Advanced Solar Irrigation Scheduling for Sustainable Rural Development : A case of India

BMS ΔX TEAM – "EVERY 💧 DROP COUNTS"

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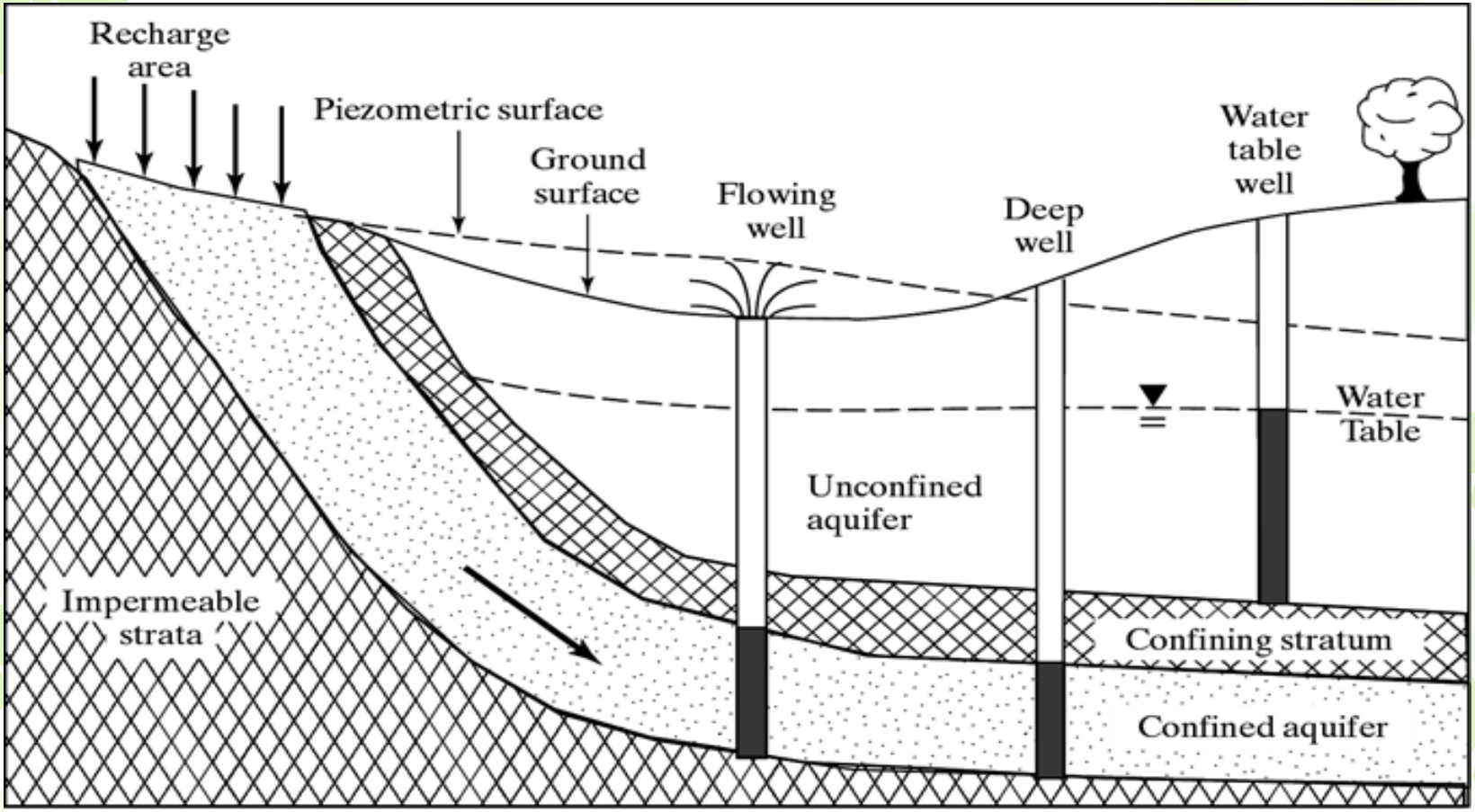
Preamble:

- India is a tropical country and an agrarian society.
- About 50% of the population depends directly or indirectly on Agriculture.
- South West Monsoon is the main source of rainfall.
- Monsoon is erratic both in space & time due to climatic changes.
- Kharif crops are rain fed whereas winter and summer crops require irrigation.

Rain Fed Agriculture

➢Well Irrigation is common in South Karnataka and hence bore wells.

- Local governments give electricity free to farmers.
- Due to the scarcity of electricity, farmers will get the electricity during night time for a limited time.

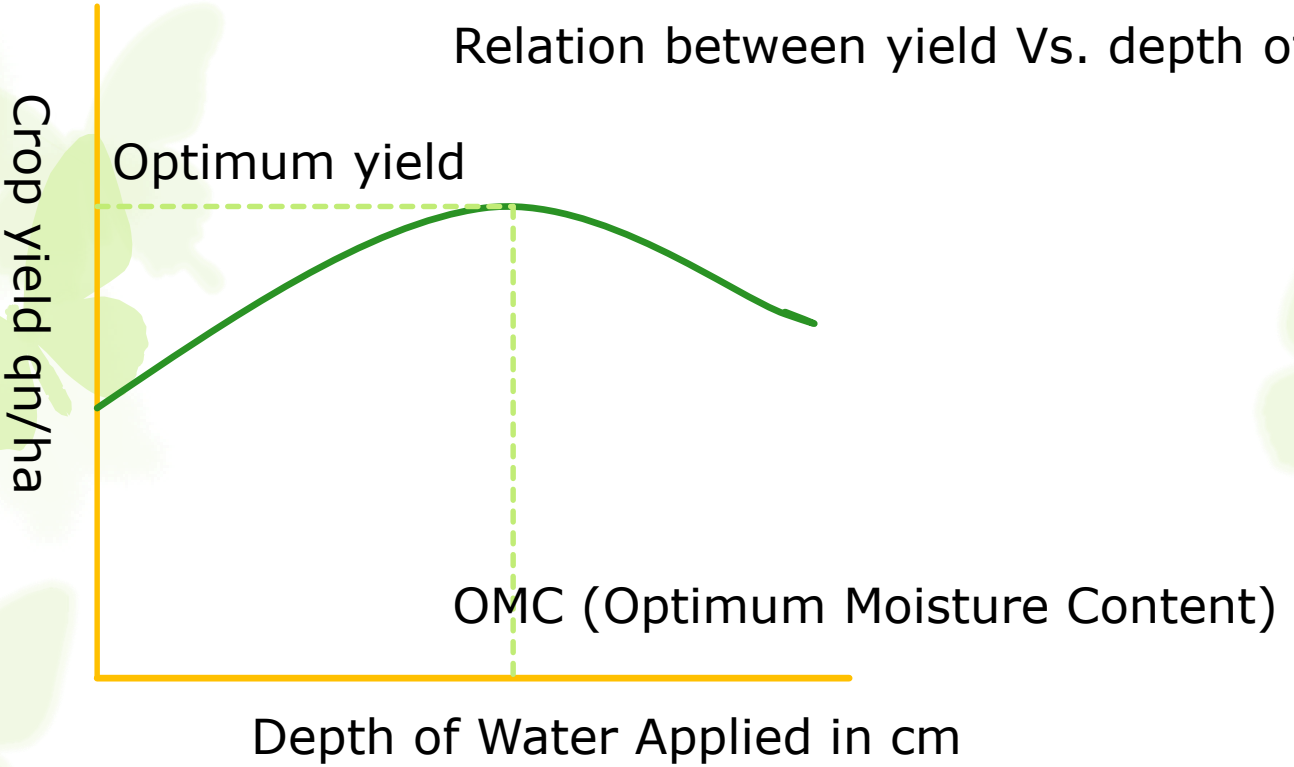


Irrigation Scenario – Furrow Method of Irrigation

Present Scenario – Furrow Method of Irrigation

Present Scenario – Drip Irrigation

Relation between yield Vs. depth of water applied



➢The farmers are forced to depend on diesel fuel operated bore wells for irrigation due to scarcity of electricity.

- The operational cost of diesel based irrigation and the gradual reduction from the bore wells results in yield reduction.

Consequence……

Stop drilling, there's no groundwater left

Overexploitation In Bangalore Urban, Rural, Says Report

Saswati Mukherjee

Bangalore: The city stares at an arid future. Bangalore Urban and Rural districts, besides Chikkaballapur and Kolar, have exhausted their

• Ban drilling, say experts, P 4

groundwater, show statistics available with the Central Ground Water Board (CGWB).

All taluks in these four districts fall under the "overexploited" category, where more than the permissible

TALUKS SUCKED DRY

- Doddaballapur, Hosakote, Nelamangala and Devanahalli in Bangalore Rural district
- Anekal, Bangalore East, North and South taluks in Bangalore Urban district
- Chikkaballapur, Chintamani, Gauribidanur, Gudibande and Sidlaghatta taluks in Chikkaballapur district
- Bangarpet, Kolar, Malur, Mulbagal and Srinivasapura taluks in Kolar district

DIRE SITUATION: All activity that causes depletion of the water table must be stopped

amount of groundwater has been drawn. Karnataka has 30 such overexploited taluks; the rest are in the critical (3), semi-critical (33), safe (77) and mixed (5) categories.

A CGWB report titled the "Groundwater Resource Estimation" reveals that in these 30 taluks, there is no scope for further extraction of groundwater — a result of more groundwater being drawn than what has seeped into the ground.

"The frequency and quantum of rainfall have become unpredictable of late. If there is heavy rainfall, water flows into rivers, and nothing percolates to recharge groundwater. When water is extracted through borewells, there is a lot of pressure on the groundwater table," G Subbarao, regional director, CGWB, told TOI.

When the water table cannot be tapped any further, a saturation level of 100% is reached. Zones where groundwater has been over-exploited have a level of 100% or more. A 90% level is critical, while 70-90% is semi-critical. If a zone has up to 70% extraction, it's categorised as safe.

The saturation level in India was 45% in 2009, while it stood at 68% in Karnataka and 136% in Bangalore. A 2011 report put the Karnataka level at 68% and 141% in Bangalore.

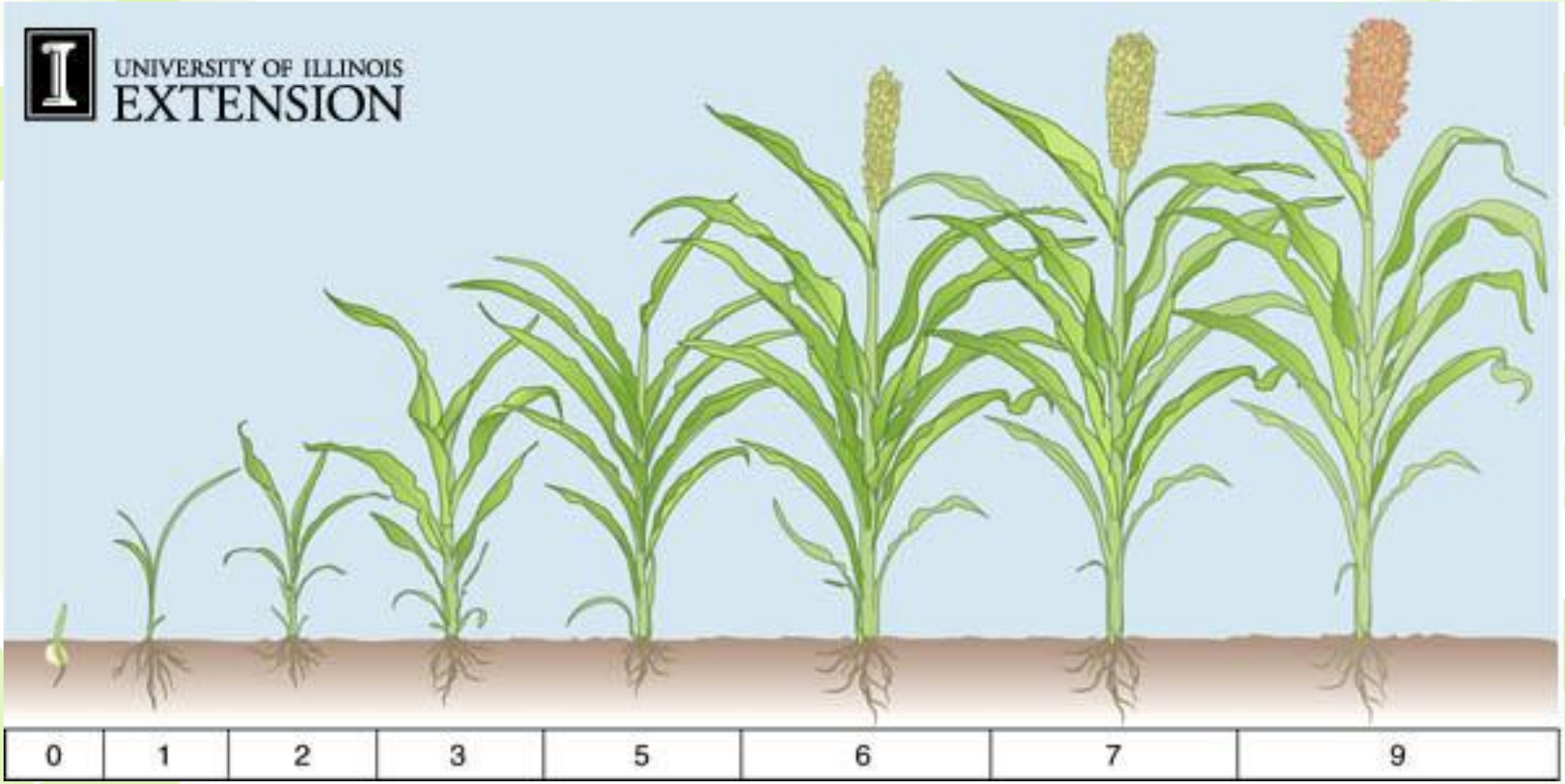
Present Method of Irrigation

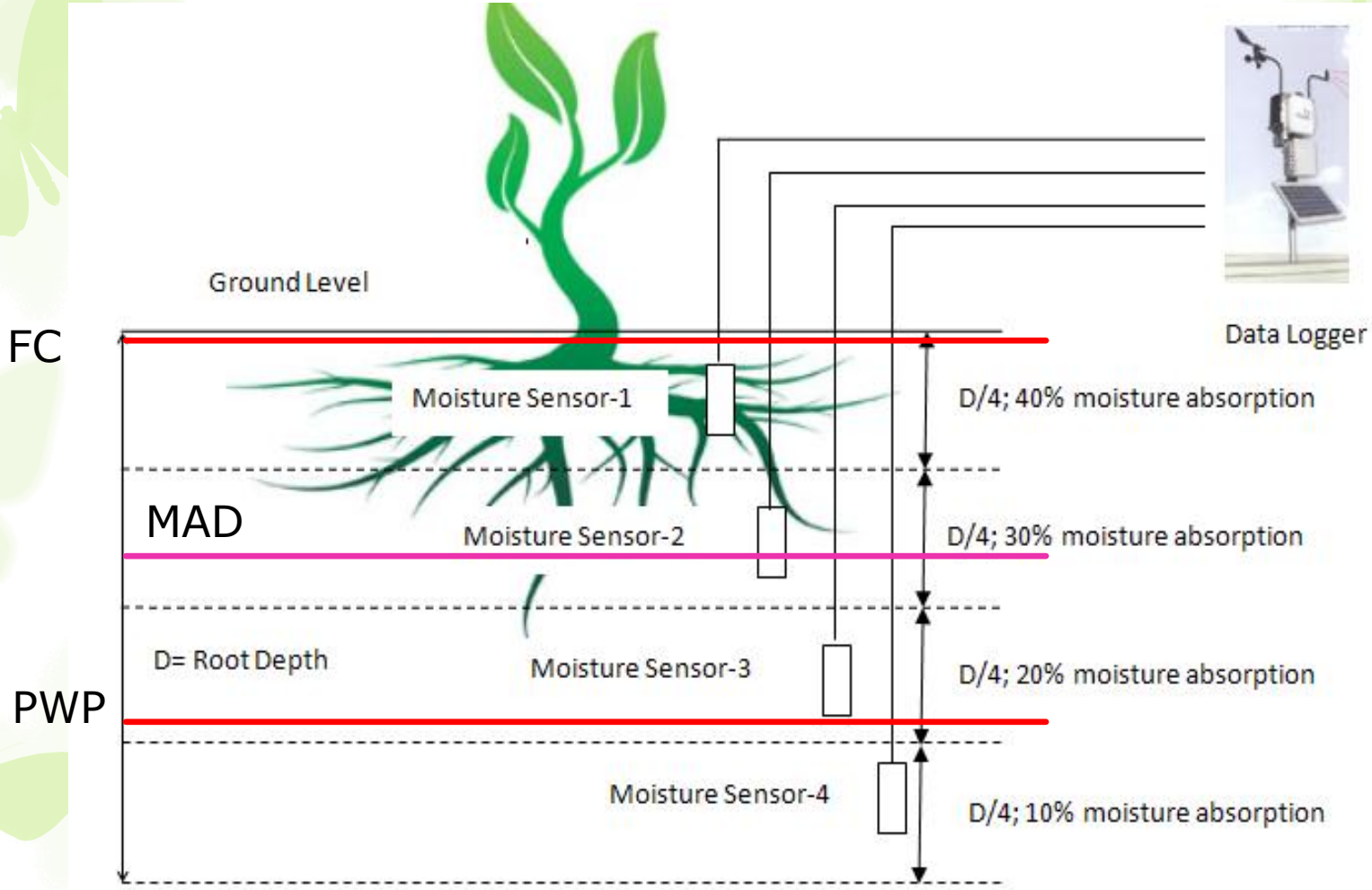
➢Migration of farmers to urban areas looking for livelihood, creating urban slums.

Objective:

- To develop and deploy an automated process that takes care of water requirements of a crop as and when the crop demands (Right quantity at right time)

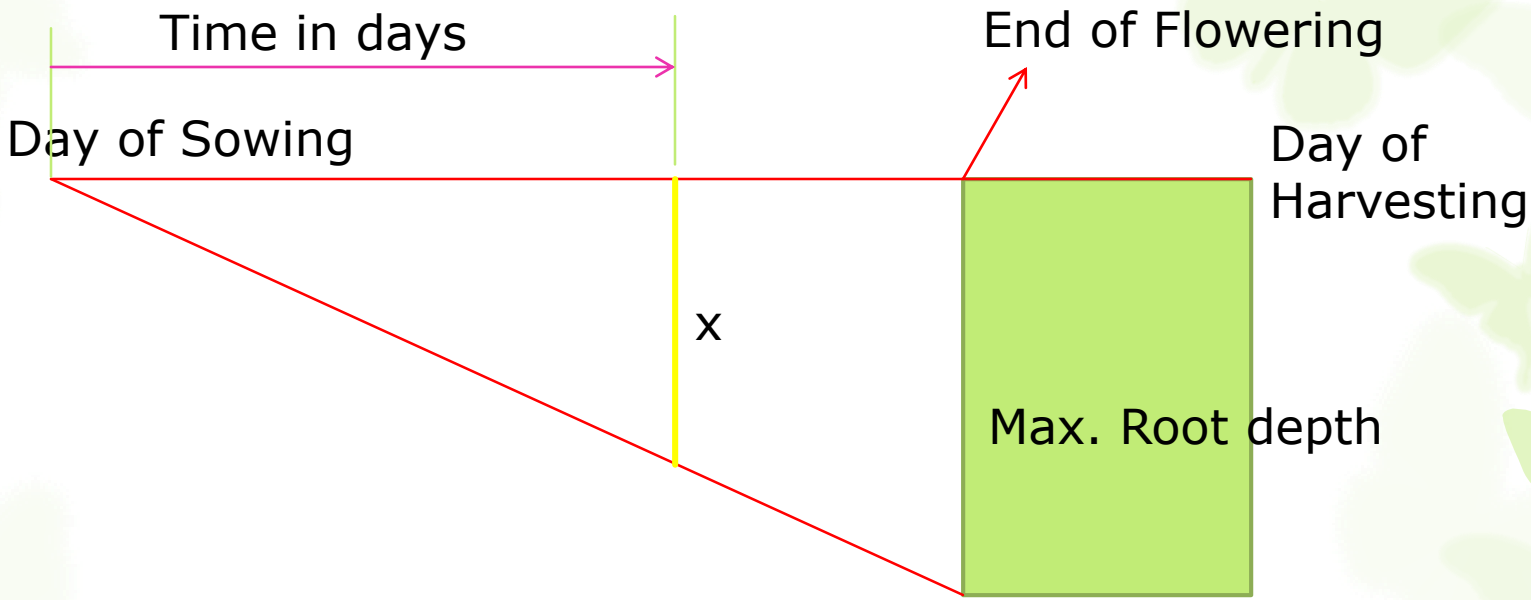
Courtesy:



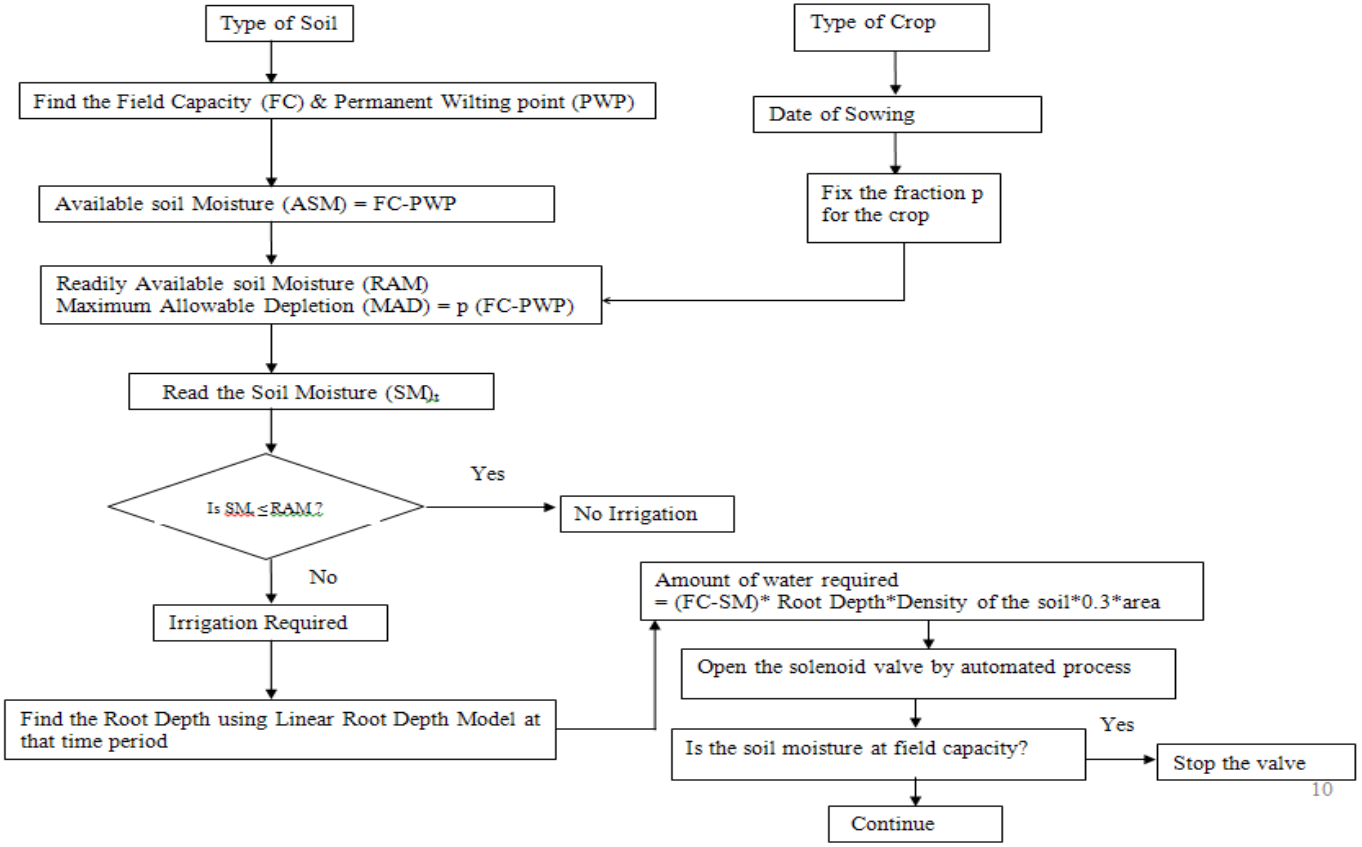

Ground Level
FC
MAD
PWP
Moisture Sensor-1
Moisture Sensor-2
Moisture Sensor-3
Moisture Sensor-4
D= Root Depth
Data Logger
D/4; 40% moisture absorption
D/4; 30% moisture absorption
D/4; 20% moisture absorption
D/4; 10% moisture absorption

Amount of water required by the crop at any time= f(FC-SM)*Root depth* bulk density of the soil.

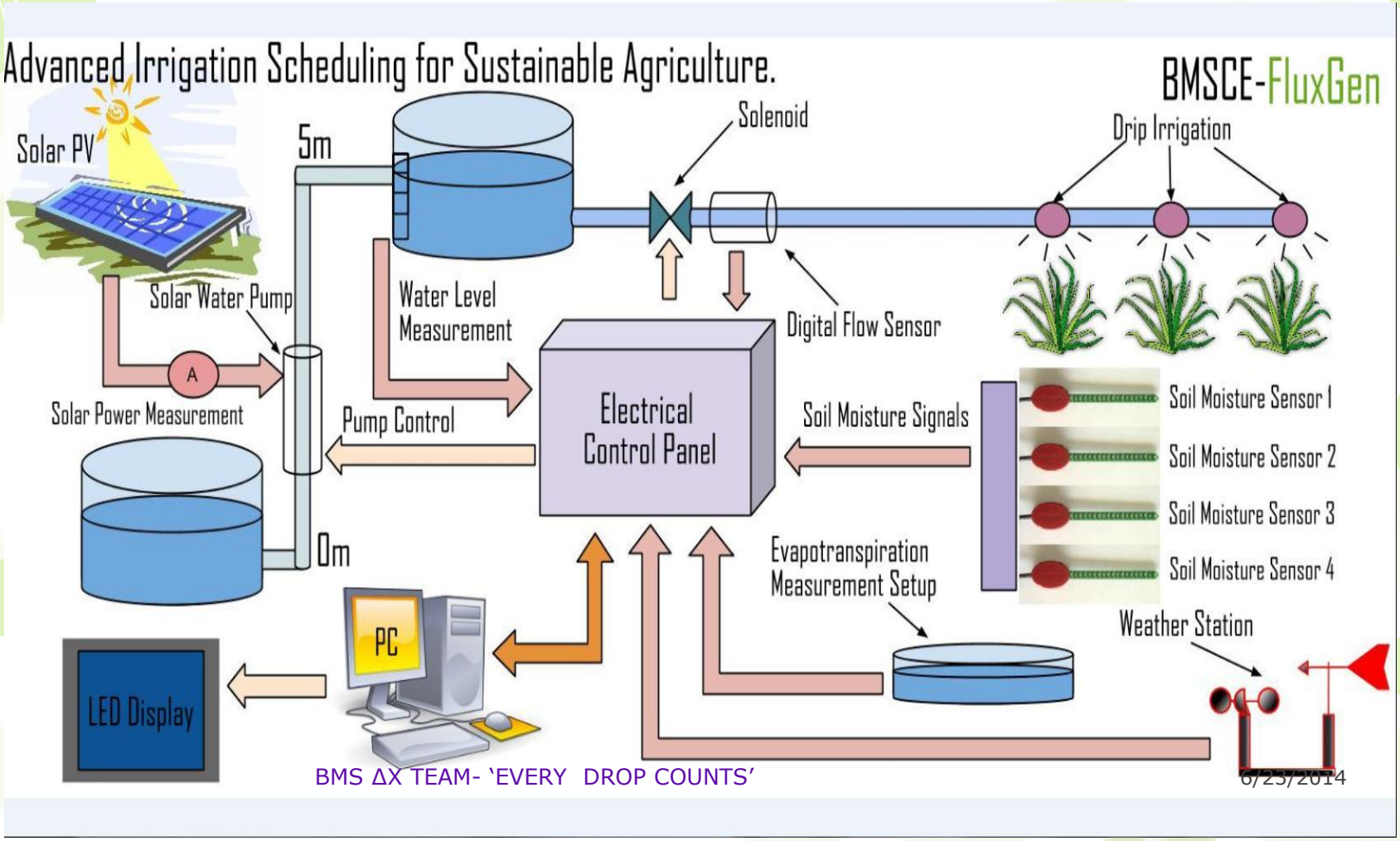
Root Depth Model: (Ramaprasad et.al)



Flow Chart


Type of Soil
Find the Field Capacity (FC) & Permanent Wilting point (PWP)
Available soil Moisture (ASM) = FC-PWP
Type of Crop
Date of Sowing
Fix the fraction p for the crop
Readily Available soil Moisture (RAM)
Maximum Allowable Depletion (MAD) = p (FC-PWP)
Read the Soil Moisture (SM)t
Is SMt ≤ RAM?
Yes
No Irrigation
No
Irrigation Required
Find the Root Depth using Linear Root Depth Model at that time period
Amount of water required
= (FC-SM)* Root Depth*Density of the soil*0.3*area
Open the solenoid valve by automated process
Is the soil moisture at field capacity?
Yes
Stop the valve
Continue

Schematic diagram



Renewable Energy

- The pumping of water into an over head tank is performed under computer control.
- The pump is a commonly available solar pump powered by solar PV module.
- All the hardware i.e., weather station and the embedded controller run from renewable energy sources.
- The technology we present is a compatible application for a rural renewable energy micro grid.

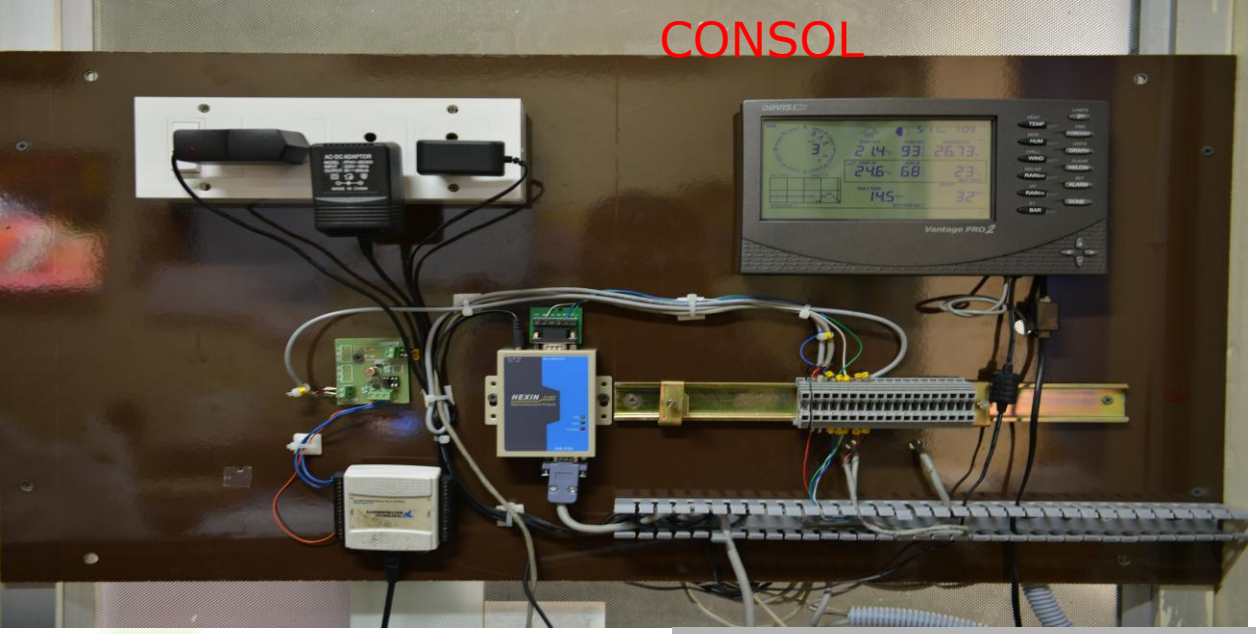
Experimental Plot in BMS College of Engineering

Weather Station in the Experimental Plot

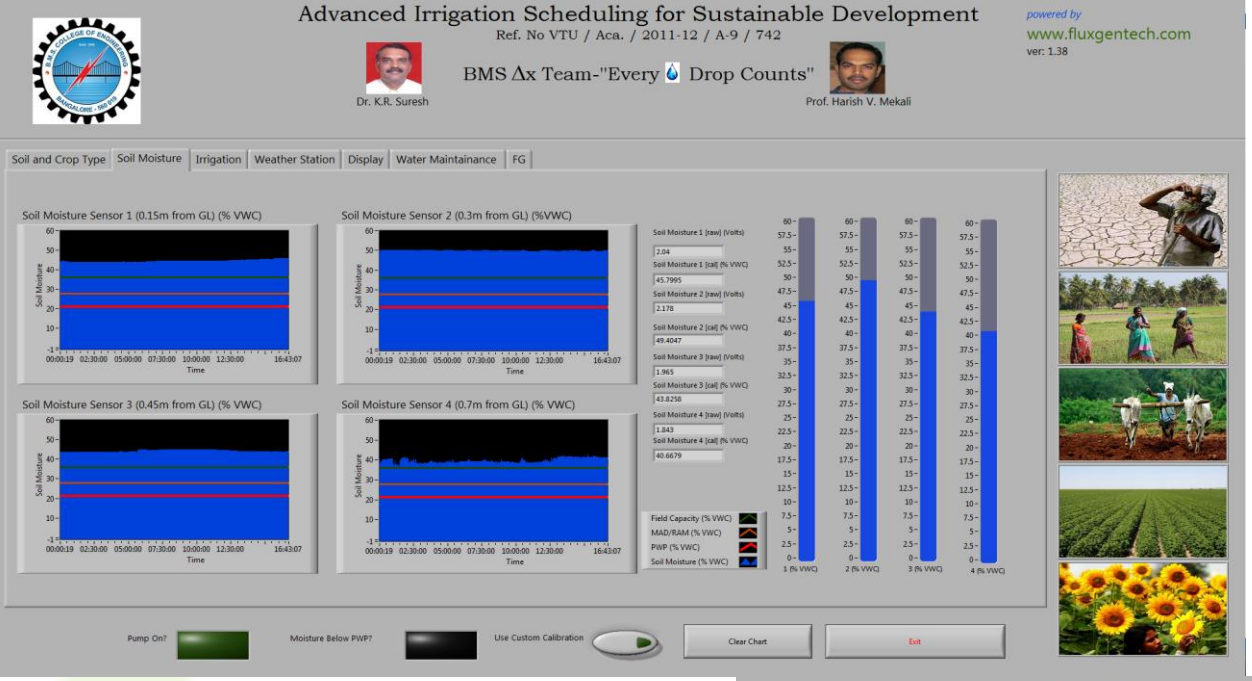
Soil Sensors Installed in the Test Plot

A View of the Test Plot

CONSOL

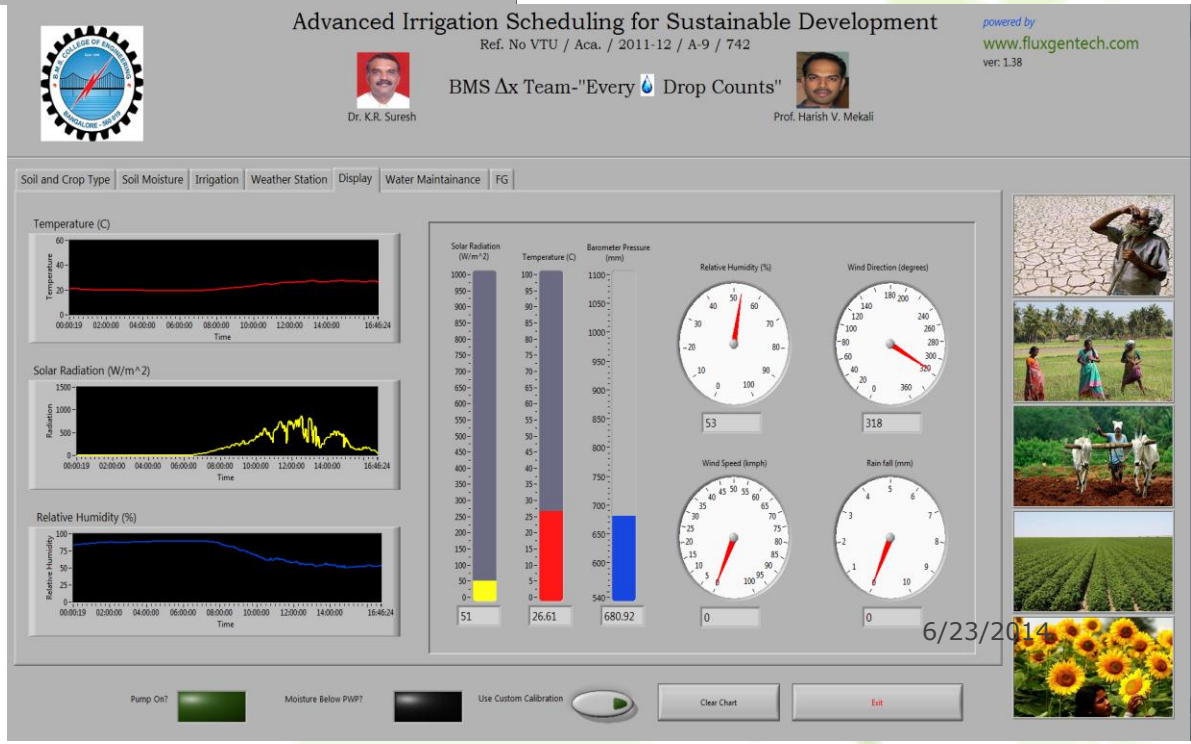


Display System-
Displaying the Real Time data.



Display System- Displaying the Real Time Soil Moisture data of 4 Sensors.

Display System- Displaying the Real Time data of Various weather parameters.



Date Month Year Hour Minute Raw Moisture 1 (V) Raw Moisture 2 (V) Raw Moisture 3 (V) Raw Moisture 4 (V) Temperature (C) Pressure (mm) Relative Humidity (%) Wind Speed (kmph) Wind Direction (degrees) Daily Rain (mm) Solar Radiation (W/m^2) Default Cal Moisture 1 (% VWC)) Default Cal Moisture 2 (% VWC) Default Cal Moisture 3 (% VWC) Default Cal Moisture 4 (% VWC) Custom Cal Moisture 1 (% VWC)) Custom Cal Moisture 2 (% VWC) Custom Cal Moisture 3 (% VWC) Custom Cal Moisture 4 (% VWC) Irrigation Status Auto-irrigation FG
31 10 13 00 00 1.823000 1.961000 2.777000 2.129000 22.055556 684.098200 79.000000 3.218680 130.000000 0.000000 0.000000 40.088947 43.720526 50.010000 48.141579 18.607383 20.808824 41.990596 23.279412 OFF OFF 1608489804.000000
31 10 13 00 01 1.823000 1.961000 2.770000 2.131000 22.055556 684.123600 79.000000 3.218680 130.000000 0.000000 0.000000 40.088947 43.720526 50.010000 48.194211 18.607383 20.808824 41.880878 23.308824 OFF OFF 1608549841.000000
31 10 13 00 02 1.824000 1.961000 2.766000 2.132000 22.055556 684.098200 79.000000 4.828020 130.000000 0.000000 0.000000 40.115263 43.720526 50.010000 48.220526 18.624161 20.808824 41.818182 23.323529 OFF OFF 1608609864.000000
31 10 13 00 03 1.823000 1.961000 2.765000 2.124000 22.055556 684.072800 79.000000 4.828020 125.000000 0.000000 0.000000 40.088947 43.720526 50.010000 48.010000 18.607383 20.808824 41.802508 23.205882 OFF OFF 1608669878.000000
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Sample output


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