

TABLE OF CONTENTS

	PAGE
1. INTRODUCTION.....	1
2. METHOD	1
3. RESULTS AND DISCUSSIONS	1
3.1 THRIMSHING GEOG.....	2
3.1.1 Total sample households.....	2
3.1.2 Site description:	2
3.1.3 Potato and maize yield and other management practices.	2
3.1.4 Soil results of Thrimshing geog.	6
i. Soil result of Tsangpo village (see figure 7).	6
ii. Soil result of Thrimshing village (see figure 8).	7
iii. Soil texture of different villages under Thrimshing geog (figure 9)	8
4. CONCLUSIONS	8
5. RECOMMENDATIONS.....	8

1. Introduction

To build up a database on the soil nutrient status of the major crops in the country to develop a proper fertilizer recommendation rate for crops, soil samples are being collected from the potato maize based farming system in the Eastern Region Dzongkhags, wetland farming system in Punakha-Wangdi valley, and potato based system in Bumthang Dzongkhag. Soil samples will be collected once every two to three years from the same areas. The sampled households are interviewed on their soil fertility management practices, cropping pattern and crop yields.

Trashigang Dzongkhag in the east is the major potato growing Dzongkhags followed by Pema Gatshel and Monggar Dzongkhags. Though potatoes are grown throughout the Dzongkhag, as it is the major source of income for the farmers, the most intensively cultivated areas under Trashigang Dzongkhag are Thrimshing, Kanglung, Khaling, Nanong and Yangneer geogs.

Between 16th November and 15th December 2002, the staff of National Soil Services Centre (NSSC) together with the staff from RNRRC-Khangma, collected soil samples from Thrimshing geog under Trashigang Dzongkhag.

2. Method

The group collected the soil samples from the farmers' fields based on the list prepared by the Extension Agent (EA) and with the help of the village Chipons. The farmers were explained about the rationale behind collecting soils samples from their fields. Soil samples were collected from the households growing potatoes in two or more langdos (1 langdo= 1350m²). One composite sample from a minimum of 8-10 sub samples was collected from one field though a composite sample was collected from the clustered fields. Soil samples were collected from the depth 0-20 cm 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 as recorded during the survey are presented while the soil results for each village under this geog is presented in the second half of this report.

3.1 Thrimshing geog

3.1.1 Total sample households

In Thrimshing geog, a total of 60 households from 2 villages were sampled. From these two geogs, the maximum number of respondents and hence more farmers growing potatoes was from Tsangpo village (67%) followed by Thrimshing village with 33%. The various management practices and other site parameters in addition to the soil results are presented below.

3.1.2 Site description:

Altitudes, slopes and aspects of the fields under potato cultivation.

In Yangneer geog, about 93% of the sampled plots are located at the low altitude range and the rest 7% in the medium range. The majority of the plots of this geog are situated on moderately sloping (35%) and steep areas (33%). The majority of the plots are west, north and north-west facing and about all the sampled area have small plot sizes (<1 acre). The farmers of this geog all grow potatoes in their own fields (100% owned) and there is no practice of sharing in and sharing out as in other villages under Trashigang Dzongkhag. About 57% of the farmers grow The white variety (variety not specified) while about 26% of them grow Desiree and about 17% grow both the white and red varieties. In this geog, all the farmers plant their potatoes in December.

3.1.3 Potato and maize yield and other management practices.

The farmers assess their own plot fertility based on the yield, soil type and the slope gradient though different farmers have their own justifications for assessing their plots, which varies from village to village and from household to household.

From Figure 1, it can be observed that though the maximum yield (tons/acre) is obtained from south facing slope with moderately sloping areas, the majority of the plots are situated on west, north and northwest facing aspects with moderately sloping and steep areas.

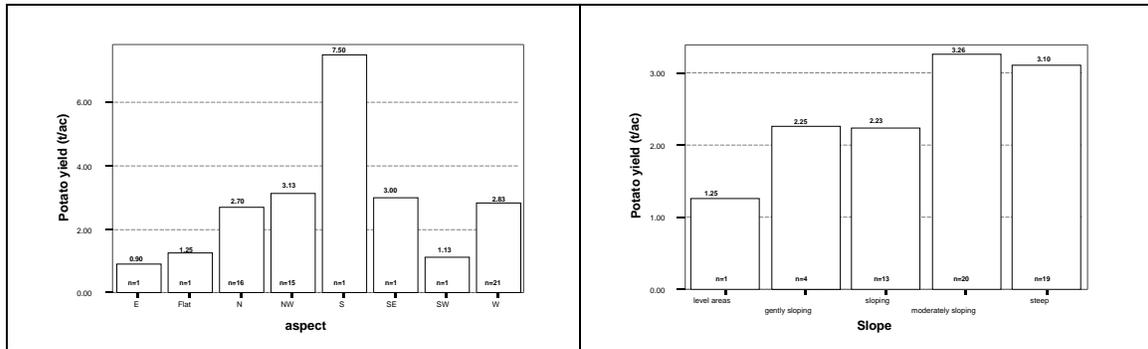


Figure 1 Potato yield in relation to aspect and slope of the plots.

As in any other village or geog in the east, potato is usually intercropped with maize. In this geog, all the farmers sow maize in March. Under favorable growing seasons, crop management and variety, the potato yield can vary from 16-20t/ac¹ though on an average, the yield is about 7-8 t/ac. The average potato yield for this geog is 2.9t/ac. Of these two villages, the more potato yield is recorded from Thrimshing village (3.2t/ac), which is less in comparison to other geogs under same Dzongkhag while Tsangpo village recorded about 3 tons per acre only. The maize yield is also higher from Thrimshing village (1.2t/acre) in comparison to Tsangpo, which is less than an acre. (See figure 2). On an average, the maize yield for this geog is 0.97t/ac.

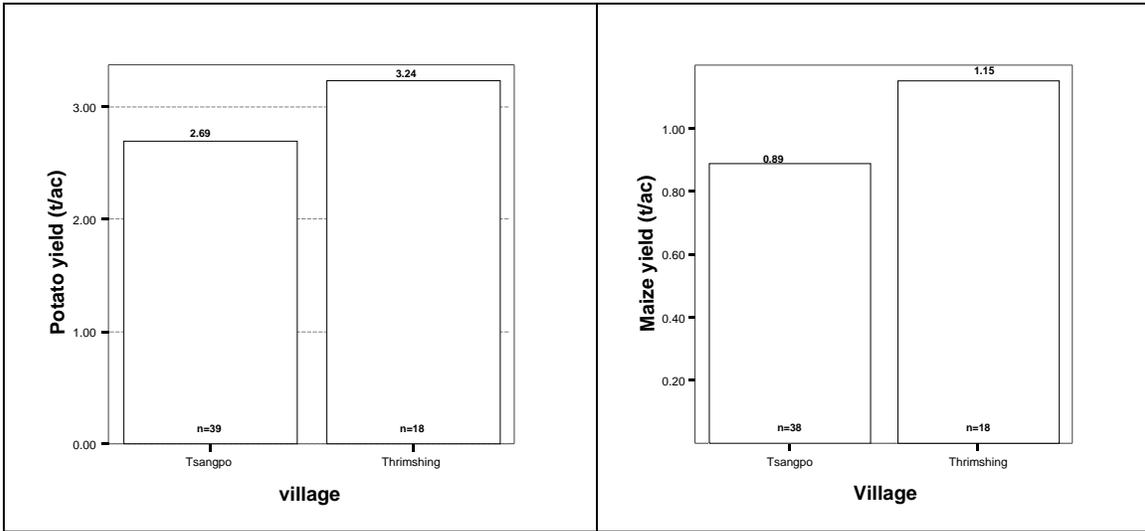


Figure 2 Average potato and maize yield (t/acre) under each village.

In Thrimshing geog, about 88% of the farmers apply Farm Yard Manure (FYM) to their fields with an average application of 5.4t/ac. This amount of FYM applied with a dry matter content of 50% is equivalent to 2.7t/ac. As in elsewhere, FYM is usually broadcasted in the fields and incorporated into the soil by ploughing during land preparation. The rate of FYM application (t/ac) is more in Tsangpo village (about 5t/ac) than in Thrimshing village, which is about 4.0 t/acre, figure 3. In this geog, about 65% of the farmers tether their cattle in the fields while about 93% of them burn trash after crop harvest. The weeding frequency of the potato ranges from once to thrice though the majority of them (73%) weed thrice and about 18% twice and very few (8%) weed only once.

¹ According to FAO reports.

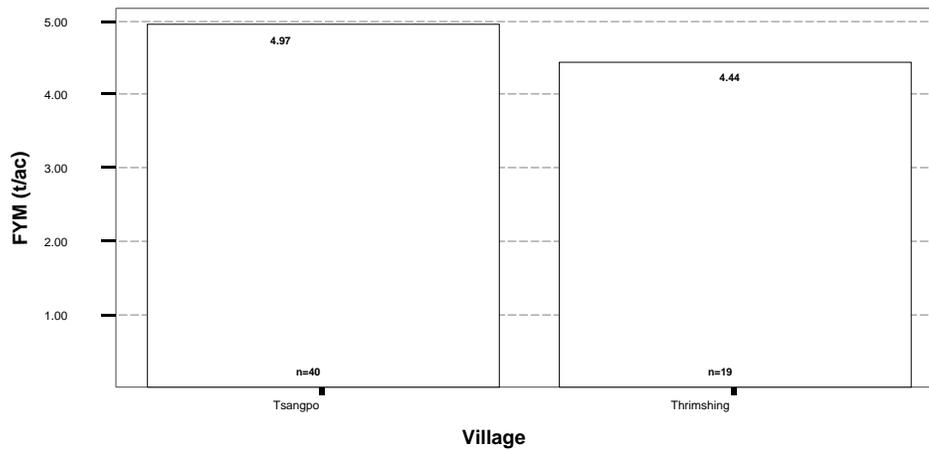


Figure 3 Amount of FYM applied (t/acre) under each village.

The survey findings indicate that about 63% of the farmers apply inorganic fertilizers such as urea and suphala addition to FYM while SSP is not applied at all. Only about 28% of the farmers of this geog apply Suphala to potato (basal dose) and about 33% of them apply urea as basal in potato while about 36% of them apply urea to maize. In this geog, the average amount of suphala applied by the farmers of Thrimshing village is slightly more than Tshangpo village, which is about 140kg/ac and 135 kg/ac respectively (Figure 4). On an average, the farmers of this geog apply about 138kg/ac suphala, which is about 21kg N per acre, 21kg P per acre and 21kg K per acre. The farmers also apply about 94kg/ac urea (which is about 44kg N per acre) as basal dose to potato.

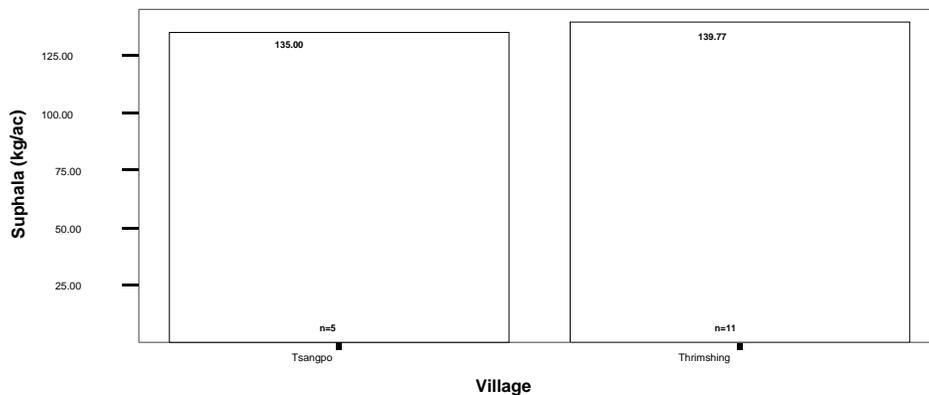


Figure 4 Amount of Suphala (kg/acre) applied under each village.

From the following figure 5, it can be seen that the rate of application of urea to potato is more in Thrimshing village (42kg/ac) in comparison to Tsangpo village

(about 12kg/ac), see figure 5.

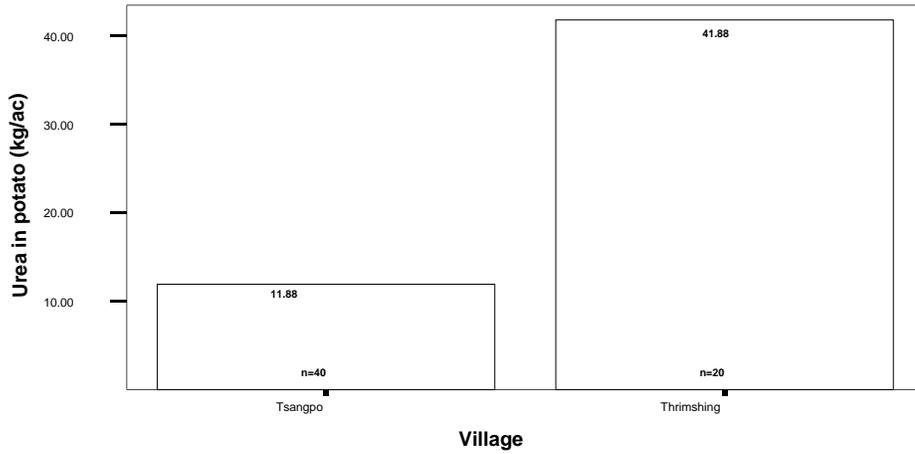


Figure 5 Amount of Urea (kg/acre) applied to potato under each village.

As reported earlier, SSP is not at all applied in this geog. In addition, the farmers of this geog also apply urea to maize at an average application rate of 112kg/acre of urea (i.e. about 53kg N per acre) as top dress to maize. Urea application rate is higher for Thrimshing village (78kg/ac) than Tsangpo village (22kg/ac).

The basal fertilizer is applied in a band while urea top dress, broadcasted near the plants is all applied in a single dose. It is not recorded as to whether the farmers are aware of the importance of split application of urea and if not, then it is worth making them aware of it. See figure 6.

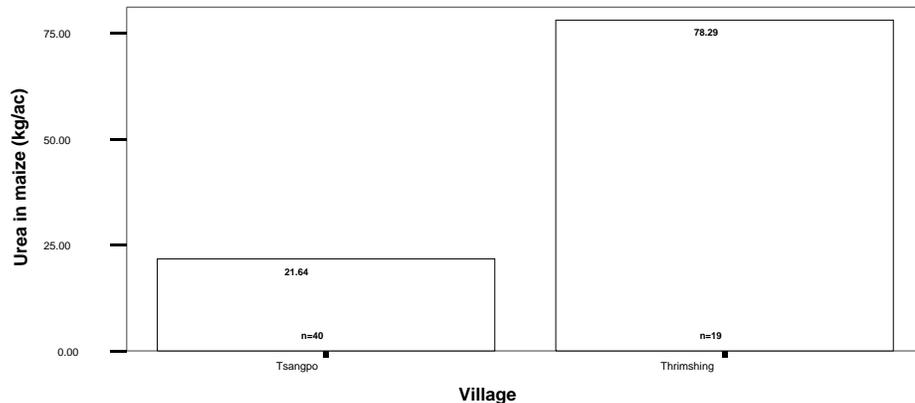


Figure 6 Amount of urea (kg/acre) applied in maize under each village.

3.1.4 Soil results of Thrimshing geog.

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.

Potato can be grown in most soil types where though its greatest productivity is from a deep, loose, crumbly and well-aerated soil. It does well in slightly acidic soils (pH range of 5.0-5.8) while it is not suitable if the soil pH is either <4.5 or is >7.0. Alkaline soil conditions can adversely affect skin quality and high alkaline soils can also induce micronutrient deficiencies. The soil results of each village under Thrimshing geog is summarised as follows.

i. Soil result of Tsangpo village (see figure 7).

The pH of the soils of this village is mostly within the medium range. As any other crops, potatoes also require adequate amount of N, P and K for optimum crop yield although its N and K requirements are high. Potatoes are efficient removers of K. The available K of this village is of low to medium range with **45% in the low range and another 35% in the very low range**. More than **55% of these soils have low available P out of which 15% is in the very low range**. There fore, the need to apply P and K containing fertilizers such as **SSP and MoP** to improve the nutrient status of these soils. The organic matter of these soils is of medium to high range with very high C:N ratio. More than 50% of these soils have low CEC values and in such low values, all major macro and micronutrients are required to attain adequate growth and yield. The BS% is distributed within very low to very high ranges. Coarse-textured soils lack both nutrient and water holding capacities while fine-textured soils often have structural and infiltration problems. The major soil types are silty clay loam and silty loam (figure 10). This soil type is of medium textured soil containing less than 40% clay content. However, for light textured soils, a split application of inorganic fertilizers especially urea is advisable.

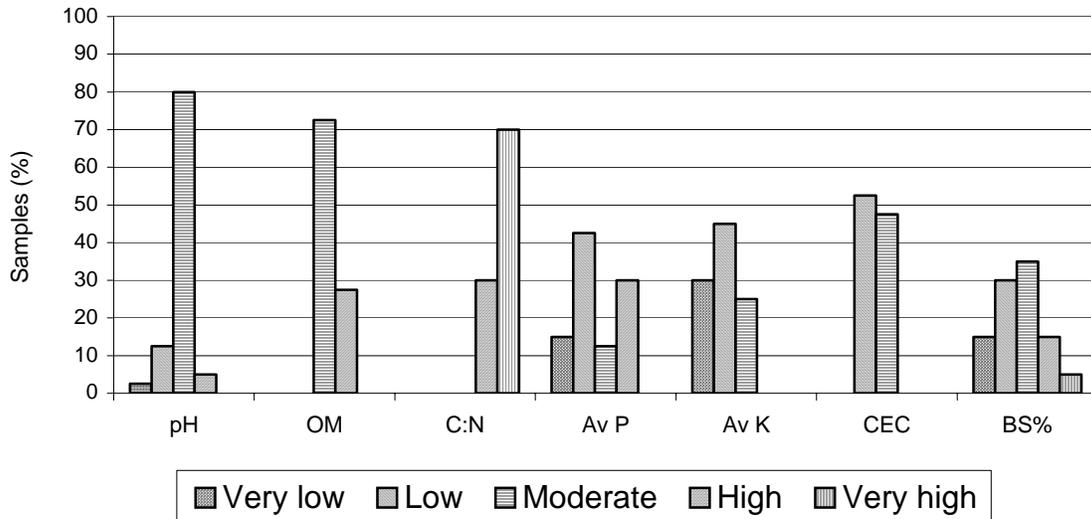


Figure 7 Soil parameters of potato fields in Tsangpo village.

ii. Soil result of Thrimshing village (see figure 8).

The pH of the soils of this village is of medium range. The available K is mostly within the low to moderate range with more than 35% in the low range. More than 60% of these soils have low available P. These figures suggest that the available P and K content of these soils are low and so it would be advisable to apply P and K containing fertilizers such as SSP and MoP to improve the P and K contents of these soils. The organic matter content of these soils is within the medium to high range with high C:N ratio. The CEC values of these soils are low to medium with 40% in the low range. In such low CEC soils, all major macro and micronutrients are needed to obtain good crop growth and yield. The BS% is distributed from very low to high ranges. The major soil types of this village are silty clay and loam (figure 18). These soil types are of medium textured soils containing less than 40% clay content and for light textured soils, a split application of inorganic fertilizers especially urea is advisable.

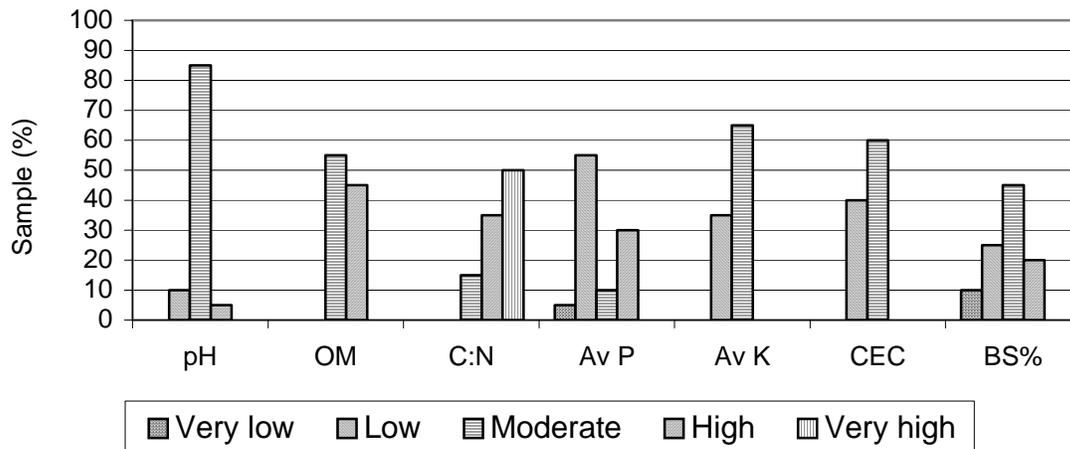


Figure 8 Soil parameters of potato fields in Thrimshing village.

iii. Soil texture of different villages under Thrimshing geog (figure 9)

The different soil textures found in each village under Yangneer geog is presented in the following figure.

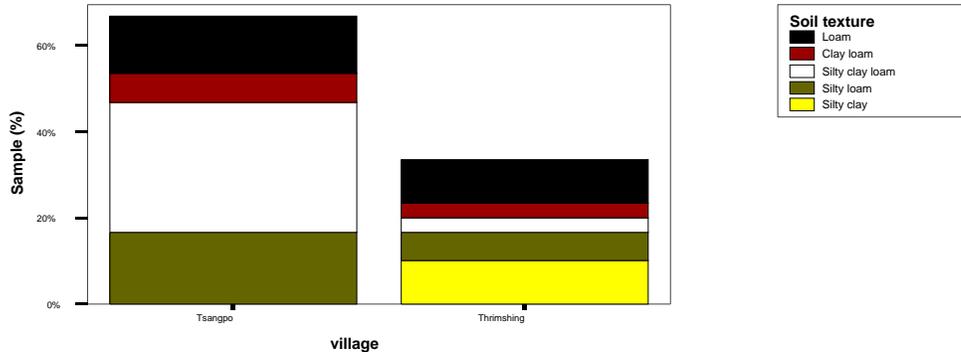


Figure 9 Soil textures of potato fields in different villages (Thrimshing geog).

4. Conclusions

In Yangneer geog the potato fields are mostly located at the low and very few on the medium altitude range with the majority of the plots on moderately sloping and steep slopes with aspects facing mostly north, west and northwesterly aspects with small land holdings. The white variety is the most common potato variety grown by the farmers, which is planted in the month of December. Maize is intercropped with potato, which is sown within one to two months after potato. Majority of the farmers (88%) apply FYM to potato at an average rate of 5.4t/acre. Inorganic fertilizers like urea and suphala are applied to potato and maize. Urea in maize is all applied as a single top dress. FYM is usually broadcasted prior to ploughing. The average yield of potato and maize for this geog is 2.9t/ac and 0.97t/ac respectively. The majority of the farmers do tethering of cattle while all the farmers burn the crop residues prior to land preparation. Weeding is done thrice by most of the farmers.

In general, the average soil pH and available P is mostly within the moderate range while the available K content of these soils is low. Therefore, the need to improve the soil nutrient status with regard to its P and K contents and hence the yield by applying P and K containing fertilizer such as SSP and MoP. The organic matter content is within the moderate range. The BS% of this geog is of moderate range while the CEC content is low to medium. Incorporating more FYM could increase the CEC values. Silty clay loam, loam and silty loam are the dominant soil types of this geog. All these soil types are of medium textured containing less than 40% clay content.

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 (Section 3.2.3) the following recommendations are suggested to improve the soil nutrient status in this geog.

- ☞ The available P content of the soils in this geog is of medium range, applying P containing fertilizer such as SSP together with urea as a basal dose could improve the P content in these soils.
- ☞ The available K content of these soils is low which may not be adequate for proper growth and yield and hence the need to apply K containing fertilizer such as MoP to replenish the K content. In addition, potatoes are efficient removers of K and therefore the need to apply it into the soil is more justified.
- ☞ 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. For this geog, K content needs to be increased since it is low. 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.

Thus the recommended rate of 100:80:100 kg/ha of N,P,K

1. Using Suphala is as follows:

- Apply about 216kg/acre of suphala as basal dose during land preparation (i.e. about $4\frac{1}{3}$ bags of suphala @50kg per bag per acre) together with 50kg of SSP (i.e. 1 bag of SSP @50kg per bag per acre) together with
- About 14 kg of MoP as basal dose; followed by about 17 kg of urea as top dress either when the plants are of 15-20 cm high (after 30-45 days of planting) or at the time of potato flowering (i.e. when the maize plants are of “knee high” stage).

2. Using SSP, MoP and Urea is as follows:

- Apply 69kg/acre of Urea as basal dose during land preparation (i.e. about 1 bags of Urea @50 kg per bag per acre).
- Apply about 203kg/acre of SSP as basal dose during land preparation (i.e. 4 bags of SSP @ 50 kg per bag per acre).
- Apply about 68kg/acre of MoP as basal dose during land preparation (i.e. about 1 bag of MoP @ 50 kg per bag per acre).

- Followed by 17 kg urea as top dress either when the plants are of 15-20 cm high (after 30-45 days of planting) or at the time of potato flowering (or when the maize plants are of “knee high” stage).
-
- ☞ In addition to this the major soil type is of medium textured and so a split application of urea is even more advisable for better utilisation of the N nutrient.
 - ☞ 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.
 - ☞ Urea top dress of incorporating it into the soil needs to be encouraged as all the farmers reported of broadcasting it without incorporating it into the soil.