A SOIL TESTING SERVICE FOR FARMERS IN THAILAND, USING MOBILE LABORATORIES

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ABSTRACT

The Land Development Department of the Ministry of Agriculture and Cooperatives, Thailand, has been highly successful in transferring soil management technology to Thai farmers through the “Dr. Soils” project. The “Dr. Soils” are farmers selected from each village who are trained in basic soil testing and land development techniques. The program has been operating for ten years. There are now 63,000 Dr. Soils from 67,000 villages. Dr. Soils are volunteers, who represent LDD in their villages and act as channels of information between LDD and farmers.

INTRODUCTION

The soils of Thailand vary widely, depending on the parent material, the climate, the vegetation and the topography. They are classified into more than 360 soil series. Approximately 41% of the country is arable land, only 10% of which is irrigated. The soils which are well suited to agricultural production make up 14% of the total, while soils which can be used for agriculture but need improvement and conservation make up 36%.

The Land Development Department (LDD) of the Ministry of Agriculture and Cooperatives is responsible for soil classification, soil conservation and soil improvement for agriculture. The soil data collected by LDD is available for the benefit of all government organizations, as well as the private sector.

Results from the analysis of 83,600 soil samples taken from farms between 1987 and 1990 indicated that the chemical properties of most arable soils in Thailand are as follows. Ninety-four percent are very low in phosphorus (P). For the same reason, many have a medium to low potassium (K) content. Secondly, the high temperature and high rainfall cause the release of nutrients into groundwater, and leaching and runoff of nutrients from fields, especially where they have been cropped continuously and the surface has been allowed to erode.

The nitrogen (N) supplying capacity of soil is closely related to its organic matter content. This is very low in most soils, because of the rapid rate of decomposition under high temperatures and rainfall. Practically all soils in Thailand must be improved for optimum production.

In the past, recommendations for fertilizers and soil amendments in Thailand were based on data and 1:50,000 soil maps. Intensive cropping over the past 30 years has been accompanied by an increased use of chemical fertilizer. Incorrect management practices and fertilizer use caused local variations in soil fertility, especially in vegetable fields and fruit tree orchards. Some nutrients became depleted while others built up in the soil, depending on the amount supplied in fertilizers and the amount removed in harvested crops.

Most agricultural soils in Thailand have been in continuous production a for long time. Soil erosion control in sloping land has not been widely practiced on most farms. Some

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farms have been fertilized, but others have received little or no fertilizer and lime. Because of this history, past land use and management practices have more influence than soil type on soil fertility.

The original soil survey data, based on only one set of samples of the soil and subsoil per square kilometer, does not give adequate information about the soil properties of every farm. Fertilizer recommendations based on soil type are not suitable for Thai farmers. Recommendations of how much fertilizer and lime and other soil amendments to apply to particular crops on each farm should be determined by individual soil tests.

**SOIL TESTING SERVICE FOR FARMERS**

In 1964, LDD set up a central soil testing laboratory. At this time, routine soil and plant analysis was carried out in support of soil surveys and soil classification projects, and research on soil amendments and soil conservation. Only a few soil samples were analyzed as the basis of fertilizer recommendations.

Problems of soil degradation led to an increasing awareness that action had to be taken to increase crop productivity through the use of fertilizers and soil amendments. In 1992, LDD set up a smaller laboratory in each of the 12 Land Development Regional Offices (LDRO). A year later, LDD launched a project “Improvement of Soils and Fertilizer Technical Services”. The main objectives were to emphasize the minimum use of chemical fertilizer, increase the use of organic fertilizer, and conserve the land under a system of sustainable agriculture.

**SOIL ANALYSIS AND RECOMMENDATIONS**

The Office of Science for Land Development, LDD, takes responsibility for the soil analysis service, and provides farmers with recommendations for soil improvements and soil conservation.

Soil samples sent from farms are routinely analyzed to determine their texture. They are also given minimal chemical analyses to assess the soil fertility. Recommendations are made as follows:

**Nitrogen (N)**

LDD laboratories do not analyze soil N as the basis for recommending how much fertilizer N to apply. Scientists have been unable to develop a reliable test for determining the ability of different soils to supply nitrogen. The rate of N released for use by crops is affected by the soil organic matter content, the temperature, the soil moisture content, the period of crop growth, and many other factors. All of these make it impossible to predict the amount of N that will be supplied by the soil to the growing crop.

Secondly, most soils in Thailand are low in organic matter, and do not vary much in their capacity to supply nitrogen. Therefore, nitrogen recommendations by LDD laboratories are based primarily on the crop requirements and the length of time under cultivation. The economic rates recommended should be adjusted periodically, according to experience and field experiments.

Nitrogen fertilizer is generally not recommended for legume crops, since they obtain most of the N required for their growth from the air, which is about 80% N. A small amount of 20-25 kg N/ha may be applied as the starter fertilizer in plots planted in legumes for the first time, especially if the seeds have not been inoculated with rhizobium.

**Phosphorus (P)**

The phosphorus (P) content of practically all soils of Thailand is inherently low. Phosphorus deficiency is a common limitation to the productivity of most Thai soils, and the application of P fertilizers is often necessary. Phosphorus recommendations made by LDD laboratories depend on soil test values and the P buffer capacity. If soils contain large amounts of oxy-hydroxides or are calcareous, more P fertilizer may need to be applied to meet crop requirements.

**Potassium (K)**

The alluvial soils of the Central plain are dominated by clayey kaolinitic and montmorillonitic soils, and are used for growing rice. Thirty years ago, most of these soils
were high in potassium. This was reflected in the compound fertilizer recommended for rice, which was 16-20-0 and 20-20-0 (N-P₂O₅-K₂O). The response of crops to potassium has been tested in many experiments throughout Thailand, and it seems that most Thai soils are deficient in K. The sandy soils of the Northeast are more deficient in K, while clay soils are generally less deficient. As crop yields have grown as the result of higher N and P fertilization, the need for K in some soils has increased.

**Calcium (Ca) and magnesium (Mg)**

Fortunately, most soils of Thailand are not deficient in either calcium or magnesium. Calcium and magnesium deficiency are generally found in the sandy soils of the Northeast, which have a very low pH.

**Micronutrients**

Most soils of Thailand contain an adequate amount of micronutrients for most crops. LDD, the Department of Agriculture and Kasetsart University have conducted research on the response of crops to micronutrients in soils. This research emphasized “problem soils” i.e. acid sulfate soils, calcareous soils, sandy soils and peat soils.

Field trials have shown that the micronutrients most often deficient are iron (Fe), boron (B) and zinc (Zn), and then only for a few crops on particular soils. Research for copper (Cu) deficiency in peat soils has been conducted in southern Thailand, but more work is still needed.

Micronutrient analysis is expensive, and is not always reliable enough to serve as a basis for fertilizer recommendations. LDD soil test laboratories, therefore, do not generally analyze soil samples for micronutrients. The most practical recommendation for these minor nutrients is to apply them to specific crops according to the results of experiments conducted on particular soils.

**Lime recommendations**

Practically all Thai soils, except for calcareous soils and some saline soils, are from slightly to strongly acid. Most crops may need the application of lime. More than one-half of the soil samples analyzed by LDD soil testing laboratories show that lime is needed. However, most research indicates that it is non-economic to apply lime to Thai soils if the pH is higher than 5.5. Therefore, LDD soil testing laboratories recommend that lime be applied to most crops only if the soil pH is less than 5.5. Marl and ground limestone are generally recommended as the best liming materials for Thai farmers. If the magnesium content is low and lime is required, applications of dolomite are recommended to correct soil acidity.

**Mobile soil testing laboratories**

LDD has accelerated the project “Improvement of Soils and Fertilizer Technical Service” by setting up mobile soil laboratories to provide an on-farm soil testing service to farmers (Fig. 1 and Fig. 2). There are now 18 mobile soil laboratories in service, analyzing a
Fig. 3. Farmers waiting to hand in their soil samples

Fig. 4. Staff of the mobile soil laboratory analyzing the soil samples

Fig. 5. Some of the volunteers who have been selected as “Dr. Soils”

Fig. 6. Some of the volunteer "Dr. Soils"

Fig. 7. Training the Dr. Soils volunteers in how to use a soil test kit. (1).

Fig. 8. Training the Dr. Soils volunteers in how to use a soil test kit. (2).
total of 73,000 soil samples each year over the whole country. Mobile soil testing is a way of transferring technology for soil improvement which enables scientists and farmers to work closely together and to share information (Fig. 3 and Fig. 4).

THE “DR. SOILS” PROGRAM

In view of the limited manpower and budget of LDD, help from farmers is needed to achieve the goal of soil improvement. Since 1997, LDD has carried out the “Dr. Soils” Project. This is now well-known and widely recognized in Thailand.

About "Dr. Soils"

The term “Dr. Soils” refers to the officers of LDD and the volunteer farmers who participate in land development programs.

Since 1977, farmers (male or female), who must be at least 20 years old, have been selected from each village to act as Dr. Soils (Fig. 5 and Fig. 6). Altogether, 63,000 farmers from 67,000 villages have joined the program. The Land Development Regional Offices have primary responsibility for selecting and training these farmers.

They are trained to understand basic soil testing and land development techniques. They represent LDD in their villages, to help give farmers a better understanding of soil management, and to follow up land development practices. They are the messengers in distributing the information about land development to the villages, and transferring messages regarding land use problems from the farmers back to LDD.

Of these 63,000 Dr. Soils, 7,125 farmers have been selected to represent sub-districts. They have been trained in how to use soil maps (1:50,000), and how to use a soil test kit to test the pH, and analyze the levels of N, P and K (Fig. 7 and Fig. 8).

They use soil maps and posters to show the suitability classes of different soils for various crops as a means of educating farmers. With the soil NPK test kit, they are able to test the soils on farms around their villages, and give local farmers basic fertilizer recommendations. All Dr. Soils are volunteers. They receive no salary, but LDD offers to construct a small pond on their farms as an incentive.