

## Farmers' nutrient management practices in organic apple production in Bhutan

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### Abstract

*This study was conducted to assess the types and amount of organic fertilizers applied and time and method of application followed by farmers in organic apple production in two popular apple growing districts (Paro and Thimphu) of Bhutan. From each district, seven representative farmers were selected using purposive sampling method and interviewed using a semi-structured questionnaire. The study found that farmers use different types of organic manure such as cow manure or farmyard manure or dried leaf litter collected from nearby forests or chicken manure or a combination of these different manures. Application rate of organic manures varied from 7 kg/tree to 11 kg/tree. Manures were applied only once a year and it was either incorporated in the soil or applied on the soil surface at the time of making basins around the tree base sometime in mid-January to early February. Apple yields varied from as low as 27 kg/tree to as high as 42 kg/tree in some farmers' fields. The yield of apple could be further enhanced if manures could be increased and applied in split doses.*

**Keywords:** Farmers' practice, nutrient management, organic apple, Bhutan.

### Introduction

Apple is one of the four important commercial crops of Bhutan. It is cultivated mainly in five districts, amongst which Paro and Thimphu districts have the maximum number of trees at 319,043 and 104,269 and production at 2,417 metric ton and 755.24 metric ton, respectively (MoAF, 2019). The total apple production has declined from 20,752 MT in 2011 to 8,039 MT in 2017 (NSB, 2019). The decline could be attributed to decline in number of apple trees, inadequate number of pollinizer trees, changing climate pattern and nutrient management amongst other factors.

Plant nutrient management in Bhutan in general is alleged to be poor due to lack of or inadequate training, knowledge and facilities (Choden & Shanawaz, 2015). Generally, plant nutrients are applied without soil nutrient and pH analyses or nutrient budget assessment. A yield of 70 t/ha of delicious fresh weight apples, which are the common cultivars cultivated in study area remove about 32 kg/ha N, 10 kg/ha P and 88 kg/ha K (Palmer & Dryden, 2006), which has to be replenished to ensure expected yield in the coming harvest season. Ensuring the exact amount of nutrients to be replenished from addition of organic manures could be difficult in organic management because the nutrient contents of organic manures vary.

Organic farming is vigorously pursued in Bhutan with a goal to become a fully organic country by the end of 2020. Many critics contend that it is an uphill battle if not an impossible task, particularly in the case of several cash crops such as apples, citrus, potatoes and paddy, which are heavily reliant on conventional production method. One of the main contentions of the skeptics pertains to plant nutrient management. Therefore, this study aims to assess farmers' method of nutrient management in organic apple production in terms of types of organic nutrient used, amount of organic fertilizers applied and time and method of application.

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## Material and Methods

The two most dominating apple growing districts located in western Bhutan, Paro and Thimphu, which experience warm to cool temperate climate were selected for the study. The average annual mean temperature of Paro (27° 25' 43" N, 89° 24' 59" E) and Thimphu (27° 27' 57.92" N, 89° 38' 30.88" E) are 12.43°C and 11.6°C, respectively and the average annual rainfall is 151.66 mm in Paro and 133.25 mm in Thimphu (NCHM, 2018). Soils in Paro district broadly is silty loam to silty clay loam whilst in Thimphu district it is sandy loam to sandy clay loam with slightly low pH in both the districts (Karma D. Dema, Pers. Communication, 15 January 2020).

Fourteen representative farmers (seven from each of the two districts) were selected using purposive sampling method. The farmers in both the districts have been growing apples for more than 17 years and their apple orchard ranged from 0.6 acre to 4.5 acres.

The farmers were interviewed using a semi-structured questionnaire. The questions were on the types of organic manure used, rate of manures applied, application method and time. Other questions included in the questionnaire were on yield, intercrops, impact of climate change and other factors contributing to apple yield increase/decrease.

The responses were collected and consolidated to provide qualitative information on nutrient management aspects in organic apple production.

## Results and Discussion

### Nutrient management

One-fourth of the respondents use only cow manure whilst more than 50% of the respondents use both farmyard manure mixed with leaflitters (Table 1). Less than 14% of the farmers use chicken manure with cow manure at 1:8 kg ratio. Dried leaflitters are collected from the nearby forests and stored in sheds before application. No analysis of the nutrient contents of these organic manures have been done so far and it is therefore hard to report how much nutrients are being replenished or if adequate nutrients have been applied or not.

About 45% of the farmers apply organic manure at the rate of 7 kg/tree, 37% apply between 8 to 9 kg/tree and remainder apply between 10 to 11 kg/tree (Table 1). Given the bulkiness of organic manure save the chicken manure, those applying 10 kg/tree or less could be undersupplying the nutrient requirement.

All farmers apply organic manure at the time of basin preparation, which is normally done in mid-January or early February. Basin is made around the tree base and its size depends on tree size with bigger trees having bigger basins. While about 27% of the farmers apply nutrient on the soil surface after making the basin others incorporate it in the soil at the time of preparing the basin. Leaving organic manure on the soil surface could risk losing nutrients through various ways.

Less than 13% of the respondents irrigate apple orchards. Others simply depend on monsoon rain for water requirement, which is confined is to four months from June to September.

Table 1: Types and amount of organic nutrient applied and time and method of application.

Types of organic nutrient applied	Amount of nutrient applied (per tree)	Time of application	Method of application
Cow manure, Farmyard manure, dried leaflitters, chicken manure	7 - 11	Mid-Jan/ early Feb	Incorporate or apply on soil surface

## Intercrops and yield

Intercropping is a good way to maximize the available space and also when done in the right way could mutually benefit both the main crop and the intercrops. Such practice is fairly common in Bhutan. In the study area, over 70% of the farmers planted intercrops, which included short-duration vegetables such as Saag and lettuces. Increasingly now because of the government's promotional programs, farmers have also planted strawberries and asparagus. About 40% of the farmers also planted potatoes as intercrops, which were followed by chilis.

In the study area, planting density is low with about 75 to 100 trees/acre. About 27% of the farmers had 75 trees/acre whilst another 40% had between 76 to 88 trees/acre. Less than 12% of the respondents had 100 trees/acre. Some of the diseased or old trees were removed without replacement. Some farmers were intentionally reducing the trees to convert the land for other economic activities because apple is not as lucrative as converting the land into other uses, for instance building.

Over 70% of the respondents reported of yield decline over the years whilst about 23% reported of experiencing alternate bearing. There has been unusual and unexpected hailstones in the last few years during flowering season thus damaging the flowers.

The lowest average yield in the study area was 27 kg/tree with about 42% of the farmers obtaining this amount. The remainder respondents harvested between 35 to 42 kg/tree. This yield is above the national average yield of 33 kg/tree (MoAF, 2019).

Table 2: Intercrops, number of trees per acre and yield per tree.

Intercrops used in apple orchard	Number of trees per acre	Yield (kg/tree)
Short duration vegetables, asparagus, strawberries, potatoes and chilis	75 - 100	27 - 42

## Conclusion

Organic apple farmers in Paro and Thimphu districts continue to follow traditional method of manure application, which is done once a year and it is either applied on the soil surface or incorporated in the soil at the time of annual basin making around tree base. Quantity and types of manure applied is based on availability and affordability. Yield differences amongst the farmers is almost 100%, which could be due to difference in rate of manure application amongst other factors. Future studies could focus on closing this yield gap and also quantify nutrient contents of various organic manures used by farmers to formulate approximate nutrient recommendation package for organic apple growers.

## References

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