# Certificate Course on Participatory Irrigation Management (PIM)

Module 14- Use of Information Technology by Water User Associations (WUAs)

## Topic 14.3 – Use of remote sensing in Agriculture

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Use of remote sensing in Agriculture.

**Topics of Module 14:**

14.1 Use of information technology in daily uses for WUAs

14.2 Use of information technology in Irrigation Management

14.3 Use of remote sensing in Agriculture

14.4 Importance of weather forecasting for WUA members

### 1. Introduction:

Agricultural production follows a strong seasonal pattern related to the natural lifecycle of crops and weather. Farmers track the physical landscape, such as soil

type and other climatic driving variables like moisture, to make many day-to-day decisions and plan efficiently to minimize costs and maximize yields and profits as a result. Productivity can change within a short time due to unfavourable growing conditions. Therefore, remote sensing can be used in the monitoring of agricultural land, crop, soil health, water management, and atmospheric conditions with emphasis to yield.

Remote sensing is all about acquiring information about the Earth's surface by measuring the reflected or emitted radiation without coming into direct contact with the object. This process involves an interaction between incident radiation and the targets.

In the last two decades, remote sensing has been applied to explore agricultural applications such as crop acreage estimation, crop discrimination, soil moisture estimation, crop condition assessment, yield estimation, precision agriculture, soil survey, agriculture water management, agro-meteorological and agro-advisories.

Remote sensing of agricultural canopies has provided valuable insights into various agronomic parameters. Its advantage is the ability to provide repeated information without a destructive sampling of the crop. Remote sensing is a cheap alternative for data acquisition over large geographical areas.

The application of remote sensing in agriculture, i.e., in crops and soils, is too complicated because of the highly dynamic and inherent complexity of biological materials and soils. However, technology provides many advantages over traditional methods. They include:

- the capability of synoptic view
- potential for fast survey
- the ability of repetitive coverage to detect the changes
- low-cost involvement
- higher accuracy
- use of hyperspectral data for increased information.

Remote sensing in the field of agriculture has found significant use. There are very many applications of remote sensing in the agricultural sector. Below is a summary of these applications.

2. **Crop production forecasting:**

Remote sensing is used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the quantity of crop that will be produced in a given farmland over a given period of time, depending on many factors including crop variety, water, and nutrient status of the field, influence by weeds, pest and disease infestation, weather parameters, etc.

3. **Assessment of crop condition, damage and crop progress:**

Remote sensing can play an important role in agriculture by providing timely spectral information to assess the biophysical indicators of plant health. In the event of crop damage or crop progress, remote sensing technology can be used to penetrate the farmland and determine exactly how much of a given crop has been damaged and the progress of the remaining crop in the farm. Drone image analysis is very useful in micro level-crop assessment for crop loss due to hailstorm, horticulture tree counting, diseases and many more. The accuracy of drone image data is directly related to the spatial resolution of the input imagery as the spatial resolution is very high ranging from 50 cm and increase as per the requirement.

4. **Crop Identification:**

Remote sensing has also played an important role in crop identification especially in cases where the crop under observation is mysterious or shows some mysterious characteristics. The data from the crop is collected and taken to the labs where various aspects of the crop including the crop culture are studied.

5. **Crop Acreage Monitoring and Estimation:**

Remote sensing has also played a very important role in the estimation and monitoring of various crops sown area. Remote sensing plays a vital role in the area of crop classification, crop acreage estimation, and yield assessment. This is usually a cumbersome procedure if it is carried out manually because of the vast sizes of the lands being estimated. However, the field of remote sensing helps in reducing the amount of field data to be collected and improves the higher precision of estimates.

## 6. Crop Yield Estimation:

Remote sensing technology can give accurate estimates of the expected crop yield in a planting season using various crop information such as the crop quality, the moisture level in the soil and in the crop and the crop cover of the land. When all of this data is combined it gives almost accurate estimates of the crop yield (**Figure 1**).

*Figure 1- Crop Yield Estimation using Drone*

## 7. Crop condition assessment and stress detection:

Remote sensing technology plays an important role in the assessment of the health condition of each crop and the extent to which the crop has withstood stress. This data is then used to determine the quality of the crop and the overall crop yield.

## 8. Identification of Pests and Crop Disease infestation:

Remote sensing has become an essential tool for monitoring and quantifying crop stress due to biotic and abiotic factors. Remote Sensing technology provides spatially distribution of information of diseases and identification of pests over a large area with relatively low cost along with mechanism to be used to get rid of the pests and diseases on the farm. With the help of satellite imagery and spatial

analysis techniques, crop infected areas are identified like Mealybug, Plant Hopper, and White Fly to get an overview for evaluating the potentially infected areas.

**9. Horticulture, Cropping Systems Analysis:**

Remote sensing technology has also been instrumental in the analysis of various crop planting systems. This technology has mainly been in use in the horticulture industry where flower growth patterns can be analyzed and a prediction made out of the analysis.

**10.Identification of planting and harvesting dates:**

Because of the predictive nature of the remote sensing technology, farmers can now use remote sensing to observe a variety of factors including the weather patterns and the soil types to predict the planting and harvesting seasons of each crop.

**11.Crop nutrient deficiency detection:**

Remote sensing technology has also helped farmers and other agricultural experts to determine the extent of crop nutrients deficiency and come up with remedies that would increase the nutrients level in crops hence increasing the overall crop yield.

**12.Reflectance modelling:**

Remote sensing technology is just about the only technology that can provide data on crop reflectance. Crop reflectance will depend on the amount of moisture in the soil and the nutrients in the crop which may also have a significant impact on the overall crop yield.

**13.Determination of water content of field crops:**

Apart from determining the soil moisture content, remote sensing also plays an important role in the estimation of the water content in the field crops.

**14.Crop intensification:**

Remote sensing can be used for crop intensification that includes collection of important crop data such as the cropping pattern, crop rotation needs and crop diversity over a given soil.

**15.Precision farming:**

Remote sensing has played a very vital role in precision agriculture. Precision agriculture has resulted in the cultivation of healthy crops that guarantees farmers optimum harvests over a given period of time.

**16.Weed identification and management:**

Precision weed management technique helps in carrying out better weed management practices. Remote sensing, coupled with precision agriculture, is a promising technology in nowadays. Though, ground surveying methods for mapping site-specific information about weeds are very time–consuming and labour-intensive. However, image-based remote sensing has potential applications in weed detection for site-specific weed management.

**17.Soil moisture estimation:**

Soil moisture can be difficult to measure without the help of remote sensing technology. Remote sensing gives the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.

**18.Soil management practices:**

Remote sensing technology is important in the determination of soil management practices based on the data collected from the farms.

**19.Soil Properties:**

Soil properties are crucial in farm management practices as it has direct impact on the yield output. Change in farming system and land management results in soil change which compromises the current and future capacity for primary production and provision of crops and by micro-nutrition's mapping as soil is a very important aspect of agriculture with characteristics like soil pH, soil organic matter, soil texture among many others. These characteristics infer information about soil condition by observing what happens on the surface in terms of vegetation growth. On the other hand, water content available within the soil is a very important factor that is taken into by soil moisture mapping.

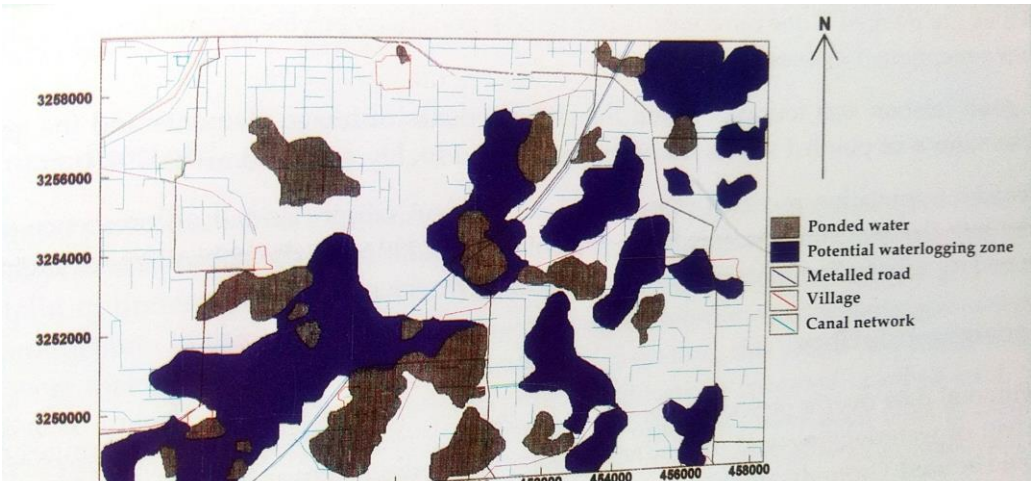
## 20.Soil mapping:

Soil mapping is one of the most common yet most important uses of remote sensing. Through soil mapping, farmers are able to tell what soils are ideal for which crops and what soil require irrigation and which ones do not. This information helps in precision agriculture.

## 21.Identification of problematic soils:

Remote sensing has also played a very important role in the identification of problematic soils that have a problem in sustaining optimum crop yield throughout a planting season. With the help of Remote Sensing Techniques waterlogged and saline soils can also be identified and steps can be taken to reclaim these soils (**Figure 2**).

*Figure 2. Waterlogged areas in the part of IGNP command, Rajasthan.*




## 22.Land cover and land degradation mapping:

Remote sensing has been used by experts to map out the land cover of a given area. Experts can now tell what areas of the land have been degraded and which areas are still intact. This also helps them in implementing measures to curb land degradation. By knowing the land degradation status, soil and water conservation works can be planned to reduce further soil erosion.

**23.Land mapping:**

Remote sensing helps in mapping land for use for various purposes such as crop growing and landscaping. The mapping technology used helps in precision agriculture where specific land soils are used for specific purposes.

**24.Irrigation monitoring and management:**

Remote sensing gives information on the moisture quantity of soils. This information is used to determine whether a particular soil is moisture deficient or not and helps in planning the irrigation needs of the soil.

**25.Water resources mapping:**

Remote sensing is instrumental in the mapping of water resources that can be used for agriculture over a given farmland. Through remote sensing, farmers can tell what water resources are available for use over a given land and whether the resources are adequate.

**26.Monitoring of droughts:**

Remote sensing technology is used to monitor the weather patterns including the drought patterns over a given area. The information can be used to predict the rainfall patterns of an area and also tell the time difference between the current rainfall and the next rainfall which helps to keep track of the drought.

**27.Flood mapping and monitoring:**

Using remote sensing technology, farmers and agricultural experts can be able to map out the areas that are likely to be hit by floods and the areas that lack proper drainage. This data can then be used to avert any flood disaster in future.

**28.Flood Impact:**

Every year in Kharif season, majority of agriculture area is damaged due to flash flood or excessive rainfall. Satellite Remote Sensing provides significant information through the use of satellite imagery along with ground-based data collected from ground surveying teams, to compute precise damage assessment. In case of flood due to rainfall, the excess amount of water caused by the precipitation affects the agricultural area where the water drainage system is absent causing inundation. Flood due to overflow ultimately forms small tributaries and joins the river, creating a

situation of flood in the vicinity of river banks and river plains. The damage assessment of flood can significantly improve the role of land use planning in managing flood risk.

**29.Monitoring of Cyclones:**

Tropical cyclones are one of the catastrophic natural disasters that affect many countries around the globe, causing considerable loss of human lives, Agricultural loss, and loss of property in coastal areas. No other atmospheric disturbance combines duration, size and violence more destructively than tropical cyclones. Remote sensing and GIS inputs are useful and used to save innocent lives and for impact assessment to infrastructure and properties. Remote sensing and GIS are used operationally for early warning and monitoring of Tropical cyclones also it help to disaster managers for damage assessment and relief operations.

**30.Collection of past and current weather data:**

Remote sensing technology is ideal for collection and storing of past and current weather data which can be used for future decision making and prediction.

**31.Climate change monitoring:**

Remote sensing technology is important in monitoring of climate change and keeping track of the climatic conditions which play an important role in the determination of what crops can be grown where.

**32.Compliance monitoring:**

For the agricultural experts and other farmers, remote sensing is important in keeping track of the farming practices by all farmers and ensuring compliance by all farmers. This helps in ensuring that all farmers follow the correct procedures when planting and when harvesting crops.

**33.Air moisture estimation:**

Remote sensing technology is used in the estimation of air moisture which determines the humidity of the area. The level of humidity determines the type of crops to be grown within the area.

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