# TABLE OF CONTENTS

**PAGE**

**1. INTRODUCTION ..... 1**

**2. METHOD ..... 1**

**3. RESULTS AND DISCUSSIONS ..... 1**

3.1 TOTAL SAMPLE HOUSEHOLDS ..... 2

3.2 SITE DESCRIPTION: ALTITUDES, SLOPES AND ASPECTS OF THE FIELDS UNDER CITRUS CULTIVATION. ..... 2

3.3 CITRUS YIELD AND OTHER MANAGEMENT PRACTICES ..... 2

3.4 SOIL RESULTS ..... 2

*3.4.1 Soil results of Tsirang Dzongkhag ..... 3*

Figure 1 pH values of Tsirang Dzongkhag. ..... 3

Figure 2 OM% of Tsirang Dzongkhag ..... 4

Figure 3 Available P of Tsirang Dzongkhag . ..... 4

Figure 4 Available K of Tsirang Dzongkhag ..... 5

Figure 5 Cation Exchange Capacity (CEC) of Tsirang Dzongkhag ..... 5

Figure 6 Base saturaition % (BS%) of Tsirang Dzongkhag ..... 6

Figure 7 Soil texture of Tsirang Dzongkhag. ..... 6

**4. CONCLUSIONS ..... 6**

**5. RECOMMENDATIONS ..... 7**

*Table 1: Suggested nutrient recommendation rate for citrus trees depending upon the age of the trees. ..... 8*

## 1. Introduction

To build up a database on the soil nutrient status of the major horticultural crops in the country to develop a proper fertilizer recommendation rate for crops, soil samples were being collected from the major citrus growing areas of Tsirang and Dagana dzognkhags. Soil samples will be collected once three to five years from the same areas. The sampled households are interviewed on their soil fertility management practices and general management practices.

Tsirang Dzongkhag in the west-central region is one of the major citrus growing Dzongkhags in the country. Citrus is grown throughout the Dzongkhag as one of the important horticultural cash crop and therefore the major source of income for the farmers. The most intensively cultivated geogs[1]. under this Dzongkhag are Mendrelgang (1village), Kikorthang (2 villages), Dungleygang (1 village), Goseling (2 villages).

Between 9th to 15th February 2004, the staff of National Soil Services Centre (NSSC) together with the Dzongkhag staff collected soil samples from these geogs under Tsirang Dzongkhag.

## 2. Method

The group collected the soil samples from the farmers' fields based on the list prepared by the Extension Agent (EA). The farmers were explained about the rationale behind collecting soils samples from their fields. Soil samples were collected from the households with ten trees and above. Two composite samples (top soil and subsoil) were collected from a minimum of 8-10 sub samples each from one location or site. Soil samples were collected from the depth of 0-20 cm (for top soil) and another sample from the depth of 20-40 cm (for subsoil) using a soil auger and put in plastic bags and sealed with a rubber band. The samples were then stored in a room with the open ends and care was taken not to contaminate the soils. These samples were then re-sealed for transportation and submitted to the Soil and Plant Analytical Laboratory (SPAL) for analysis. Aspects, slope angles, altitudes and the GPS readings of the fields were also recorded in the questionnaire form. The analysis of this survey was done using SPSS 11 for windows.

## 3. Results and discussions

In the first half of the report, the general observations of the Dzongkhag as recorded during the survey are presented while the soil results for each village under each geog is presented in the second half of this report.

[1] Mendrelgang geog =Mendrelgang village,
Kikorthang = Saalami, Upper Bokray villages,
Dungleygang = Bichgaon village.
Goseling geog = Riserboo, Pemashong villages.

### *3.1 Total sample households*

In Tsirang Dzongkhag, a total of 8 households from 6 villages covering 4 geogs were sampled. The total number of soil samples collected was 30 including both top and subsoil samples. The number of citrus trees varied from 47 to 400 from the sampled areas. The various management practices and other site parameters in addition to the soil results are presented below.

### *3.2 Site description: Altitudes, slopes and aspects of the fields under citrus cultivation.*

The sampled areas were located in altitude range varying from 1158 m.asl to 1333 m. asl. Citrus orchards are located in areas from gently sloping (slope gradient <8%) to very steep slopes, with the majority of them on moderately sloping (slope gradient<25%) to steep slope (slope gradient 25-50%) with mostly facing northwest aspects.

### *3.3 Citrus yield and other management practices*

The total yield varied from 250 pons[2] to a maximum of 1600 pons from this Dzongkhag with an average production of 392 pons per acre. The area under citrus cultivation varied from 0.45 to 3.5 acres with an average area of 2.2 acres from the samples areas.

In Tsirang Dzongkhag**,** more than 67% of the farmers do not apply FYM to citrus while those that apply do so @ of 1- 5 baskets per tree. All the farmers tether cattle for duration of three days to one week per tree per year. Neither leaf litter nor compost materials are applied to citrus. Almost 87% of the farmers do not apply any chemical fertilizer to citrus. Urea, SSP, MoP etc are not at all applied by any of the farmers while about 13% apply suphala in February (@1kg suphala per tree per year). Almost 93% of the farmers do not irrigate their orchards. Only about 17% irrigate and is done only once a year usually with the help of pipe.

### 3.4 Soil Results

In the soil analysis result, with the exception of soil pH, the classifications are normally categorized as very low, low, moderate, high, and very high. For fertility factors (N, P, K, micronutrients) very low and low classifications indicate a high probability for obtaining a fertilizer response; moderate classifications indicate a fertilizer response may or may not occur; high and very high classifications indicate a fertilizer response is not likely to occur. Crops need all the essential nutrients but not in equal quantities and supplying of only one nutrient i.e. unbalanced nutrient such as urea leads to rapid depletion of soil reserves of other nutrients.

[2] 1 pon = 80 nos.

Ideally, the soil should be a sandy loam or loam for citrus to do well. The soil should be more than one meter deep and should have moderately porous soil layers for good drainage. Citrus growing in poorly drained soils may become immersed in stagnant water during rainy seasons, thus inducing diseases. On the other hand, gravel soils or sandy soils (light soils) may also not be profitable, as frequent irrigation and fertilization are needed. In general, the ideal soil pH for citrus is between 5.5 and 6.5 (optimum pH) due to improved availability of most of the soil nutrients such as P, K, Mg, Cu and Fe . If the pH falls below 5.0 aluminum and manganese toxicity occur in citrus roots. A low pH can also cause deficiency of nutrients such as calcium, magnesium, phosphorus (which are easily fixed by the soil particles) and molybdenum. At higher pH levels, higher than 7.5, then citrus suffers from deficiency of other nutrients such as iron, manganese, copper and zinc.

### 3.4.1 Soil results of Tsirang Dzongkhag

The soil results of each geog under Tsirang Dzongkhag is summarised as follows.

The pH of the soils of this geog is mostly within the medium (pH 5.5-6.5) range with the exception of Dungleygang geog with the exception of one plot (plot B) of Kuber Singh Pradhan with high pH value (figure 1).

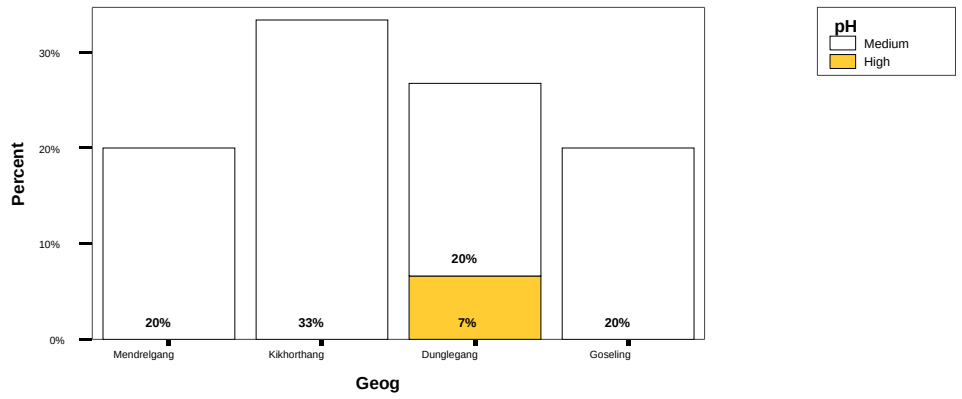


*Figure 1 pH values of Tsirang Dzongkhag.*

The organic matter content of these soils in this geog is within the medium (2-5%) to high range (OM% >5). The OM% of Kikorthang is within the medium rnage while that of Mendrelgang geog is high. Dunglegang and Goseling geogs have values with the medium to high ranges, figure 2.

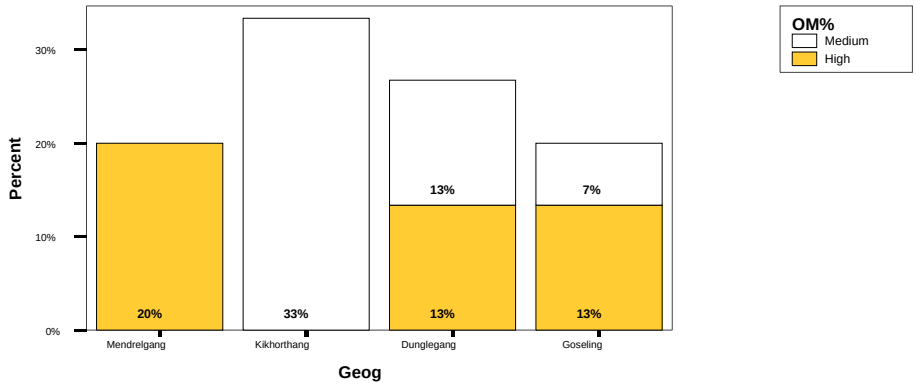


*Figure 2 OM% of Tsirang Dzongkhag .*

In general, the nutrient requirement for citrus is of medium range although N and K requirements are high as the additional dose of potassium fertilizer is essential especially during fruit development. The available P of Mendrelgang and Dungleygang geogs are high (>30 mg/kg) while that of of Goseling have medium to high values. *Kikorthang geog have values ranging from very low (Prem Lal Adhikari from Upper Bokray village) and plot no B of Tshering Norbu have low P values)*. Prakash Chhetri of Saalami village has high P values (figure 3).

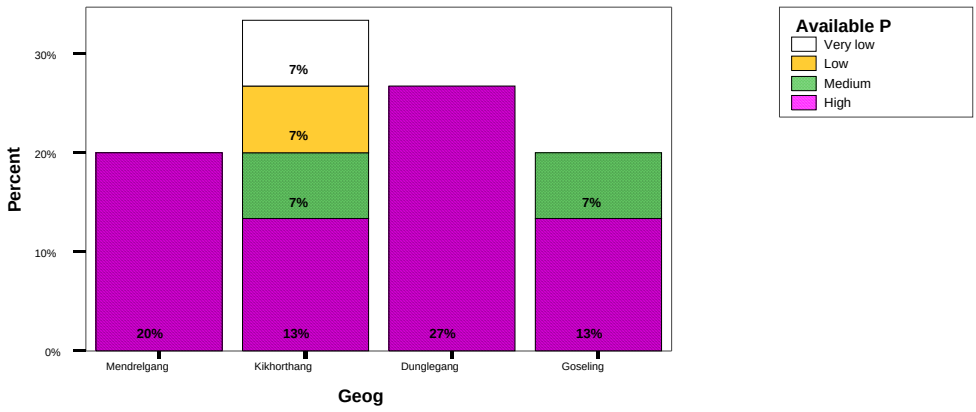


*Figure 3 Available P of Tsirang Dzongkhag .*

*The available K of Mendrelgang geog is low* while that of Kikorthang is mostly within the medium range. *The available K from Tshering Norbu's plot no B is low*. The available K from Plot no. A of Prakash Chhetri is high while plot no. B is within the medium range. The available K of Dunglegang geog ranges from medium to very high values while that of Goseling varies from low (Lham Dorji) to high values. *Lham Dorji of Pemashong village, Goseling geog has low available K.* The plot on the right of Norbu has high K and that on the left has medium values (figure 4). These figures suggest that there is a need to apply P and K

containing fertilizers to improve the nutrient status of these soils with low values and also deficit K limits fruit size.

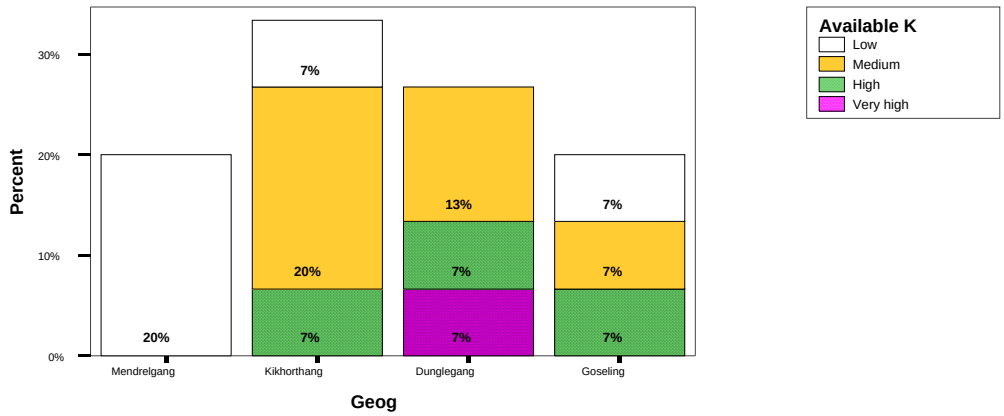


*Figure 4 Available K of Tsirang Dzongkhag*

The CEC of this soil is within the low (5-15 meq/100g) to medium (15-25 meq/100g) range. In soils with low CEC values, all the major macro and micronutrients may be required to attain adequate growth and yields. Mendrelgang geog has medium CEC values while the rest of the other geogs have low to medium values. *Lham Dorji (Pemashong village), Plot no B of Prakash Chetri (Salami), both the plots of Tshering Norbu (Saalami), Prem Lal Adhikari (Upper Bokray), and both the plots of Kuber Singh Pradhan (Bichgaon) have low CEC values (figure 5).*

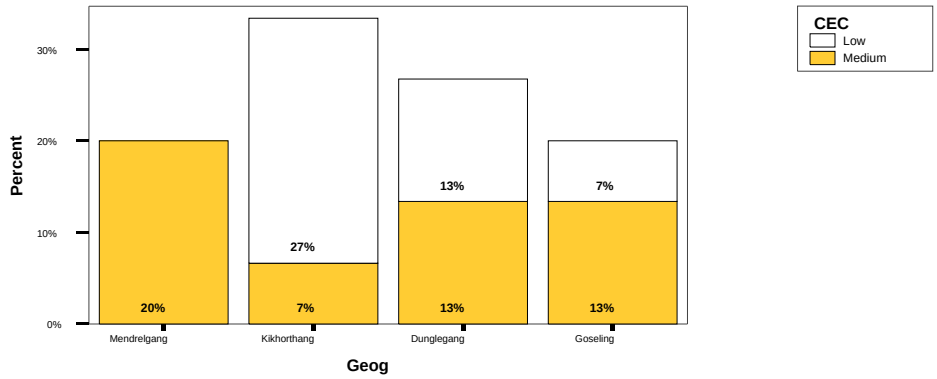


*Figure 5 Cation Exchange Capacity (CEC) of Tsirang Dzongkhag*

The base saturation (BS%) of this Dzongkhag varies from very low to very high values. The BS% for Upper plot of Tandin Wangmo (Mendrelgang village) has very low values while the rest of the other farmers in this geog have values within the medium to high ranges. Dungleygang and Goseling geogs have values ranging from medium to very high. Prakash Chetri's plot no B has low BS% value

while the rest of the other farmers have values within the medium to high ranges (figure 6).

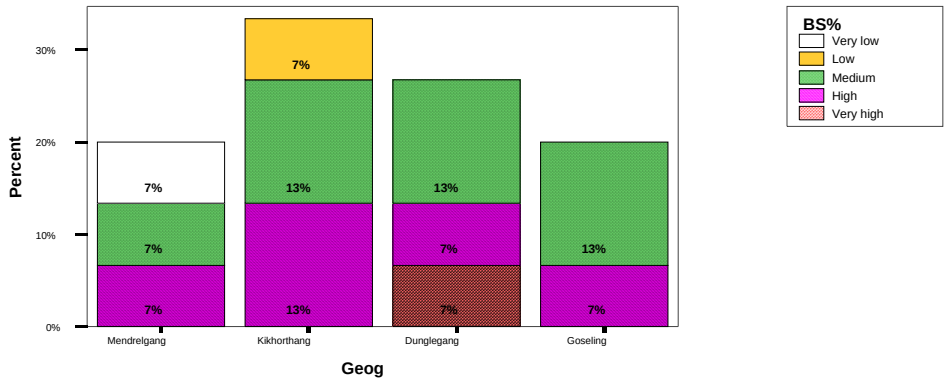


*Figure 6 Base saturaition % (BS%) of Tsirang Dzongkhag*

Coarse-textured soils lack both nutrient and water holding capacities while fine-textured soils often have structural and infiltration problems. Sandy loam is the prominent soil type of Mendrelgang geog while silty clay loam and sandy loam are the two major soil types of Goseling geog. is the dominant soil type of Pungshi. Sandy loam, loam and silty loam are the major soil types of Dungleygang geog. Kikorthang geog has sandy loam, loam, silty clay loam and silty loam. All these soil types are of light to medium textured soils containing less than 50% clay, for details see the following figures.

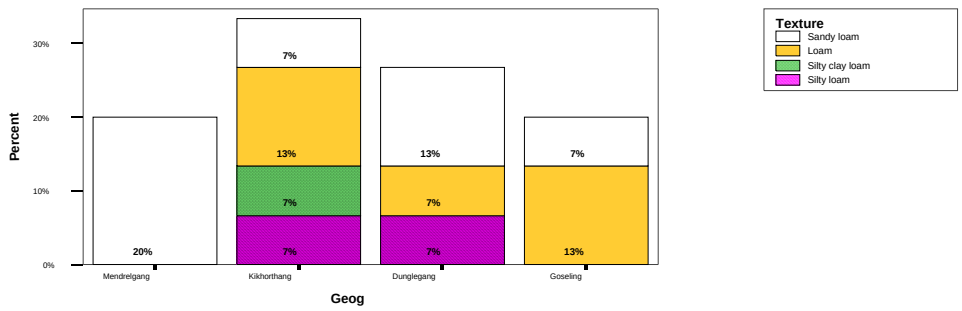


*Figure 7 Soil texture of Tsirang Dzongkhag.*

## 4. Conclusions

Most of the citrus in Tsirang Dzongkhag are grown at an altitude range of 1158–1333 m. asl and located mostly on moderately sloping to steep slopes with mostly northwest facing aspects.

Majority of the farmers do not apply FYM to citrus. All the farmers do tethering of cattle. Neither leaf litter nor compost materials are applied to citrus. Most of the farmers neither apply any chemical fertilizer to citrus nor do they irrigate their orchards.

The average soil pH of this Dzongkhag is mostly within the moderate range and that of the organic matter content is also mostly within the medium to high range. Generally the average available P and K of this Dzongkhag are within the medium to high range. The average CEC is mostly within the low to medium range while the BS% is mostly within the medium to high ranges. Sandy loam and loam are the two major soil types of this Dzongkhag.

## 5. Recommendations

For a precise fertilizer recommendation, yield and management history, sources of plant nutrient applied in the past in particular are required in addition to the soil information. Given the above soil results, the following recommendations are suggested to improve the soil nutrient status in this geog.

- The available P content of the soils in most of the villages are within the medium to high range with the exception of few farmers with low P values and for these farmers, applying P containing fertilizer such as could improve the P content in these soils (especially for those with low values).

- The available K content of these soils is mostly within the medium range to high range though almost 33% of the farmers have low K values. Though K might be adequate for those villages with moderate values, it might not be sufficient for those with low K values and hence the need to apply K containing fertilizer such as MoP to replenish the K content of these soils as more K is required especially during fruit development.

- The CEC of most of these soils is within the low to medium range and this low value indicates that almost all the major macronutrients are required to obtain adequate yield.

- An application of balanced nutrients with proper recommended rate needs to be encouraged i.e. the rate of 50:20:100g/tree per year (for non bearing trees) and 150:50:250g/tree/year for bearing trees[3]. From the above mentioned soil information, the following recommendations are suggested to improve the soil nutrient management program: What, when, how and why are answered below.

    1. **Thus the recommended rate of 50:20:100g/tree/year NPK (for non bearing trees)**

[3] For details see table 1.

❖ ***Using SSP, MoP and Urea is as follows:***

- For 50g N per tree per year, apply 110g/tree/year of Urea as basal dose after harvest and prior to spring flush.

- For 20g P per tree per year, apply 126g/ tree/year of SSP as basal dose after harvest and prior to spring flush.

- For 100g K per tree per year, apply 170g/tree/year of MoP as basal dose after harvest and prior to spring flush.

**2. The recommended rate of 150:50:250g/tree/year NPK (for bearing trees)**

❖ ***Using SSP, MoP and Urea is as follows:***

- For 150g N per tree per year, apply 330g/tree/year of Urea as basal dose after harvest and prior to spring flush.

- For 50g P per tree per year, apply 315g/ tree/year of SSP as basal dose after harvest and prior to spring flush.

- For 250g K per tree per year, apply 425g/tree/year of MoP as basal dose after harvest and prior to spring flush.

❖ The timing of fertilizer application with adequate soil moisture is crucial for obtaining good yield and therefore, application of fertilizers on dry soil is not encouraged.

Table 1: Suggested nutrient recommendation rate for citrus trees depending upon the age of the trees.

| Plant nutrients | Non bearing (g/tree/year) | Bearing (g/tree/year) | Time of application |
|---|---|---|---|
| **N** | 50-100 | 150-250 | After harvest & prior to spring flush |
| **$P_2O_5$** | 20-50 | 50-100 | After harvest & prior to spring flush |
| **$K_2O$** | 100-150 | 250-350 | After harvest & prior to spring flush |
| **Micronutrients** | To be applied based on soil & plant analysis result | | When trees have the most fully expanded leaves |
| **FYM** | To be applied based upon availability | | |