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Existing crop productivity of vegetables growing areas of Neelkantha municipality of Dhading District, Nepal

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Abstract
A study was conducted on, "Existing crop productivity of vegetables growing areas of Neelkantha Municipality of Dhading District, Nepal" for estimating productivity status of vegetable growing areas of Neelkantha municipality of Dhading district. Ward number 3 and 12 were purposively selected, with two land category; upland and lowland. Total 30 households were questioned (15 from ward number 12 and 15 from ward number 3) and 30 soil samples were collected from respective farmers using soil sampling auger at the depth of 0-20 cm which was subject to lab test. Based on the laboratory analysis ward number 12 soil pH was found to be neutral (7.0), high in organic matter (4.42%), medium in total nitrogen (0.22%), high in potassium (333.38 kg ha^{-1})and high in phosphorus (225 kg ha^{-1}). Similarly, ward number 3 soil pH was alkaline (7.8), high in organic matter (5.47%), high in total nitrogen (0.27%), high in potassium (347.71 kg ha^{-1}) and high in phosphorus (118.7 kg ha^{-1}). Altogether, 30 household soil sample was analyzed. Out of these 17% was slightly acidic, 33% was found to be neutral and 50% was alkaline. SOM of 10% of households was very high, 10% was high, 57% was medium, 10% was low and 13% was very low. Total nitrogen percentage of 13% of households was found to be very high, 27% was found to be high, 43% was medium, 3% was low and 14% was found to be very low. Available potassium of 17% of households was very high, 30% was high and 40% was medium, 13% was low. Available phosphorus of 63% of households was very high, 23% was high, 7% was medium and 7% was low. About 60% of farmers reported increasing trend of productivity. Likewise, 20% farmers reported decreasing trend of productivity and remaining 20% confirmed stagnant crop productivity trend. Commercially vegetable cultivated total areas were 8 hectares. Estimated total vegetables production of previous year was 100 tons worth 45 lakhs with an average cost of Rs. 45/ kg. Thus, the crop productivity of 30 households surveyed is 12.5 tons/ hectare. Majority of farmers claimed that the increase in production was due to the application of chemical fertilizers whereas farmers reported decreasing trend of vegetable productivity due to imbalance application of input like chemical fertilizers. Farmers reported the deterioration of soil fertility due to application of chemical fertilizer in an excessive amount. Thus, farmers were suggested to apply recommended dose of fertilizers for the enhancement of vegetable productivity. It was also suggested to the vegetable grower farmers to carry soil analysis periodically and continue addition of organic matters in the field.

Keywords: Commercial vegetable production, Soil nutrient, Organic matter, Soil properties

Introduction
Being a country with subsistence agriculture as a prime occupation, Nepal has total cultivated area of 3.09 million hectares. The most important crops grown in Nepal are rice, maize, wheat, millet, barley, potato and sugarcane. Minor crops are grown all over the country. These occupy 7.3 percent of the total cultivated agricultural land (MOAC, 2008/09) indicating the increasing value of agriculture sector in Nepalese economy. Dhading district spreads from 27.9711° N and 84.8985° E with a population of 336,067 (CBS, 2011). Dhading is one of the most agro-based district of Nepal which lies in Bagmati zone of Central Development Region surrounded by Rasuwa, Nuwakot, Kathmandu and China. The total area of Dhading is 192,600 hectares, i. e. 1.3% of country's area. Dhading besi is headquarter of Dhading district that lies in the Neelkantha municipality. Dhading has subtropical monsoon climate and the annual precipitation is 2,120mm with peak rainy season from mid of June to the end of September. This district is ranked 41st position in most backward district in Human Development Index. Almost 99% of the population of Dhading is dependent upon agriculture for generating income along with livestock rearing. Dhading has both steep slopes and limited flat areas. Major crops that are grown in Dhading is maize, paddy, millet, potatoes, wheat, sugarcane, oilseeds, barley. Vegetables are grown commercially hereby in traditional ways. Around a year 3 crops can be grown using different cropping pattern. Approximately 20,000 ha of primary lands and marginal and marginal uplands is cultivable.
According to District Agriculture Office vegetable are grown around 6,022 hectares of lands with total production of 76,479 tons annually whereas 10,000 farmers in 19 villages are

involved in commercial vegetable production (Rauthaur, 2016).

Materials and Methodology

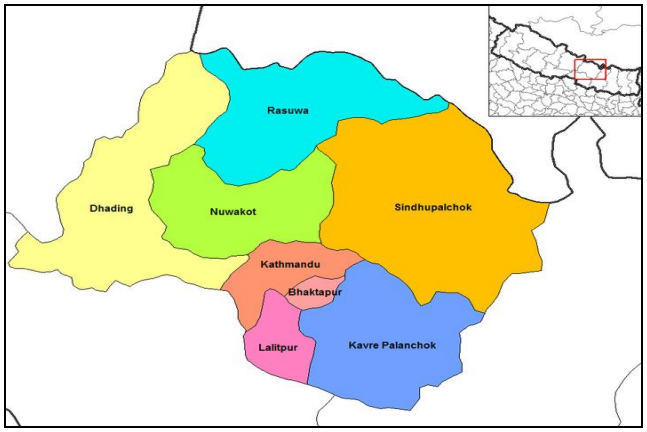

Fig 1: Map of study location

Study location selected was Dhading besi, Neelkantha ward number 12 and 3 separated by Trishuli River. Ward number 12 lies 200 meters above from the Trishuli River whereas ward number 3 lies at riverside. Dhading is located in Bagmati zone of Central Development Region. Climate of Dhading is warm and temperate. The driest month is November with only 12 mm of rainfall whereas July receives the maximum amount of precipitation. The warmest month of the year is July with an average of 27.6 ^{0}C. Lowest average temperature in the year occurs in January with an average temperature of 15.1 ^{0}C. Difference of 5897 mm of precipitation between driest and wettest month can be seen. Survey was conducted from July 15-July 19, 2017 for primary data collection and the collected composite soil samples were analyzed from September 08-September 13, 2017. Altogether, 30 households were selected were selected for the survey and surveyed. 15 households were selected from the upland belt i. e. ward number 12 and 15 households were selected from the lowland belt i.e. ward number 3. Participation of vegetables growers from two different wards was involved. Through random sampling method, one composite sample was taken from one household filed from 0-20 cm soil depth using Auger. Altogether 30 households within the two wards were surveyed and collected soil samples. Vegetable grown areas were identified for the soil sampling. Soil sampling was done according the method prescribed by the Soil Management Directorate. About half kg of soil was collected from each household. 30 soil samples were collected from the farmers of two wards. Soil analysis was carried out in the soil laboratory of Soil Management Directorate (SMD), Department of Agriculture (DOA) under the supervision of the Senior Soil Scientists. Bar graph, Pie-chart, Mean, Soil nutrient status, Standard deviation, Standard error and Total Productivity analysis was done using Microsoft Office Excel 2007 data tool and analysis tool bar.

Table 1: Soil parameters and their methods adopted at lab of SMD, Hariharbhawan.

S. N.	Parameters	Methods used
1	Total nitrogen (%)	Kjeldahl Method
2	Available phosphorus (ppm)	Modified Olsen's bicarbonate method
3	Available potash (ppm)	Flame Photometric Method
4	Organic matter (%)	Walkely and Black Method
5	Soil pH	Blackman's pH Meter
6	Soil texture	Hydrometer method

Source: SMD, 2010

Results and Discussion

Soil fertility Evaluation Soil Reaction (pH)

Soil with pH value < 5.5 is considered as acidic soil, 5.5-6.5 is considered as slightly acidic soil, 6.5-7.5 is considered to be neutral, > 7.5 is considered to be alkaline soil (SMD, 2010).

Among 30 households, 17% of household's soil was slightly acidic, 33% was found to be neutral and 50% was alkaline

The average pH of ward number 12 was found to be neutral (pH7.0) and ward number 3 was found to be alkaline soil (pH7.8) as shown in figure 1. The analysis result indicates that the pH of ward number 3 was higher than that of ward number 12.

The soil analysis data indicates that the soil pH was found to be slightly acidic (5.7)-alkaline (8.2) in ward no. 12. Similarly soil pH was found to be neutral to alkaline (7.1-8.2) in ward no. 3.

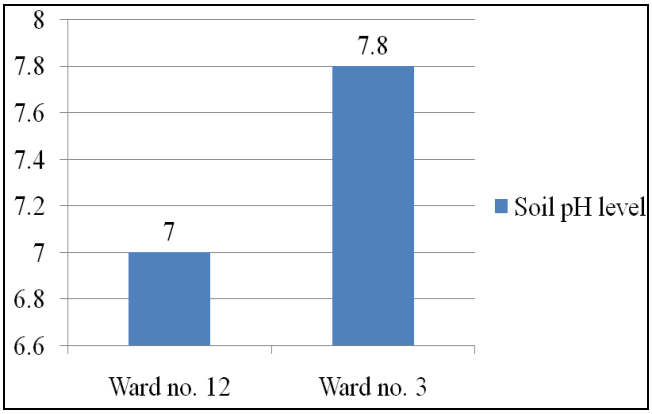

Fig 2: Average soil reaction (pH) in ward number 12 and 3 of study area

Total Nitrogen

Soil with nitrogen percentage of 0.05 is very low, 0.05-0.10 is low, 0.1-0.2 is medium, 0.2-0.4 is high and above 0.4% is very high (SMD, 2010).

Among 30 households, total nitrogen% of 13% of households was found to be very high, 27% was found to be high, 43% was medium, 3% was low and 14% was found to be very low.

The nitrogen percentage of ward number 12 was found to be 0.22% (high). The nitrogen percentage of ward number 3 was found to be 0.27% (high). The total N% of ward number 3 is relatively higher than that of ward number 12 as shown in figure 2. The total N% of both ward numbers is high due to incorporation of N supplying chemical fertilizers and manures.

The soil analysis data indicates that the total nitrogen percentage was found to be very low (0.01% N) to very high (0.64% N) in ward no. 12. Similarly the total nitrogen percentage was found to be very low (0.04 % N) to very high (0.91 % N) in the ward no 3

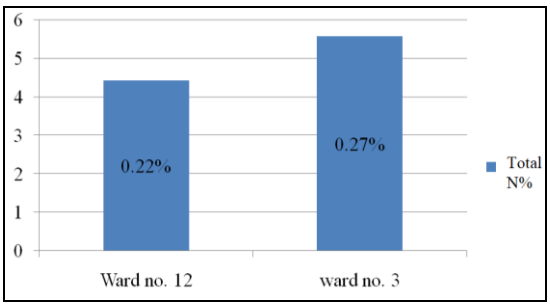

Fig 3: Average total nitrogen % in ward number 12 and 3 of study site

Total Soil Organic Matter

Soil organic matter (SOM) below 1% is very low, 1.0-2.5% is low, 2.5-5% is medium, 5-10% is high and above 10% is very high (SMD, 2010).

Among 30 households, SOM of 10% of households was very high, 10% was high, 57% was medium, 10% was low and 13% was very low.

The average organic matter percentage of ward number 12 was found to be medium (4.42%). The average organic percentage of ward number 3 was found to be high (5.47%). The OM% of ward number 3 was higher than that of ward number 12 as shown in figure 3.

The range of organic matter 0.14%-12.87% (very low to very high) was detected in the ward no. 12. Similarly the range of OM 0.79% to 18.13% (very low to very high) was detected in ward no 3.

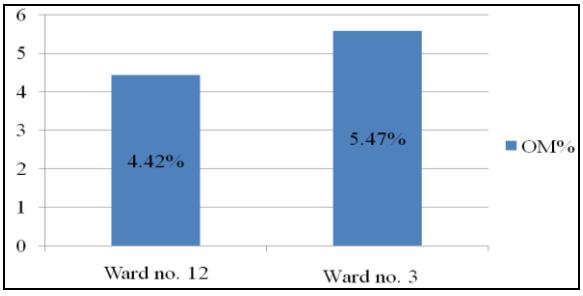

Fig 4: Average total OM % in ward number 12 and 3 of study site

Available Potassium

Soil with potassium below 55 kg ha^{-1} is very low, 55-110 kg ha^{-1} is low, 110-280 kg ha^{-1} is medium, 280-500 kg ha^{-1} is high and above 500 is very high in potassium (SMD, 2010).

Among 30 households, available potassium of 17% of households was very high, 30% was high and 40% was medium, 13% was low.

The average available potassium content of ward number 12 was found to be 333.38 kg ha^{-1}. The average available potassium content of ward number 3 was found to be 347.71 kg ha^{-1}. The average available potassium of ward number 3 was higher than that of average available potassium of ward number 12 as shown in figure 4. Both of the ward numbers comprises high potassium content in soil.

The soil analysis data indicates that the total potassium was found to be low (75.504 kg ha^{-1}) to very high (877.008 kg ha^{-1}) in ward no.12. Similarly the total potassium was found to be low (104.544 kg ha^{-1}) to very high (1196.448 kg ha^{-1}) ward no. 3.

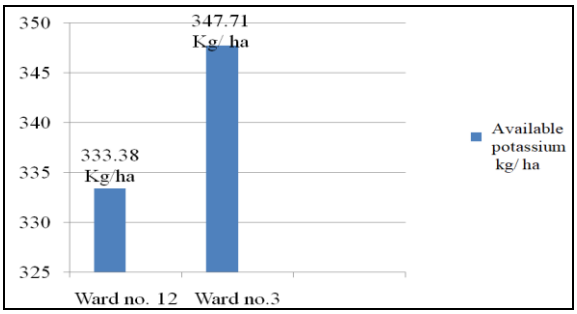

Fig 5: Average available potassium kg ha^{-1} in ward number 12 and 3 of study area

Available Phosphorus

Soil with phosphorus below 10 kg ha^{-1} is very low, 10-30 kg ha^{-1} is low, 30-55 kg ha^{-1} is medium, 55-110 kg ha^{-1} is high, and above 110 kg ha^{-1} is very high (SMD, 2010)

Among 30 households, available phosphorus of 63% of households was very high, 23% was high, 7% was medium and 7% was low.

The average available phosphorus of ward number 12 was found to be 225 kg ha^{-1}. The average available of phosphorus ward number 3 was found to be 118.7 kg ha^{-1}. The average available phosphorus of ward number 12 was higher than that of average available phosphorus of ward number 3 as shown in figure 5 which may be because P-availability occurs in neutral soil whereas acidic and alkaline soil limits P-availability. Both the ward numbers comprises higher phosphorus content.

The soil analysis data indicates that the total phosphorus was found to be high (87.9kg ha^{-1}) to very high (629.8 kg ha^{-1}) in ward no.12. Similarly the total phosphorus was found to be very low (17.4 kg ha^{-1}) to very high (292.2 kg ha^{-1}) in ward no. 3.

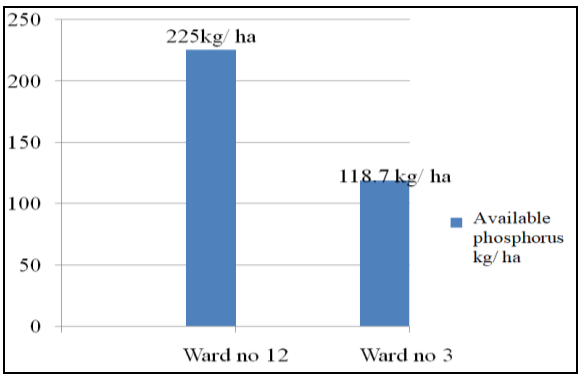

Fig 6: Average available phosphorus kg ha^{-1} in ward number 12 and 3 of study area

Overall Soil Fertility Status of wards surveyed Soil pH
The average soil pH in two wards found to be 5.7-8.2 which is medium acidic-very slightly alkaline.

Total Nitrogen
The average OM% in two wards found to be 0.01-0.91% which is very low to very high. Thus, need to apply high amount of organic manures depending upon crops.

Total Organic Matter
The average OM% in two wards found to be 0.14-18.13% which is very low to very high.
High risk of decrease in OM% can be observed because of high use of chemical fertilizers.

Available Potassium
The average available potassium content in two wards found to be 75.504-1196.448 kg ha^{-1} which is low to very high.

Available Phosphorus
The average available phosphorus content in two wards found to be 17.40-629.8 kg ha^{-1} which is medium to very high.

Soil type
Among 30 households, 93% household's soil texture was found to be Sandy Loam whereas 7% household's soil texture was found to be Loam as shown in figure 6.

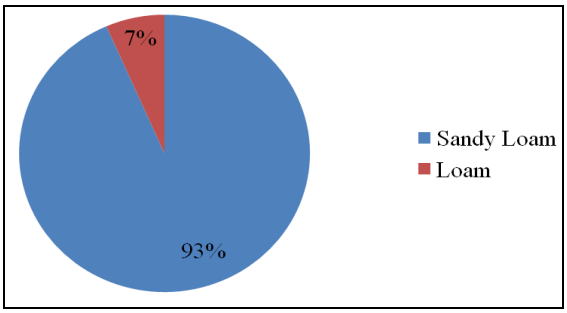

Fig 7: Soil textural classes of 30 households

Crop productivity trend perceived by respondents
About 60% of farmers reported increasing trend of production. 20% farmers reported decreasing trend of production and the remaining 20% reported stagnant production trend as shown in figure 7. Majority of farmers claimed the increase in production was due to the application of chemical fertilizers whereas the decreasing trend of productivity was due to imbalanced and insufficient application of chemical fertilizers. The total surveyed area where vegetables were grown commercially was 8 hectares. The total productivity of vegetables grown previous year was 100 tons ha^{-1}. Hence, the total crop productivity determined was 12.5 tons ha^{-1}.

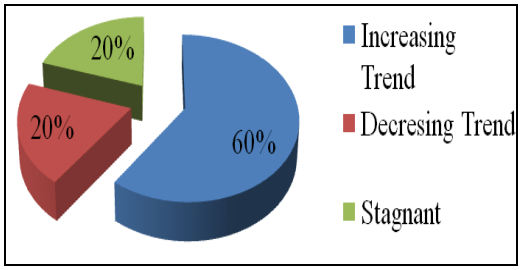

Fig 8: Crop productivity trend

Descriptive analysis of soil parameters

Ward number 12

Soil parameters	Standard deviation	Standard error
Soil pH	0.8018040	0.20702490
Average total N %	0.17439155	0.04502770
Average OM %	3.4877989	0.12594193
Available Phosphorus Kg/ha	160.12408964	41.34386221
Available Potassium Kg/ ha	206.37941613	53.28693452

Ward number 3

Soil parameters	Standard deviation	Standard error
Soil pH	0.50990195	0.02556672
Average total N %	0.24783191	0.06398992
Average OM%	4.96521319	1.28201253
Available Phosphorus Kg/ha	74.432338870	19.21834727
Available Potassium Kg/ha	277. 97508424	71.77285812

Conclusion
Soil nutrients content of Dhading was found to be medium to high level. Very few soils have found to be very low to low nutrients content. The farmers have adopted crop rotation, different cropping systems, and use of organic matter which helps to enhance soil productivity. The better soil productivity was observed by the application of chemical fertilizers. On the other hand, excessive and imbalanced use of chemical fertilizers might be deteriorating soil quality. Majority farmers of study areas have not analyzed their soil in time interval due to lack of knowledge. Moreover, the farmers have been adopting traditional methods of vegetable production and low inputs application was observed that hindered the soil productivity. Ward number 12 has neutral soil and medium to high soil nutrients. Therefore, suggested the continuous application of organic matter in soil to maintain soil fertility. Ward number 3 has slightly alkaline soil reaction with high amount of soil nutrients content. In both the wards, application of balance chemical fertilizers and organic manures is recommended. Use of suitable improved varieties, adoption of scientific technologies of cultivation practices, crop rotation and inclusion of leguminous crops in the cropping systems is highly suggested.

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