent wilting point is that water content at which a plant can no longer extract sufficient water for its growth and wilts up.

Water available to plant = Field Capacity - P.W.P water.

$$\text{P.W.P water} = \frac{\text{water available to plant}}{\text{Field capacity}}$$

(C) Available and Readily Available moisture content

Available Moisture content :-

The range of available water that can be stored in soil and be available for growing crop is known as available moisture content.

⇒ It is the difference b/w the amount of water in the soil and at field capacity and the amount at the permanent wilting point referred to as the available water or moisture.

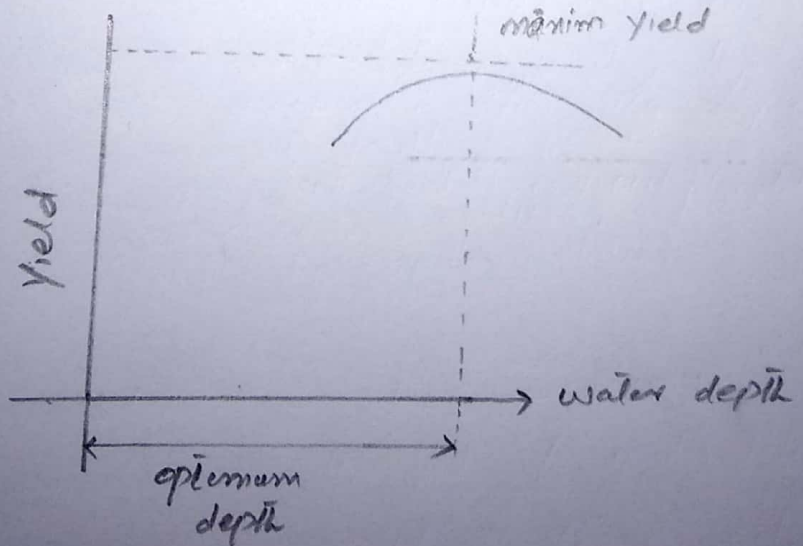
Water available = F.C - P.W.P

Readily Available Moisture :-

It is that portion of available moisture which is mostly easily extracted by plants and is approximately 75% to 80% available moisture

④ Optimum Utilization of water :-

It is the crop is sown and produced under absolutely identical condition using different amount of water depths, the yields is found to vary. The yield increases with water reaches a certain maximum value & then falls down as shown in fig.



The quantity of water at which the field is maximum called optimum water depth.