# Soil Doctors programme:

# Guidelines for implementation in Pacific Islands Countries and Territories

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## INTRODUCTION

### Background and Rationale

Sustainable soil management is a prerequisite for long-term success in agriculture. Unfortunately, the recent *Status of the World's Soil Resources* report (ITPS 2015) presented a disturbing account of the plight of agricultural systems in the Pacific region. Atoll islands are of particular concern because of increasing populations, poor soils, vulnerable groundwater systems and climate change. In other parts of the Pacific, land degradation, nutrient imbalances, soil acidification, decline in soil biological function and high rates of erosion threaten the viability of current agricultural systems and curtail future management options.

In addition, poor soil knowledge is a constraint on the sustainable intensification of agriculture and soil resilience to meet future challenges. Various regional and national capacity needs assessments of extension services conducted in the Pacific from 2005 – 2015 documented diverse capacity needs that were clustered into two main categories – technical and functional skills. Assessment results found recurring capacity needs, with the top three technical capacity needs identified as soil health, pests and disease diagnostics/management and research methods, while the functional skills findings included participatory methods, communication, and facilitation skills.

Follow up capacity assessments conducted by Commonwealth Scientific and Industrial Research Organisation (CSIRO) under the ACIAR SMCN 2016/111 'Soil Management in Pacific Project' found that at present, extension officers are unable to reliably ascertain which nutrients (or other factors such as diseases) are limiting production and are additionally unable to reliably recommend optimal nutrient inputs. The lack of access to information on soil types and their distribution further limits the ability to extend the results from previous research studies or well-understood farming systems to other locations across the Pacific Island Countries and Territories (PICTs). Consequently, understanding whether a farming system is well-matched to the qualities of the soil requires some form of diagnostic system both to identify the most appropriate management practices and to monitor how the soil is functioning.

In 2016, the PICTs, through the Pacific Soils Partnership Network (PSP), agreed on several recommendations to tackle these ongoing challenges. These are, among others, to: i) strengthen collaboration in the region on developing appropriate soil management solutions, ii) design efficient and effective methods for soil analysis that are locally appropriate and robust, iii) enhance soil information and collate new and legacy soil data into more useable forms, and iv) share capacity, including laboratories, portals and resources.

These guidelines outline an implementation approach to the Soil Doctors programme in Pacific Island countries, with training of extension workers as Soil Doctors in the region. The trained Soil Doctors will provide soil management training to farmers.

## The Global Soil Doctors Programme

The Global Soil Doctors Programme is a farmer-to-farmer training initiated by the Global Soil Partnership (GSP) to be implemented on a volunteer basis. It is based on the Soil Doctors initiative of Thailand that aims to build the capacity of smallholder farmers on the practice of sustainable soil management. This programme supports governmental agencies and organizations working on agricultural extension with interested farmers in the community who are willing to help the community and share knowledge with other farmers. This can be done through host gatherings, for example, to demonstrate how to manage soil sustainably. Farmers are selected for training on sustainable soil management and those trained are called Soil Doctors.

The Global Soil Doctors programme provides technical and practical trainings through regional and national promoters based on farmer needs and local priorities. Soil doctors are equipped with a toolbox consisting of an implementation manual that provides guidelines on how to execute the programme, a soil testing methods manual (STMM) that contains easy methods to measure soil properties in the field, and other educational materials such as posters and videos, all preferably in the local language.

## The Pacific Soil Doctors Programme

This manual is based on the *Manual for the implementation of the Soil Doctors Global Programme at the country level* (FAO 2020), with adjustments in consideration of the local environment in Pacific Island Countries and Territories.

In the Pacific context, it can be difficult to find interested and enthusiastic farmers that will help the community voluntarily and continuously with soil management trainings and knowledge sharing. On the other hand, agriculture extension workers are available in all PICTs. Therefore, it will be appropriate to train and utilise the agriculture extension workers as soil doctors for PICTs through training of trainers (TOT).

## Who is a Soil Doctor?

A Soil Doctor is a trained person that will share knowledge on sustainable soil management with farmers for achieving food security and adapting to and mitigating climate change using a “learning by doing” approach and making use of the participatory mechanisms already available in their community. Participatory mechanisms can be village meetings and discussions, local events, etc. or visits to experimental or demonstration plots.

## Why is Soil Doctors needed?

In small island countries of the Pacific, soil testing laboratories and soil experts are not available in all countries and these services are not easily accessible to farmers.

However, food security and the agricultural economies in the island countries are largely dependent on proper soil health management. Therefore, a second line of solutions such as Soil Doctors, which imparts basic soil management knowledge and equips those in need with preliminary soil analytical procedures and equipment, can be created to support smallholder farmers for sustainable soil management.

## OBJECTIVES

The Pacific Soil Doctor Programme through the soil doctors will:

- Establish a farmer training system by building the sustainable soil management capacity of agriculture extension workers.
- Support the efforts of governmental agencies and organisations working on agricultural extension, particularly on soil health management at the field level.
- Support field research based on interactions between the Soil Doctors, universities, and national research institutes, including access to demonstration and experimental fields.
- Promote the concept of soil testing prior to making recommendations on soil management.
- Make immediate decisions in the field by putting into practice the methods in the soil testing manual.
- Develop farming community confidence for improving farming systems and the quality and productivity of soils. This is a result of the Soil Doctors working closely with the farmers as a member of their community. This will ultimately lead to increasing their food security (quantity and quality of the harvest).
- Create a preferential channel to communicate with the promoter(s), particularly in relation to farmer needs.

## Pacific Soil Doctors

The Pacific Soil Doctors programme will be developed through collaborative activities among different partners at the regional and national levels (**Figure 1**). At the regional level, SPC will provide the coordination and promotion of the Soil Doctors programme in collaboration with the University of the South Pacific, School of Agriculture, Geography, Environment, Ocean and Natural Sciences, Agriculture and Food Technology discipline (USP-SAGEONS (AFT)). Further, the Pacific Soils Partnership Network (PSP) will mobilise scientific and technical trainings with the relevant regional partners such as CSIRO, Manaaki Whenua Landcare Research (MWLR), and the GSP Secretariat and other partners. At the national level, the Ministries of Agriculture (MOAs) play the lead role in promoting the Soil Doctors programme with different governmental agencies, extension services, national universities, research organisations, nongovernmental agencies (NGOs) and farmer organisations for selecting soil doctors and training.

**Box 1**. Steps to follow in implementing the Soil Doctors programme:

1. Identification of the promoter(s)
2. Identification of extension workers that will be trained as soil doctors
3. Field surveys and awareness campaign
4. Capacity assessment
5. Training arrangements and preparation of the training material
6. Identification of appropriate methods and review, if required
7. General training to identified extension workers
8. Higher level training to potential Soil Doctors
9. Establish demonstration farms and experimental fields
10. Training of farmers
11. Support and monitoring of the established Soil Doctors partner communication system

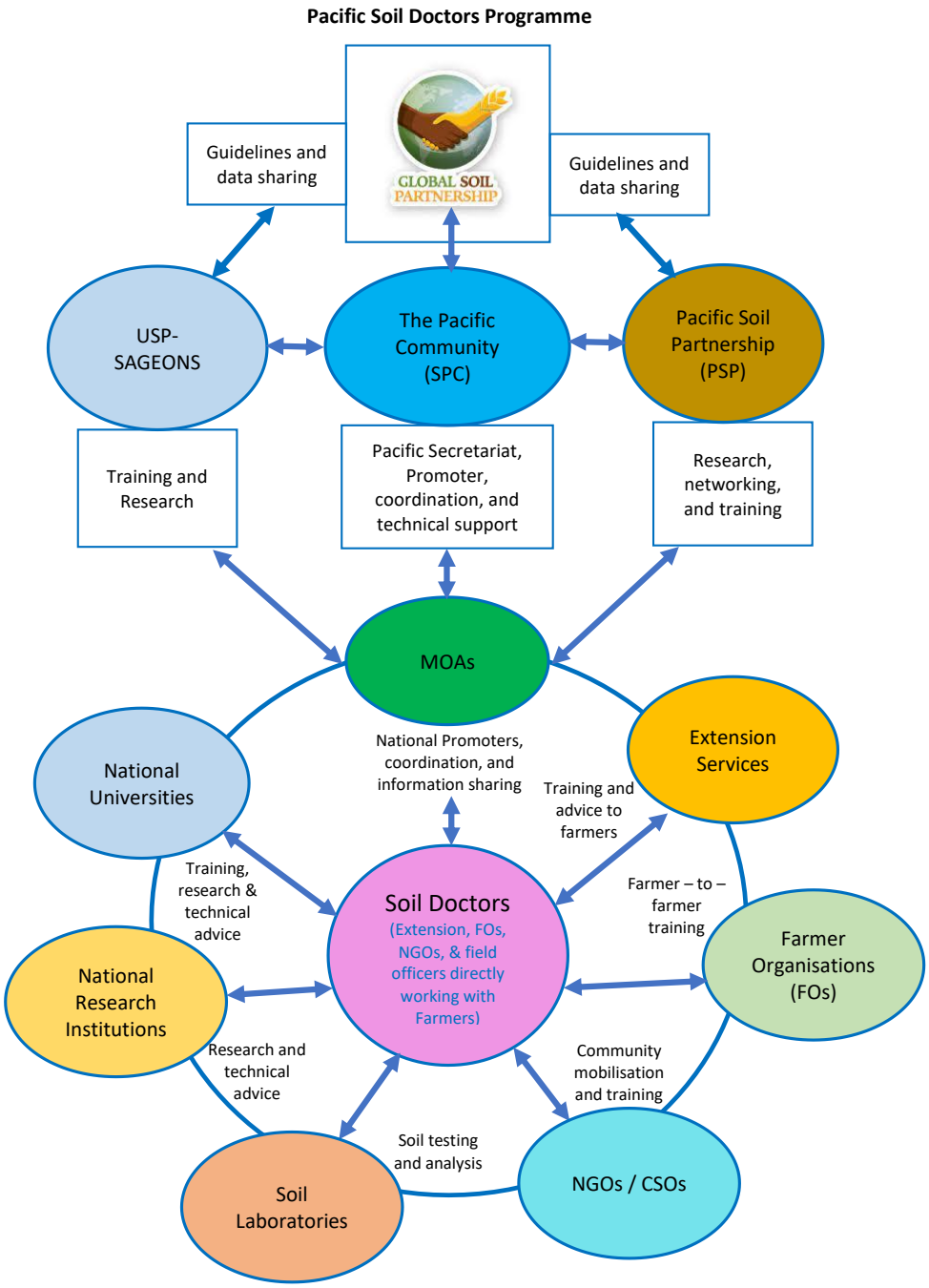


**Figure 1. Interrelation between the main stakeholders involved in the Pacific Soil Doctors Programme**

The soil doctors will be trained to share their knowledge with the farmers. In return, countries will provide the Soil Doctors programme with feedback collected from participating organisations, soil doctors and farmers in the programme to build on practical experiences and local knowledge. This feedback will inform the development of new educational material for global, as well as regional, distribution (**Table 1**).

**Table 1. Pacific Soil Doctors stakeholders and their roles**

| Stakeholder | Roles/ Responsibilities |
|---|---|
| 1. GSP | Provision of resources and tools to support implementation of the soil doctor programme at the regional and national levels |
| 2. SPC | Promotion and coordination the Soil Doctors programme at the regional level |
| 3. USP – SAGEONS | Training and research |
| 4. PSP (CSIRO, MWLR, etc) | Networking, research, and Soil Doctor training |
| 5. MOAs | Coordination, promotion and sharing information on the Soil Doctors programme at the national level |
| 6. Extension Services | Training and advice to farmers |
| 7. National Research Institutions | Training, research, and technical advice |
| 8. Soil Laboratories | Soil testing and analysis |
| 9. NGOs/CSOs/Projects | Community mobilisation and training |
| 10. FOs | Farmer to farmer training |
| 11. National Universities | Training, research and technical advice |

## IMPLEMENTATION OF THE SOIL DOCTORS PROGRAMME IN PICTs

### Identify national or regional promoters

Promoters will be selected based on the following criteria:

a) Full awareness with sufficient information about the programme (how it works, benefits, incentives, roles within the community, etc.)
b) Full awareness about the importance of practicing sustainable soil management. If they have some prior experience on dealing with soil management issues, it will be a bonus.
c) Their access to farmer contacts, with a range of farmer networks.
d) Their relationship with the farming community (the promoter(s) should be trusted by farmers).

**Box 2**. Toolbox to socialise the Soil Doctors programme:

1. Soil awareness materials https://drive.google.com/file/d/1bHVI4f9G_8BD0Ab_hUEc7w_HevJRdlyg/view?usp=sharing
2. Field campaign at community/village level
3. Posters
4. Social media campaign

e) Their area of competence. Ideally, promoter(s) should have influence in the national or regional area.
f) Their access to financial resources to support the programme, or ability to seek funding from national or international organisations working in this field.

**Box 3**. Tools:

1. Participatory extension approaches
2. Laboratory demonstrations

### Soil Doctors selection

All, or a selection of, extension workers can be included in the Soil Doctors regional programme and trained accordingly. Graduates with a degree in soil science or agriculture related fields would be an advantage. Additionally, access to technology such as laptops, smartphones, internet etc., and strong networking skills, being proactive in helping others, having good knowledge on soil management, and the ability to pass that knowledge to others, may also be necessary.

Once the selection of the Soil Doctors is complete, the promoter oversees providing the Soil Doctors with the trainings most appropriate to their skills and needs. Selected candidates will first receive a general training on the importance of soil and land resources management, conservation and basic sustainable soil management practices. A higher level training course will then be provided to those extension workers that excelled during the general training. The trained extension workers will be appointed to serve as a Soil Doctor in their area of work.

### Capacity Assessment

A capacity assessment is needed before conducting the training to determine localised training needs related to soil management. This can be done through a field survey and group discussion for each specific community. This community-based participatory problem analysis will help in identifying local soil problems, knowledge and skills gaps and sustainable soil management training requirements. In general, training requirements will mostly be standardized, except under certain special circumstances, for example atoll soil, coastal soil, etc.

### Training of Soil Doctors

Selected candidates for the Soil Doctor Programme will undergo three main types of training as described below.

#### 1. General training

This training will be provided to a maximum of 10 selected candidates in a group among those participating in the general training as potential Soil Doctors. This training will include:

a) Participatory approaches

b) A basic training to increase the efficiency of Soil Doctor candidates in transferring the acquired knowledge to others
c) Training on dealing with specific issues affecting soils (general and region-specific issues)
d) Training on communication skills with the promoter(s) of the programme.

## 2. Technical training

Sustainable soil management training will be provided to the Soil Doctors. Components of this training are as follows:

a) The training topics are chosen by the promoter(s) depending on national priorities and local community needs. Communication between the promoter(s) and the Soil Doctors to identify priorities is therefore critical.

b) All Soil Doctors receive the same training that consists of theory and practical classes that include site visits.

c) Technical theory classes are delivered to the Soil Doctors, using booklets, brochures, posters and presentations. The theory oriented classes are followed by practical activities. After being trained, the Soil Doctors will share their acquired knowledge and skills with the farmers in their communities, using a "learning by doing" approach and making use of the participatory mechanisms already available in their community. To facilitate this, they will use educational materials provided by the programme promoter, and additional materials (posters and presentations) that they may have prepared. Visits to experimental or demonstration plots prepared on the properties of participating farmers is highly encouraged for the success of the practical activities.

**Box 4.** Training materials:

1. Pacific Soil Sampling Protocols
2. Soil test interpretation
3. Soil field test kits
4. Soil testing methods manual http://www.fao.org/documents/card/en/c/ca2796en
5. FAO tools http://www.fao.org/global-soil-partnership/pillars-action/2-awareness-raising/soil-doctor/en/
6. Pacific Soil Doctors implementation manual

## Soil Testing Methods

The SPC published soil sampling and analysis manual provides countries with a list of methods and equipment that can be used for assessing parameters that are critical to soil quality. These parameters include soil texture, soil bulk density, soil pH, soil salinity, soil moisture and soil biological properties, as well as visual soil assessments.

**Box 5.** Tools:

a) FAO Guidelines
b) Soil Test Kits/ Palin test kit
c) Soil testing method manual (https://doi.org/10.4060/ca2796en)
d) Soil sampling protocols
e) Soil test interpretation guidelines
f) Nutrient deficiency symptoms guideline (Annex 1)

The STMM developed by FAO is a general manual for use in any country where applicable. However, the manual may be re-designed and tailored for the needs of Pacific Island Countries and Territories to include relevant examples from their soils to make it more appropriate for the region. This manual also needs to be updated regularly based on farmer and Soil Doctors feedback, and when local requirements change.

The most suitable soil testing methods for the PICTs sourced from STMM are listed below.

**A. Soil physical properties**

***1. Soil texture***

Method 1: Feel method

Method 2: The ribbon method

***2. Bulk density***

Method 1: Core method

Method 2: Excavation method

***3. Soil moisture***

Method 1: Gravimetric water content

Method 3: Feel and appearance method

**B. Soil chemical properties**

***1. Soil pH***

Method 1: Soil pH meter method

Method 2: Color cards method

Method 3: Soil pH test strip

***2. Soil salinity***

Method 1: Electrical conductivity

Method 5: Field symptoms (visual symptoms of soil salinity)

**C. Soil biological properties**

Method 1: Earthworm density

Method 2: Litter decomposition (tea bag method)

**D. Visual soil assessments**

1. Soil structure
2. Soil porosity
3. Soil colour
4. Number and color of mottles
5. Earthworms
6. Potential rooting depth
7. Surface cover
8. Soil erosion

**E. Nutrient deficiency symptoms**

An assessment key on nutrient deficiency symptoms is provided in **Annex 1**

**Standard soil analysis**

If the above mentioned simple soil assessment procedure fails to identify nutrient deficiency or crop failure, soil samples using standard soil sampling protocols should be collected and sent to a soil laboratory for a standard soil analysis.

## Demonstration Farms: Training of Farmers

Field demonstrations should be held on a farmer's field to demonstrate good soil management practices under different production systems. In a demonstration field, good soil management practices should be illustrated alongside existing soil management practices for better comparison and motivation. Demonstration farms will adopt the Farmer Field School (FFS) approach. FFS is a farmer-centered participatory experiential learning approach. Using this approach, a conducive learning environment is created whereby farmers can easily exchange their knowledge and experiences in a risk-free setting. FFS offers space for hands-on group learning where local knowledge and relevant scientific concepts are tested, validated and integrated into the context of local ecosystem and socio-economic settings to solve local problems. It enhances a farmer's skills for critical analysis and improves decision making by local people. First, a community-based problem analysis needs to be conducted to identify local soil problems and knowledge and skills gaps in sustainable soil management. Accordingly, a location specific soil management methods/curriculum should be developed. Farmers will be trained using demonstration plots set in their own fields.

**Steps on operationalising the Soil Doctors Farmer Field School**

- The Soil Doctors Farmer Field School (FFS) is a field-based study and lasts for a full cropping season. Depending on the crop, the school may last for 4 to 5 months.
- FFS activities involve simple field experiments, agronomic practices, regular field observations and group analysis.
- FFS participants meet once a fortnight or month, and the total number of meetings may range from 10 to 15, depending on the crop duration. There should be one FFS meeting one or two weeks before land preparation and planting/sowing and one during harvest to assess soil health.
- The Field School meeting place should be close to the learning plots, and is often in a farmer's home or under the shade of a tree
- In every FFS, participants conduct a study comparing good soil management practices with a farmer's existing soil management practice(s).
- The FFS often includes several additional field studies, depending on local field problems.
- A total number of 25 to 30 farmers can participate in an FFS and participants should learn together in small groups of five or six to maximise participation.
- A pre- and post-participation test needs to be conducted as part of every field school for diagnostic purposes and for determining follow-up activities.
- All FFSs include a field day during which farmer participants make presentations on the results of their studies.
- Final meetings of the FFS often include planning for follow-up activities.

## Educational materials

To support the promoter in training the Soil Doctors and for the Soil Doctors to train farmers, the programme will provide the following educational materials:

***1. Posters***

An initial set of posters describing basic principles of soil science and sustainable soil management, in addition to basic sustainable soil management practices, will be made available by the programme. Additional posters may be developed after learning from local experiences and identifying country requirements. The programme provides both theoretical and practical posters.

**Box 5**. Tools

1. Theoretical posters
2. Practical posters
3. Videos
4. Flip charts
5. Booklets
6. Brochures

a. Theoretical posters, also called “WHAT IS” posters, aim to explain the theory behind the practice of Sustainable Soil Management.

b. Practical posters, also called “HOW TO” posters, aim to show how to practice sustainable soil management.

***2. Videos***

Videos are to be developed after the successful launch of the programme as a way of learning “how to teach” the concepts of sustainable soil management, and how to use the educational materials.

## ANNEX 1: Flowcharts for Identifying nutrient deficiency symptoms

Flow charts are provided below for visual identification of plant nutrient deficiency symptoms in the filed as described by Halavatau (2021). The first flow chart (**Figure 2**) shows deficiency symptoms of mobile nutrients (N, P, K, Mg, Cl & Mo) while the second (**Figure 3**) shows symptoms of immobile nutrients (S, B, Ca, Zn, Fe & Cu).

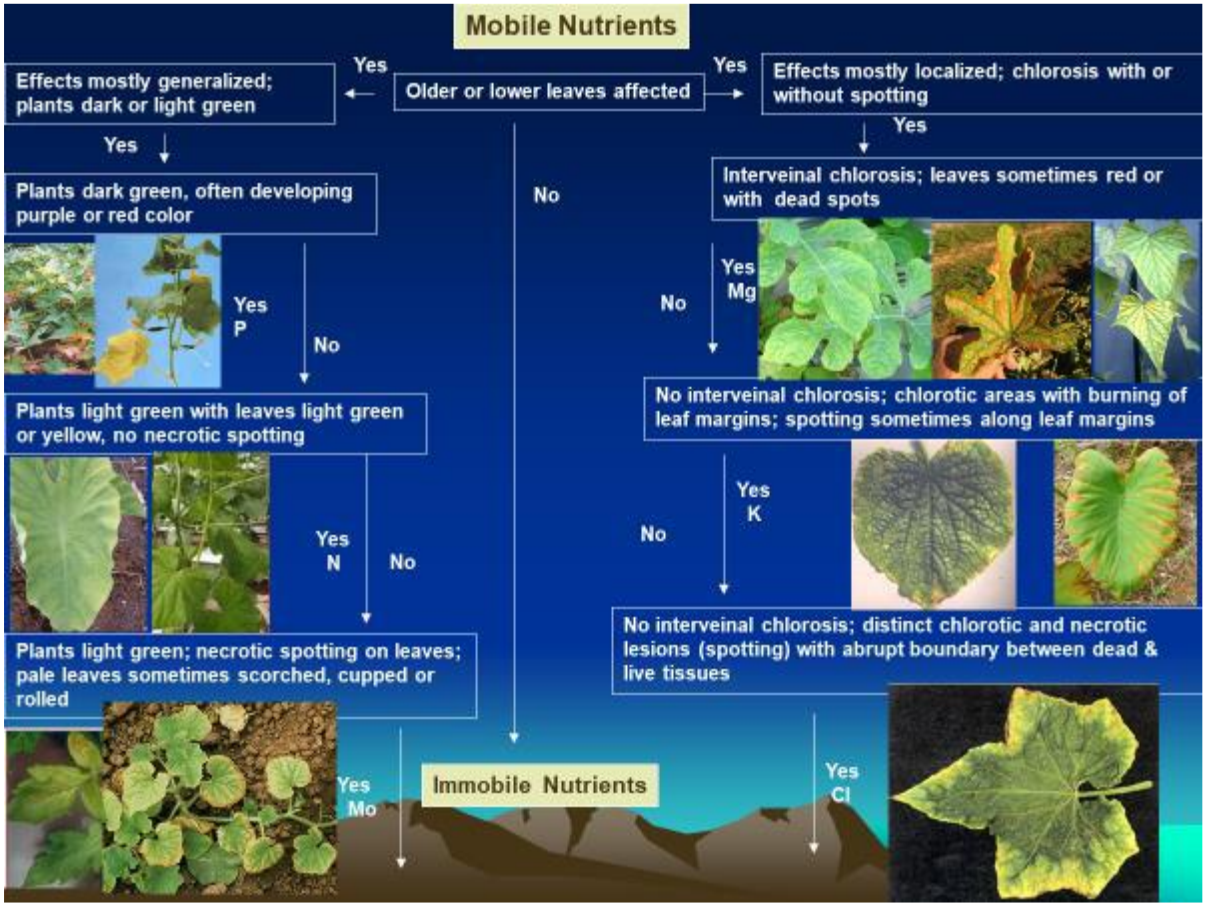


**Figure 2. Mobile nutrients (N, P, K, Mg, Cl & Mo) deficiency symptoms**

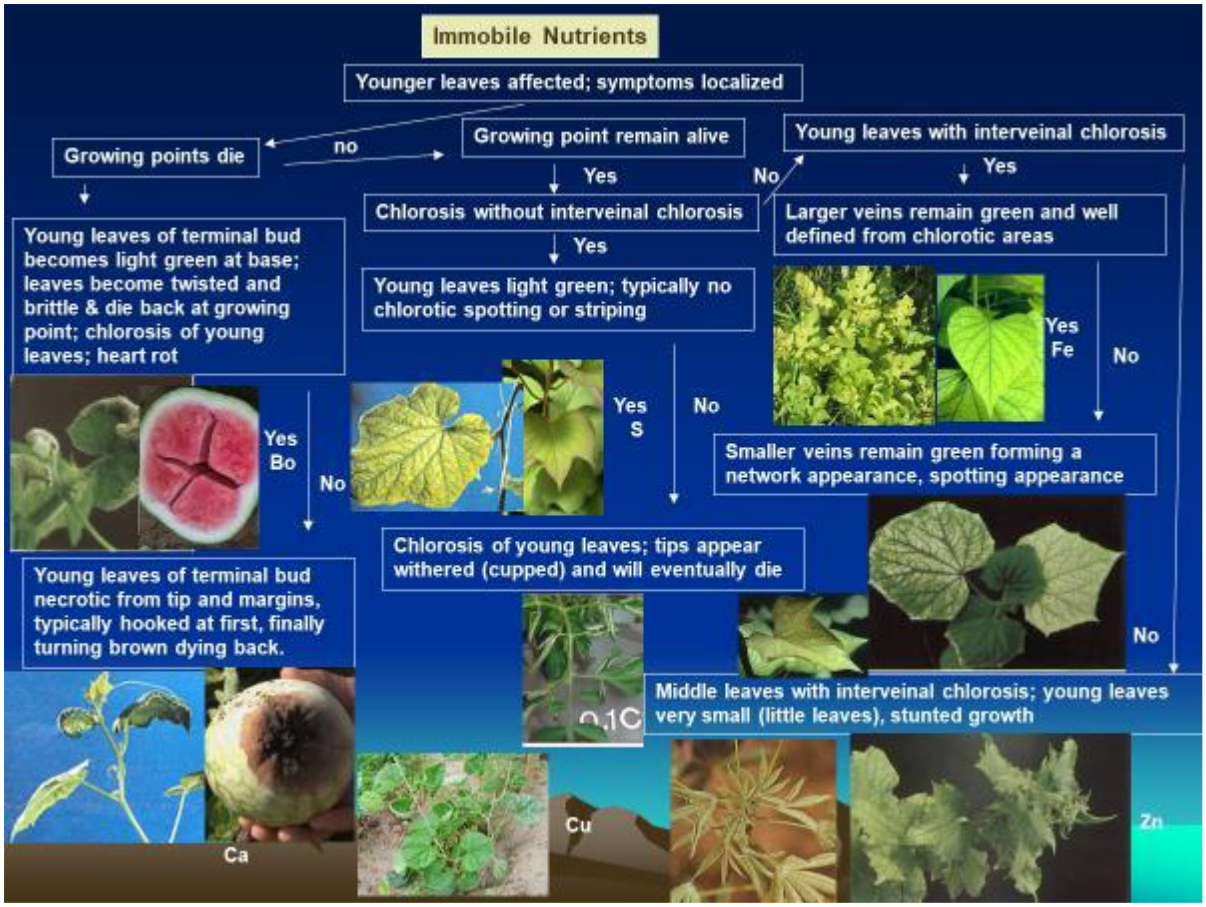


**Figure 3. Immobile nutrients (S, B, Ca, Zn, Fe & Cu) deficiency symptoms**

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