

DIAGNOSIS

FERTILITY AND MOISTURE

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1. CHARACTERISTICS OF THE PLOT

Although an important concern in any kind of diagnosis, a thorough examination of the characteristics of farmers' fields is particularly relevant for understanding fertility and moisture management. This may be done in part from secondary data, such as soil maps, in part by collecting samples for laboratory analysis, and in part by direct examination.

Physical properties of the soil help determine both fertility and moisture management. Researchers should assess the color, texture, structure, and depth of the soils. Chemical properties are also important for understanding fertility problems. Most of these require laboratory tests, but information on pH, organic matter, cation exchange capacity and salinity, as well as perhaps an analysis for phosphorus and potassium, will be useful.

Other characteristics of the plots are also important in a diagnosis of fertility and moisture management. The slope and drainage of plots can affect management, as can the rotation pattern and tenancy of the plots.

a) Physical properties

Color, texture, structure, depth, moisture holding capacity. See R. Knapp, "Soil Productivity Guide".

b) Chemical properties

Organic matter, cation exchange capacity. See R. Knapp.

- What is the pH of the soils? Are there any current practices which are causing changes in pH?
 - Should soil tests be done for P, (highly-weathered soils; acid soils, etc.)? For K?
 - Is there evidence that would encourage analysis for micronutrients (highly leached, acid soils; high pH; intensively cropped land; etc.)?
 - Are there salinity problems with these soils? What causes them?
- c) Other characteristics of the plot.
- What is the slope of the fields?
 - What is drainage like in these fields? Are there problems with waterlogging?
 - Is there evidence of erosion?
 - What are the rotation patterns?
 - How do fertilizer and manuring practices vary with the rotation?
 - Are fields owned, rented, borrowed, etc.?

2. RAINFALL

Rainfall patterns obviously affect moisture management. The rainfall pattern will determine the cropping cycle (except in irrigated areas) and may be one of the most important sources of risk for farmers. Moisture problems depend not only on rainfall, but on temperature and humidity conditions as well. If fields are irrigated, a knowledge of timing, quantities and methods is essential for a diagnosis.

Rainfall patterns are also related to fertility. Natural or added fertility is not effective without adequate moisture, and the risk of low moisture may affect farmers' fertility management.

Questions and Observations

- Try to obtain rainfall data for the area. What is total rainfall, and what is the variability from year to year?
- How is rainfall distributed throughout year? What variation is there in the onset and termination of the rains?
- What are the chances of mid-season droughts? Can such droughts occur at any time in the season, or do they tend to come at a particular time?
- What are the chances of heavy rain and/or flooding? When does this occur?
- What are temperature and humidity patterns? Combined with soil moisture holding capacity, how do these affect moisture availability?
- If irrigation is used, how is irrigation water regulated?
- How often is irrigation done? Do the crops depend completely on irrigation, or is it supplementary?
- What is the irrigation system like (condition of canals, management of water, etc.)?
- What type of irrigation is carried out?
- What quantities of water are applied?
- How does planting date depend on moisture availability? Do farmers dry plant, wait for first rains, wait until rains are well established, etc.?

- What are the problems with late planting (heavier rains when crop is germinating, lower total moisture availability for season, etc.)?
- How do rainfall patterns determine the amount and timing of fertilizer application?

3. TYPE OF FERTILIZER

Farmers attempt to maintain the fertility of their fields in a number of ways. They may apply chemical fertilizers and/or organic fertilizers. They may also practice various rotation patterns that help maintain fertility. Their ability to use chemical fertilizers depends upon availability and costs. Organic fertilizer use is limited by the number of animals owned by the farmer, or by the market for organic fertilizer. Rotation patterns are limited by the amount of land available to the farmer and by the types of crops that are profitable for the farmer to grow.

Questions and Observations

- What types of fertilizer are used on the crop?
- What causes variation in the type of fertilizer used?
- Is fertilizer used every year?
- What quantities of fertilizers are applied? How does this vary?
- What is the source of the fertilizer? How is it transported to the farm?
- Does the farmer require credit, or does he purchase the fertilizer?
- On what other crops does the farmer use fertilizer?
- If manure is used, approximately what quantity?

- Is manure used on certain crops, or certain parts of the field, or Is it applied more generally?
- What kind of animals provide manure for the farm. How many of these animals does the farmer own?
- How is manure collected and stored?
- Are any green manure crops grown?
- What crops are grown in rotation with the target crop? How do these affect fertility?
- Is fallowing practiced? How many years are fields left fallow?
- If crop residues are incorporated, what is the timing of this incorporation in relation to planting?

4. METHOD OF APPLICATION

The method of applying chemical or organic fertilizers is conditioned by the type of product, the condition of the field, and the labor or machinery available. The placement of the fertilizer can affect its chances of evaporation, leaching, fixation, or contact with plant roots.

Questions and Observations (For each type of fertilizer and time of application)

- Is fertilizer broadcast, placed in lines, spread near plants, or placed in holes?
- How is fertilizer incorporated into soil?
- What is fertilizer placement in relation to level of irrigation water?
- What is the relation of P fertilizer placement to roots?

- If fertilizer is applied by machine, what type is it?
- Is the machine rented or owned?
- How is manure incorporated? How much time between application and incorporation?
- What labor is used for applying fertilizer?

5. TIMING OF APPLICATION

The timing of fertilizer application depends on several factors. One of these is the availability of labor. Another is moisture availability; farmers may delay or split their fertilizer application depending on rainfall. The availability of fertilizer itself is sometimes a problem; if it arrives late to the area farmers will have to delay their application.

Questions and Observation

- When is fertilizer normally applied? How does this timing vary?
- What other work does the farmer have at the time of fertilizer application?
- Is fertilizer application ever combined with other operations, such as weeding?
- Is fertilizer application delayed because of late rainfall?
- Is uncertain rainfall a reason for splitting fertilizer application?
- Are there heavy rains early in the cycle? Is there danger of leaching for a single fertilizer application?
- What are soil moisture conditions at the time of fertilizer application?
- How much time between the application of manure and planting?

6. WEED - MOISTURE - FERTILITY INTERACTIONS

There are many interactions among weeds, crop growth, moisture, and fertility. Researchers should look for these when they do the diagnosis. Weeds compete with the crop for both nutrients and moisture. Adequate crop growth, aided by good fertility, may provide a canopy that helps control weeds and conserve moisture. Inadequate weed control may mean that added nutrients are largely lost to the crop, or that fertilization results in increased demand for weeding. Weed problems may be less in areas or years of low rainfall. Moisture-fertility interactions have been described in section 2.

Questions and Observations

- When is weed control carried out in relation to the rains?
- When is weed control carried out in relation to fertilizer application?
- Do farmers do more weeding if higher levels of fertilizer are applied? Is there labor available to do this?
- Is crop stand establishment and density such that a good crop canopy is provided?
- How does the weed burden vary between years of adequate and inadequate rainfall?
- Which weeds seem to be most important in competing for moisture or nutrients?

7. EROSION

Erosion contributes to both moisture and nutrient losses. The amount of erosion depends on slope, tillage methods, type of crop, and

ground cover, among other things.

Questions and Observations

- What is the extent of erosion in the field; in the area?
- What is the principal cause of this erosion?
- Are mulches used on the crop?
- Do weeding practices contribute to, or guard against, erosion?
- Is the crop canopy sufficient to provide some protection to the soil from heavy rain?

8. SIGNS AND SYMPTOMS OF MOISTURE AND FERTILITY PROBLEMS

Researchers should observe the crop for evidence of moisture and fertility problems.

Questions and Observations

- Are there signs of moisture stress (leaf rolling, firing)?
- Are there symptoms of major nutrient deficiency?
- Are there symptoms of secondary or micronutrient deficiency?
- Examine root growth. Does it seem limited by soil insects, soil depth, mechanical root pruning, low phosphorus, or other factors?