Food and Agriculture Organization
of the United Nations

# GUIDELINES FOR TECHNICAL CLEARANCE OF SYSTEM DESIGN AND SPECIFICATIONS

## ITB OPERATION MANUAL

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ITALIAN AGENCY
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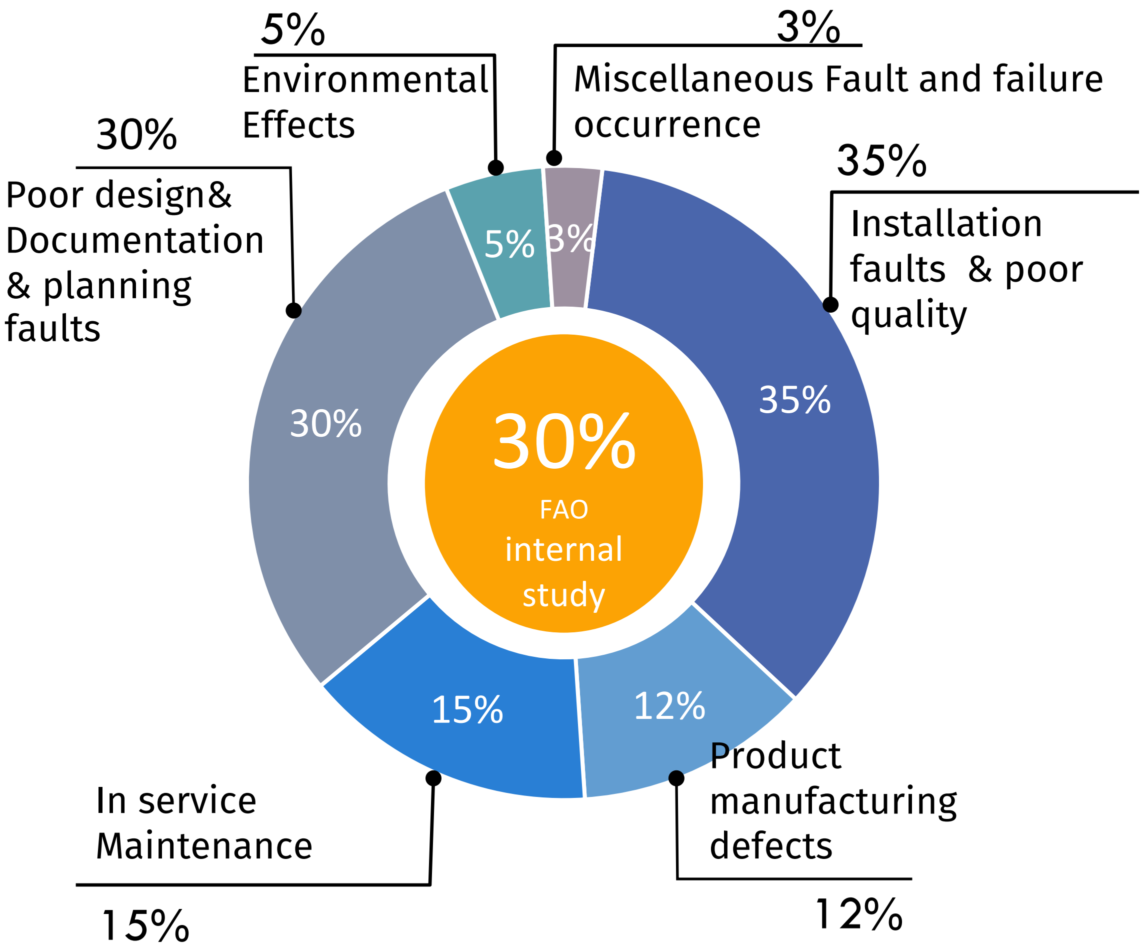
# GUIDELINES FOR TECHNICAL CLEARANCE OF SYSTEM DESIGN AND SPECIFICATIONS

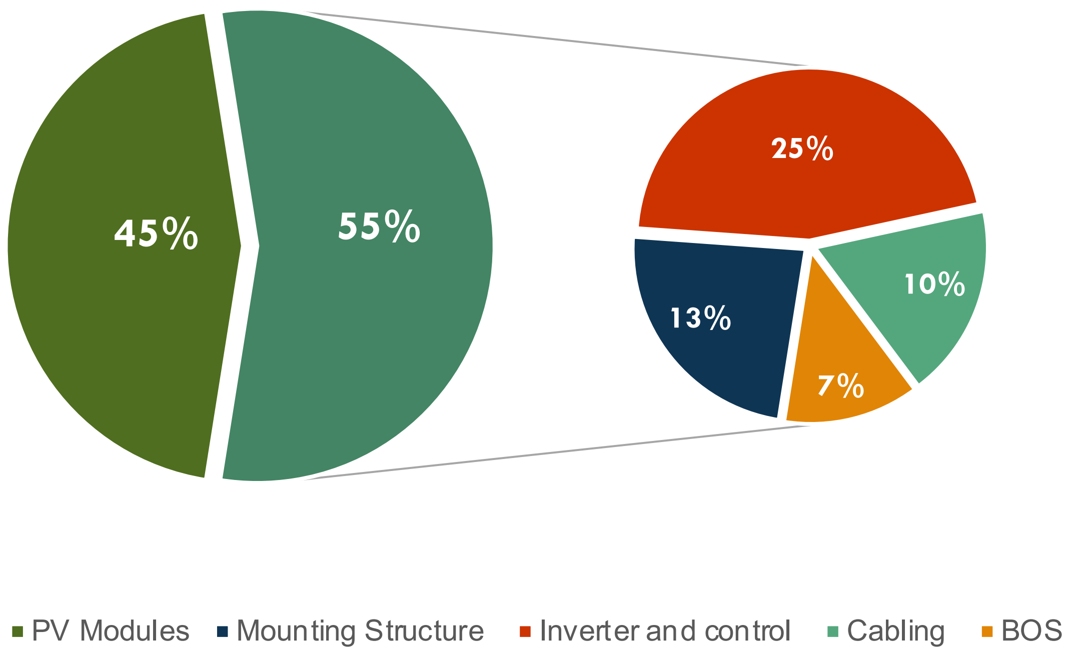
The purpose of ensuring stringent quality control during the procurement and installation of the system is to reduce the failure caused by potentially faulty components or workmanship

- 30 % of PV power plants show serious and particularly serious defects (including safety issues) or large number of issues requiring immediate corrective action
- > 35 % of defects are caused by installation errors , poor design and poor material selection.

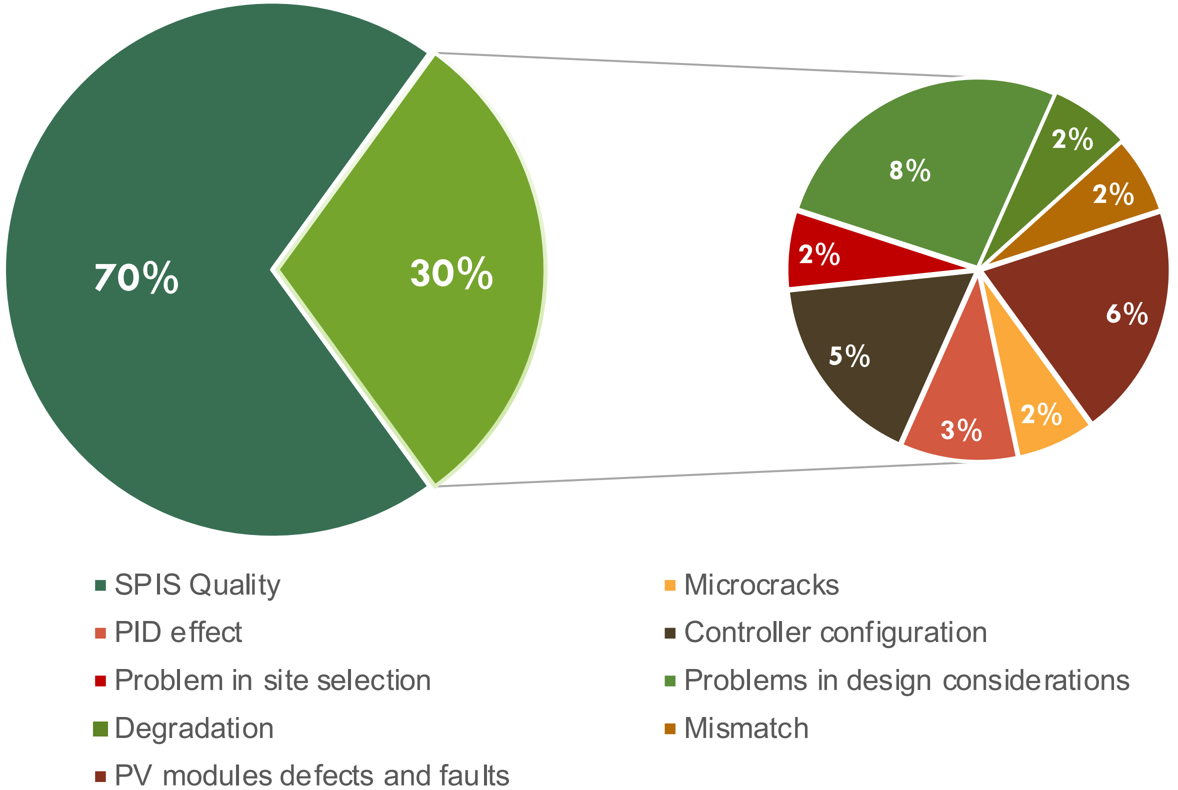


# ANALYSIS AND CHARACTERIZATION

2018-2019 budgetary breakdown % for SP Standalone system for direct Irrigation.
Source: FAO projects references EG,JOR,UGA




Example , 30% of PV power plants show serious and particularly serious defects and can lead to Loss of Revenue



# TECHNICAL SPECIFICATIONS OF SPIS COMPONENTS

The SWPS will be designed to yield the maximum possible amount of energy on yearly average basis, based on a tilt equaling the latitude of the sites condition.

## SPECIFICATION OF SOLAR PV PANELS

PV modules of different technologies can be found on the market. They are classified as first, second or third generation.

| Solar cell grad | Characteristic | Allowable Power variation | Power guarantee | Maximum bending/deflection |
|---|---|---|---|---|
| A | No visual defect or measurable electrical issue | -2 to +10% of the rated power | 90% power up to 10 years and 80% power up to 25 years | 2 mm |
| B | Have visible defects and cosmetic flaws | -10% to +2% of the rated power | 90% power up to 5 years and 80% power up to 10 years | 2 to 2.5 mm |
| C and D | Highly apparent visual flaws and obvious defects | -20% to 2% | 80% power up to 5 years | >2.5 mm, Short Circuits: Possible Cells with horizontal cracks which intersect all the bus bars on the surface of the cell |

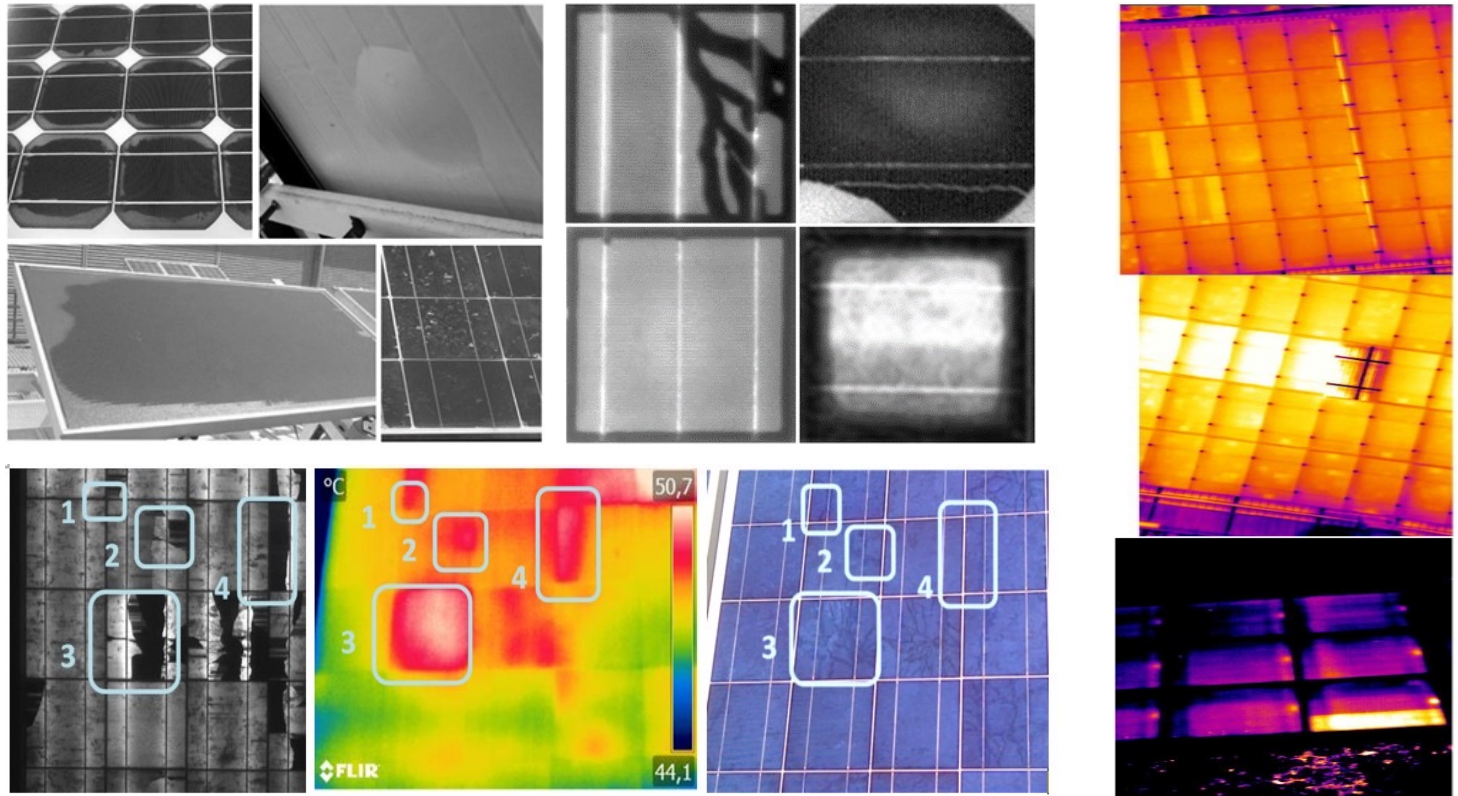
**Al-Afir project – Solar powered irrigation system in the Nile Delta.**
Source: FAO, 2017, El- Behiera Governorate, Egypt

# POSSIBLE QUALITY DEFECTS OF A PV-SYSTEM

## POSSIBLE DEFECTS

- Shadowing
- Angle of installation
- Soiling, dirt
- Corrosion
- Delamination
- Cell breakage
- Non complying component
- PID
- B-Class modules
- C-Class modules
- Browning
- Cabling & failures on PV modules, connectors
- Cell breakage

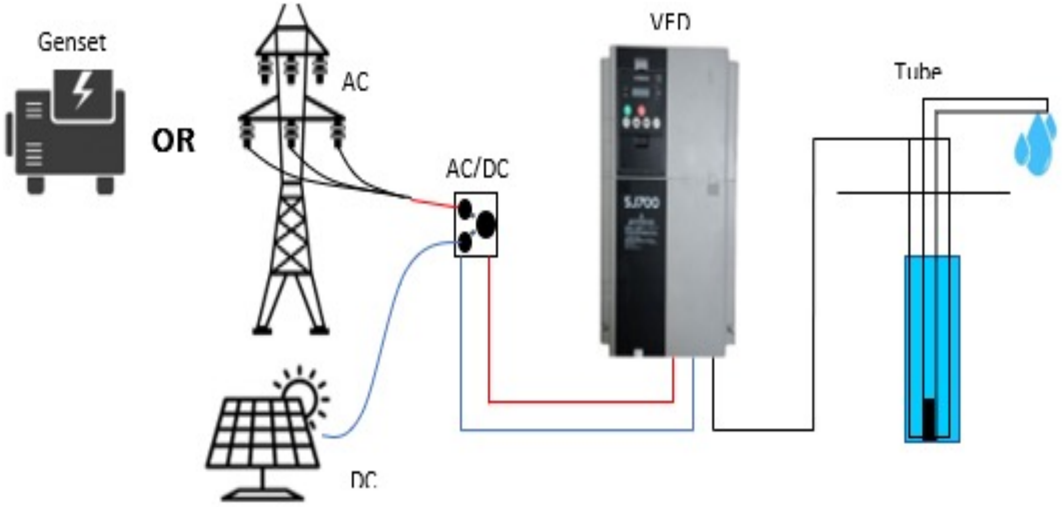
Example of visual assessment for PV modules (corrosion, delamination in front and back sides, browning, thermal vision assess, no failure, cell cracks, insulated cell part and disconnected cells. (Source : Solar engineering blog IEEE Journal of Photovoltaics)



# PUMP CONTROLLER

# INVERTER/VFD

The pump controller links the motor pump to the solar modules and is essential for system reliability. Pump controllers and safety devices are incorporated into PV-powered water pump systems to adjust the output frequency of PV modules and control the DC electric power input to the pump. They also play a critical role in protecting the system by turning it off when the voltage is too low or too high compared to the operating voltage range of the pump. This system controls when and for how long the pump operates.

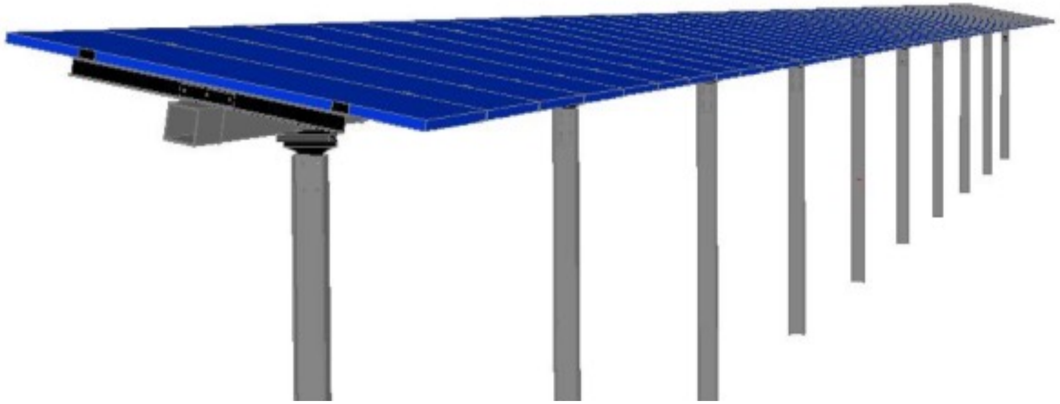



Schematic diagram of SWPS with Hitachi, SJ700 VFD controller installed at Al Ghadeer Al Abyad solar water pumping project in Al-Mafraq governorate, Jordan.

# MODULES SUPPORT/ PV MOUNTING STRUCTURE

The standard to be utilized for designing and evaluating all structural members should be:

- The mounting structures design should consider both static loads, which are primarily due to the weight of the racking system, and the PV modules and dynamic loads, which are a combination of wind and earthquake loads and forces.
- PV mounting structure and framework play a vital role in setting up sustainable solar energy systems. Support structures should be anodized aluminum, galvanized or stainless steel and need to be designed to withstand the maximum possible wind loading for the particular location. The mounting structure should comply with mechanical strength to withstand wind speeds resistance up to 50 m/s (180 Km/hr) for a period of 15 minutes, and 35 m/s (126 Km/hr.) for extended periods of time (several hours) or comply with national code standard and should be simulated and submitted as manufacturer approve.



Source: FAO Under construction double post mounting structure at Al-Afir project – El- Behiera Governorate, Egypt, (B) Concept design of a single post mounting structure.

# POSSIBLE QUALITY DEFECTS OF MOUNTING STRUCTURE

- The support structure should be designed for simple mechanical and electrical installations. It should support PV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.

- Linear thermal expansion of all racking system material should be considered for design of the structure frame and for determining the maximum length and dimension of the adjacent structures to which the PV module arrays will be mounted.

damaged due to high stress or deflection developed in the structure which is often wrongly designed and installed

Source : Global sustainable energy solutions India

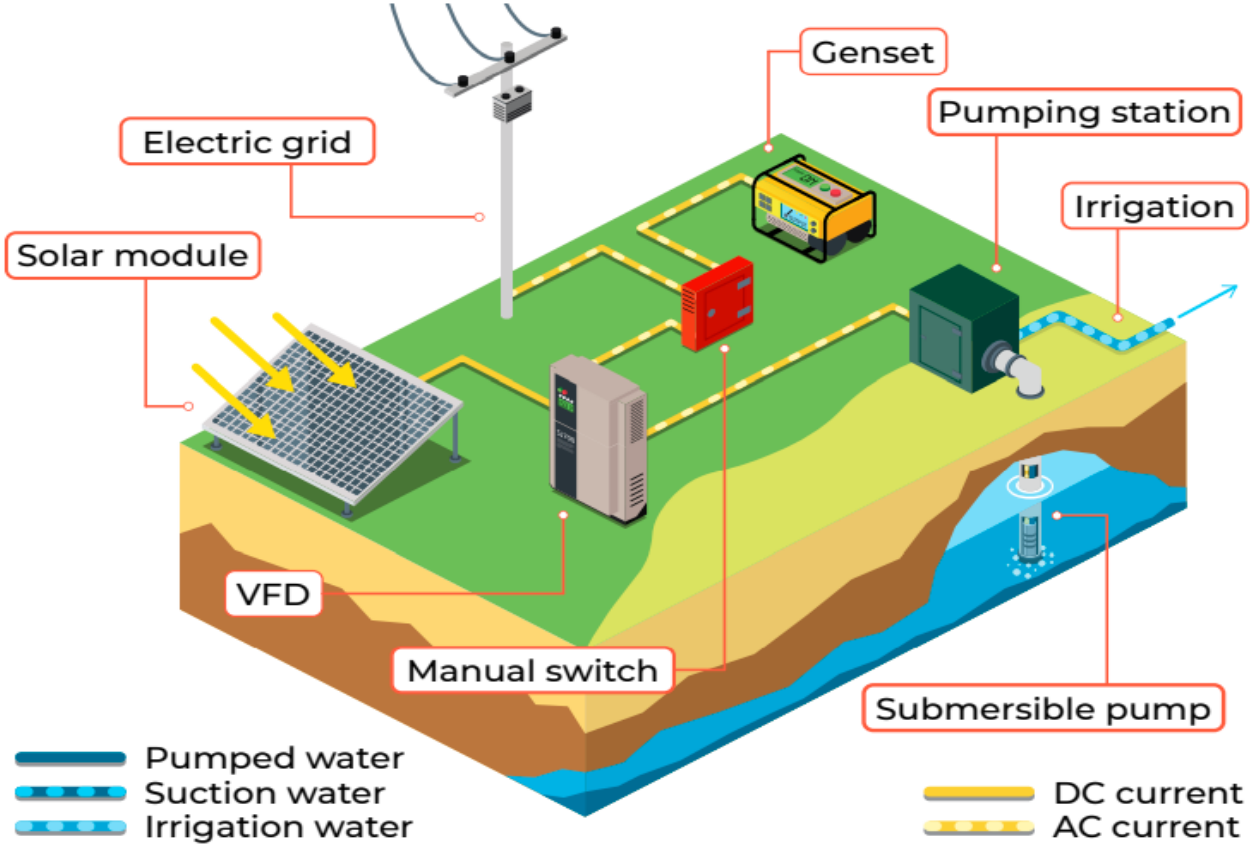
Corner overturning failures, Incorrectly calculated module-specific wind loads , Wind deflector liberation

Source : . Rocky Mountain Institute® and RMI®

# PHYSICAL INSTALLATION OF SPIS COMPONENTS

Visual Inspection

Common mistakes



# TYPES OF IRRIGATION SYSTEMS AND THEIR SPECIFICATIONS

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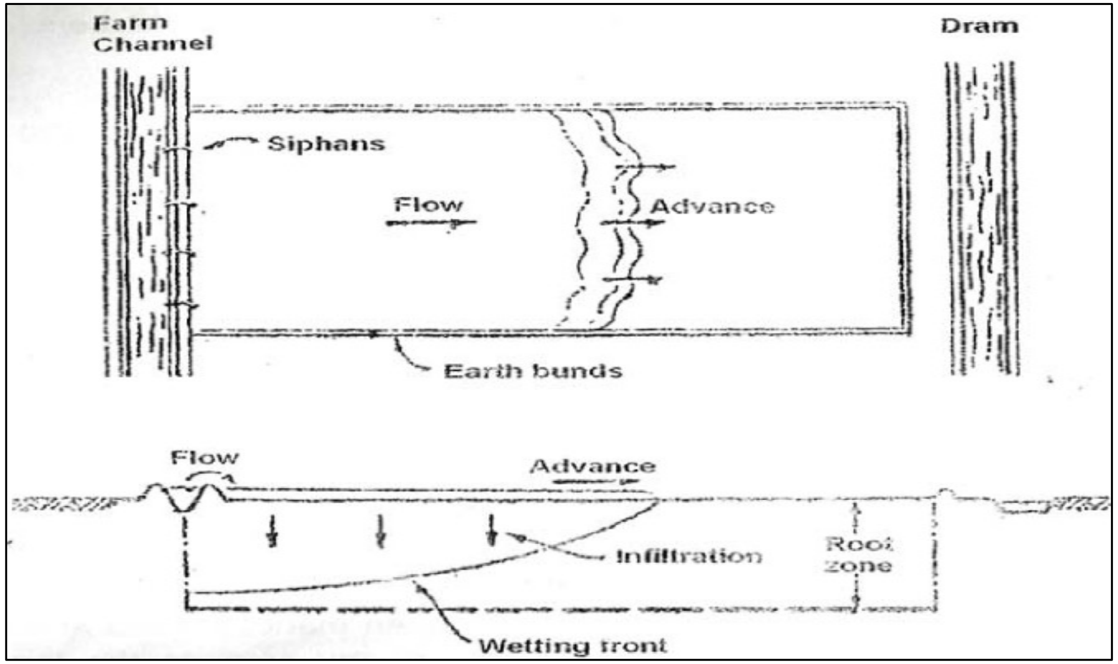
# TYPES OF ON-FARM IRRIGATION SYSTEMS

1. Surface irrigation
2. Sprinkle irrigation
3. Drip irrigation
4. Manual irrigation

# SURFACE IRRIGATION

- Most common and least expensive irrigation type in world
- Water is diverted the upstream end of farm which flows through gravity
- Best suited for moderately textured loam soils (7 to 10 days irrigation interval)
- Least complex systems (network of open channels)
- Least energy demanding – mostly gravity operated
- Least efficient (typically 40 %)
- Can lead to waterlogging and salinity




## SUB TYPES OF SURFACE IRRIGATION


Flood irrigation

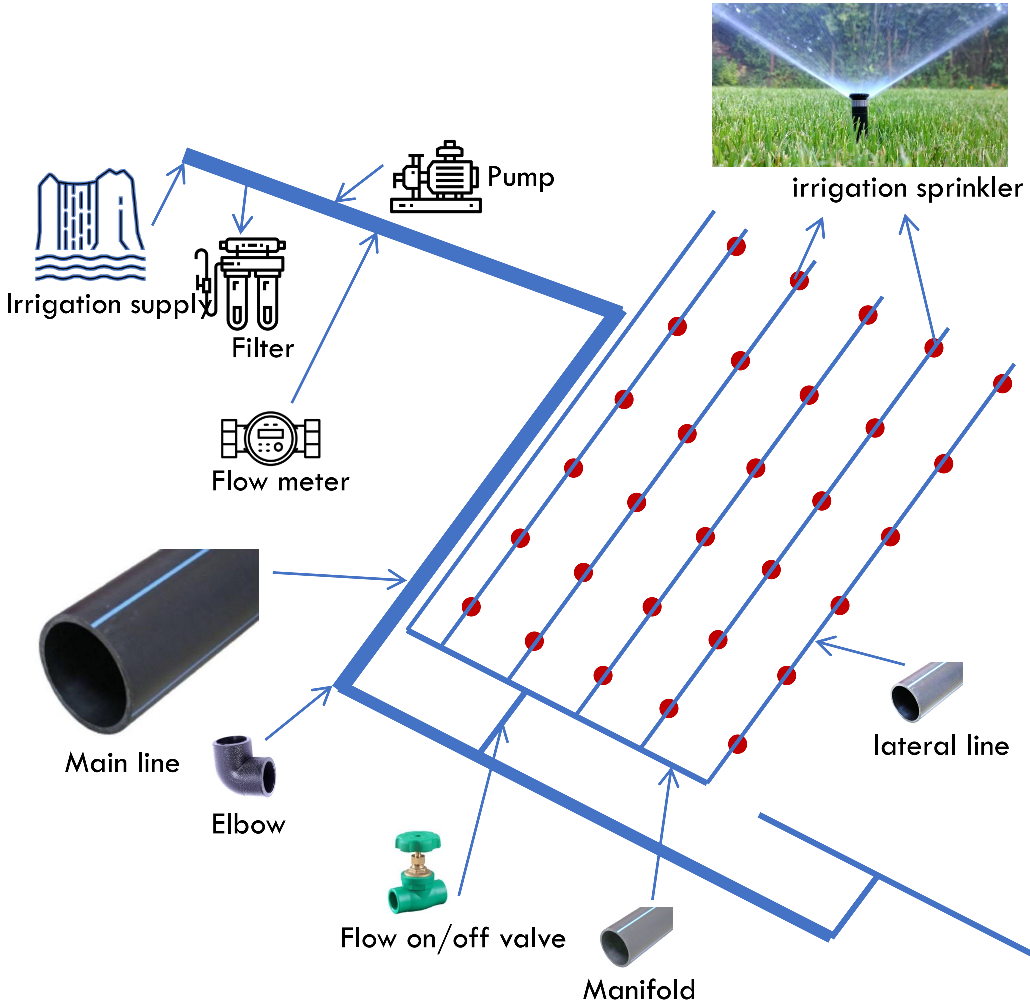

Basin irrigation


Border strip irrigation


Ridge and furrow irrigation

# SPRINKLER IRRIGATION

- Simulates the natural rainfall effect by spraying
- High initial and O&M cost (energy demanding)
- Operates on-demand under high pressure (typically 2 bar)
- Complex construction and needs skill operators
- Not suitable for certain crops and in hot windy areas
- Makes optimal water use, 65 – 75 % efficient
- Uniform irrigation application in permeable soils
- Not suitable for highly saline water (>7 dS/m)




## SUB TYPES OF SPRINKLER IRRIGATION


Center pivot


Linear move

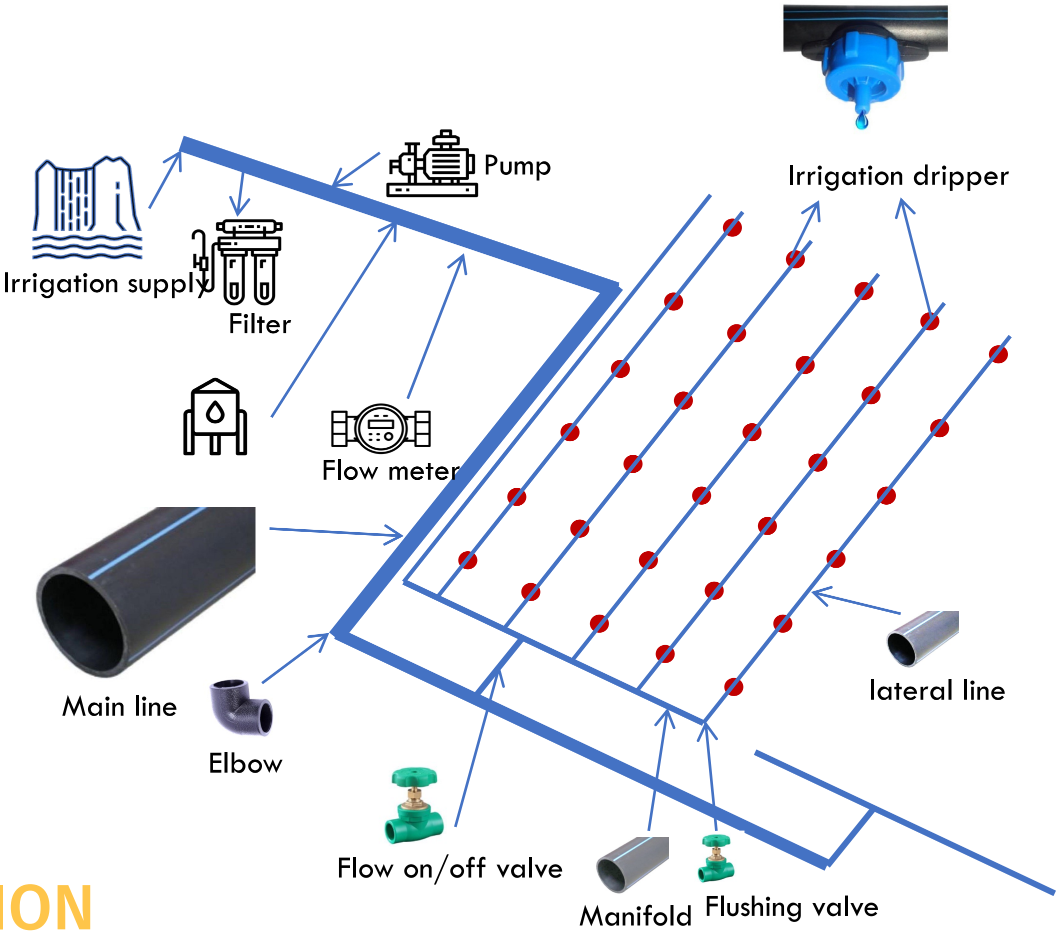

Rotary


Micro sprayer


Pop-up sprinkler

# DRIP IRRIGATION

- Drip, localize OR trickle irrigation applies water to individual plant
- High initial and O&M cost (energy demanding)
- Operates on-demand on moderate pressure (0.6 to 2 bar)
- Complex construction and needs skilled operator
- Suitable for large number of row crops, vegetable and gardens in arid regions
- Maximize water use, (> 80 % efficient)
- Uniform irrigation application in highly permeable soils
- Not suitable for highly saline water (>7 dS/m)




## SUB TYPES OF DRIP IRRIGATION

1. Surface drip irrigation
   - Pressure compensation (PC) drip suitable for undulating fields
   - Self closing dripper
   - Labyrinth drippers
   - Perforated tubes
   - Pigtail dripper

2. Subsurface drip irrigation
   - Perforated pipes
   - Responsive drip irrigation (release water in the root zone in response of plant need)

# THANK YOU

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