JCBPS; Section D; November 2018 – January 2019, Vol. 9, No. 1; 074-080. E- ISSN: 2249 –1929
[DOI: 10.24214/jcbps.D.9.1.07480.]

Journal of Chemical, Biological and Physical Sciences

An International Peer Review E-3 Journal of Sciences

*Available online at*www.jcbsc.org

Section D: Environmental Sciences

CODEN (USA): JCBPAT Research Article

A Review on Role of Cattle Dung and Urine for Sustainable Soil Management

P.K.C.[1] and S. Pandey[2]

[1] Tribhuwan University, Kathmandu,Nepal

[2] Soil and Fertilizer Testing Laboratory, Pokhara, Nepal

Received: 26 November 2018**; Revised:** 18 December 2018; **Accepted:** 26 December 2018

Abstract: Nepal's traditional agriculture used to depends a lot on livestock for nutrients supply in the agricultural field. But with the introduction of chemical fertilizer the soil of the country is degrading. However this soil can be improved with the use of enough cattle manure and urine. These days the focus should be on sustainable agriculture and balanced fertilizer which is the judicious use of chemical fertilizer and organic manure. But due to less availability of chemical fertilizer and considering its harmful effect on the soil, it is emphasized for balanced fertilization by minimum use of chemicals and maximum use of organic fertilizers such as farm yard manure and animal urine.

Key words - balanced fertilization, chemical fertilizer, manure, organic, urine

INTRODUCTION

Farming of Nepal is characterized by a close relationship between crop production, livestock and forestry, with trees and crops providing fodder and bedding materials for livestock, which in turn provide draft power and manure. Nowadays the linkage between forests, livestock, and cropping systems is becoming weak. Soil fertility is largely maintained by the application of compost and manure, but in recent years a

decline in soil fertility has been reported[1]. The decline in soil fertility is due to the indiscriminate and excessive use of chemicals such as urea and DAP[2].

The chemical fertilizers have caused physical, chemical and biological degradation of the soil. Reduction in soil organic matter, decline in biomass carbon and decrease in biological diversity of soil fauna are some indicators of biological degradation. Chemical degradation is also caused by the buildup of some toxic chemicals and an elemental imbalance that is injurious to plant growth[2].

This review is done to study the fertility status of Nepal and find out the ways to ameliorate the soils with the use of animal wastages such as animal dung and urine. It also suggests the ways to use these wastages and to minimize the loss of these nutrients from the agricultural soil.

METHODOLOGY

This article is the result of the literature review of several works such as research and case study done by scientists, researchers and the institutions. Several related papers were consulted from different sources (published papers in journals, proceedings, books, internet etc). The views and outputs of the studies are tried to be reinterpreted and conclusions have been drawn from different workers (researchers, scientists).

RESULTS AND DISCUSSION

Fertility Status of Nepalese Soil

Soil pH: The pH of a soil is an important chemical characteristic as it indicates the availability of many plant nutrients and toxic elements. More than 64% of the soil in Nepal are acidic in nature and about 13% are alkaline **(Table: 1).** But the soil acidity is increasing over the past 10 years [14].

Table1: Soil Reaction of western development region on fiscal year 2017-2018

Soil Reaction	**Acidic (pH<6.5)**	**Neutral (pH=6.5-7.5)**	**Alkaline (pH>7.5)**	**Total No of Samples**
	269 (64%)	99(23%)	53(13%)	421

(RSTL, Pokhara, 2018)[14]

One of the factors that contribute to soil acidity is the increasing use of chemical nitrogenous fertilizer. In the past, farmers used to apply high doses of organic manure to buffer the soil. But fodder and labour shortages have led to less use of organic manure in recent years.

The problem of soil acidification has also been reported from terai districts. For example, the agricultural research station at Bhairahawa in the Western terai has reported heavily acidic soils at a number of experimental plots, after only 10 years of continuous fertilizer use[3]. As a result, crop yields have decreased significantly on such soils.

Status of NPK, Micronutrients and Organic Matter in Nepalese Soil*:* Laboratory analyses of nitrogen levels in farmers' field mostly show deficiencies. Likewise, phosphorus is found to be low. In the past most of the soils were high in potassium content. But these days the potassium content of soil samples

was found to be low to medium **(Table: 2).** With the increasing shortage of compost, the introduction of plantation and orchard systems and the lack of use of compost materials, micronutrients deficiencies are increasingly being recognized. Zinc deficiency is reported in rice, while boron and molybdenum deficiencies are reported in cauliflower.

Despite the very crucial role of soil organic matter in agricultural production system, most of the Nepalese soils are low in organic matter content.

Table 2: Nutrient content in the soil of western development region, fiscal year 2017-2018

Soil parameters	Low	Medium	High	Total No of Samples
O.M.	167	219	35	421
Nitrogen	109	217	95	421
Phosphorus	123	61	237	421
Potassium	159	148	114	421

(RSTL, Pokhara, 2018)[14]

Ways to Improve the Deteriorated Soil: The judicious application of the organic manure and chemical fertilizer should be done to improve the degraded soil. Nepal does not produce any chemical fertilizer and is fully dependent on imports. The share of foreign grants and loans in total imports has declined sharply over time [4]. The use of inorganic fertilizers has drastically declined following the energy crisis, which has immensely affected most of the developing countries [5]. Although the agriculture development plans emphasize on the increased use of chemical fertilizer the consumption is decreasing due to unavailability in the market. Therefore the Nepalese farmers have to depend more on organic manure than on chemical fertilizer for the production of crops.

One of the major factors that limit productivity of many tropical soils is soil acidity. Application of conventional liming materials such as $CaCO_3$ and $MgCO_3$ is used for the amelioration of this problem. These conventional liming materials are scarce, very expensive and beyond the reach of resource poor farmers. However, several studies have shown that addition of some materials of organic origin such as plant materials and poultry manure to acid soils increases the soil pH appreciably [6].

Where pH levels have dropped below 4.5, depending on the soil's exchange capacity, rates of 2 to 4 tons of limestone per ha are prescribed to restore the soil to a more acceptable pH. The availability of local lime sources is very scarce and it is difficult for the remote villagers to use crushed limestone as part of their soil fertility management strategy due to difficulty of transportation. Use of organic matter in the soil buffers the soil acidity [3].

Dung and urine contain several nutrients such as nitrogen, phosphorus and potassium **(Table: 3)** and the solid fraction contains organic matter that is important to maintain soil structure and fertility. They also contain micronutrients such as zinc, copper, boron and iron.

But the Nepalese farming system lacks the proper management of the organic manure. Less use and poor handling of FYM, loss of cattle urine from the field and loss of cattle dung by burning are some of the major problems of the organic manure.

Table 3: Nutrients content and pH status of the different organic manure

Source	N (%)	P (%)	K (%)	pH
Cattle dung	1.56	0.45	1.01	7.4
Buffalo dung	1.52	0.49	1.30	8.2
Cattle urine	0.215	0.01	0.45	8.8
Buffalo urine	0.415	0.01	1.30	8.5

(RSTL, Pokhara, 2012)[15]

Problems of Nutrients Management

Loss on Nutrients through wrong Method of Storage and Handling*:* The time of organic manure application and the method of its preservation in manure pits play an important role in its nutrient availability. The common practice in Nepal is that farmers bring organic types of manure, mainly FYM, during late winter to early spring for showing seeds after the first monsoon shower, which is not desired, from nutrient management perspective. Leaving the manure for long time in small heaps facilitates the loss of nutrients either by volatilization or leaching. Leaving manure exposed in the direct sunlight causes volatilization and oxidation of nutrients and leaching of dissolved ions during summer rains [7]. Carrying manure to the field at the time of planting and mixing it immediately with soil, on the other hand, reduces the loss of nutrients. The loss of nutrients from the manure heap is also a common problem in Nepal. Farmers leave manure in the open heap for a long time, allowing nutrients to be lost either by sun or by rain [8].

Table 4: Rating of different plant available nutrients and O.M. in the soil

Soil parameters	Low	Medium	High
O.M. (%)	<2.5	2.5-5.0	>5.0
Nitrogen (%)	<0.1	0.1-0.2	>0.2
Phosphorus (kg/ha)	<31	31-55	>55
Potassium(kg/ha)	<110	110-280	>280

Decreasing Number of Animals*:* The amount and quality of urine and dung produced depends on the type of animal, its size and the type of feed as well as on the management of the farmers. One large animal of 300 kg live weight has a feed intake that averages 2.5 per cent dry matter of its live weight, within an average digestibility of 55 percent, the animal will produce 1232 kg of dung every year.

Similarly, a small ruminants weighing about 35 kg has a feed requirements of 3.5 percent dry matter daily of its live weight, consume 320 kg dry matter. The average digestibility of the feed is estimated at 60 percent. Hence, one small ruminant produces around 128 kg of dry matter faeces per year. But the numbers of the animals is decreasing in the country and the use of the organic manure is also falling down [9].

Loss of Urine from Agricultural Land: It is interesting to note that total nitrogen content is exceedingly high in fresh cow urine compared to fresh dung, FYM and slurry compost. Similarly, ammonical nitrogen, total phosphorus and organic carbon are also high in fresh urine compared to dung and other type of organic manure. Out of total cattle excreta, 66% of the nitrogen is present in urine and only 34% in dung [10]. But out of 80% of the excreted nitrogen 52% is present in urine and 28% in dung[11]. However, out of 8 parts of the excreted nitrogen 5 parts is present in urine while 3 parts is present in dung[12].

Since the urine is not channelized directly to the bio-digester in many cases, most of the urine gets lost before entering the bio-digester. Moreover, the practice of collecting only clean manure for the digester leaving out the bedding material causes loss of about 50% of the dung itself. This means nitrogen content of the dung entering the bio-digester is only 17%. Again, it is assumed that almost 50% of the remaining nitrogen gets lost in the process of composting, transportation, and incorporation into the field through leaching and volatilization [10].

Burning of Dung*:* Dried manure of animals (dung cake) is being used as a cooking fuel. For the farmers who rear animals the dung cake fuel involves no cash cost. But, the pollution costs from this fuel are very high. This includes the health costs to women and children due to the indoor air pollution by burning the dung. On the other hand, using the dung as cooking fuel leaves the farmers with the choice to use only environmentally harmful chemical fertilizers, thereby pushing up the costs of production. The use of chemical fertilizers has increased agricultural production, but the chemical fertilizers are not perfect substitutes for organic manure. The taste and nutritional value of the foods produced using chemical fertilizers are not as good as that produced by using organic manure [13].

Ways to Manage FYM and Animal Urine

Proper Handling of FYM: If the storing and use of the manure is done in a correct manner the amount of plant nutrients added in the agricultural field from these sources will be increased. The manure should be saved from light and moisture by constructing the shed while storing and it should be incorporated in the soil immediately after taking to the field. If it is impossible to apply in the field immediately it should be put in a heap by covering.

Correct Use of Livestock Manure in the Farming System*:* The number of cattle in the country is decreasing, however if the manure of the livestock is used in a correct way it can fulfill most of the demand of nutrients in the country.

Collection of Cattle Urine for Agricultural Use: Cattle urine is a resource to the farmers which should not be wasted. Therefore, every care should be taken to prevent its loss and to utilize it profitably. It can be conserved by improving the cattle shed and making a pit for urine collection. Instead of water, urine can be mixed with the dung so as to feed into the bio-digester or it can also be put in the composting materials to enrich the product [10].

Search for Alternate Energy Source for Burning*:* To stop the burning of the dung as the dung cake the farmers should have alternate sources of energy for burning. If a biogas plant is constructed they can fulfill the demand of the fuel and the slurry produced as by-product can be used as manure which is also a good source of plant nutrients.

CONCLUSION

The degrading soil can be managed by the proper use of the manure and they must be managed well by applying the above mentioned ways such as proper handling of FYM, correct use of the manure in the farming system, collection and use of animal urine and use of biogas for the alternate source of energy for cooking. As the chemical fertilizer and limestone are less available the maximum use of the animal wastages can help in the balanced nutrition of the plant and ameliorate the acidic soils. As livestock wastage play a major role in supplying nutrients to the soil for Nepalese agriculture, they are important for the sustainable development of the agriculture in the country.

REFERENCES

1. B. Shrestha, S.L. Maskey, R.K. Shrestha, B.P. Tripathi, Y.J. Khadga, R.C. Munankarmy, E.M. Bhattarai and S.P. Shrestha. *Soil Fertility Management: Farmers Practices and Perceptions in the Hills of Nepal*, Lumle Technical Paper No. 2000/4. Lumle (Nepal): NARC. 2000.
2. K.B. Karki. Soil degredation in Nepal and some measures to rehabilitate. In: *Agriculture and Environment*, Government of Nepal, Ministry of Agriculture and Cooperatives, Gender equity and environment division, Agri- environment and biodiversity section, Singh Durbar, Kathmandu, Nepal. 2006.
3. B. Carson. *"The land, the farmer, and the future: a soil fertility management strategy for Nepal"*. International Centre for Integrated Mountain Development Occasional Paper No. 21, Kathmandu, Nepal. 1992.
4. Agricultural Projects Services Centre and John Mellor Associates. *Nepal Agricultural Perspective Plan (final draft)*, prepared for National Planning Commission of Nepal and the Asian Development Bank, Kathmandu, Nepal. 1995.
5. F.W. Hauck. Organic recycling to improve soil productivity. In: *Organic materials and Soil Productivity*. FAO. Soil Bulletin. No. 45. FAO. Rome. pp. 1981, 15-17.
6. N.V. Hue, and I. Amien. Aluminum detoxification with green manures. *Comm. Soil Sci. Plant Anal*.1989, 20: 1499 – 1511.
7. K.L. Schilke-Gartley, and J.T.Sims. Ammonia volatilization from poultry manure-amended soil. *Biol Fertil. Soils*, 1993, 16, 5-10.
8. P. R. Bista, Ghimire, S.C. Sah and K.R. Pandey. *Assessment of Soil Fertility Management Practices and Their Constraints in Different Geographic Locations of Nepal*. 2010.
9. D.P., Parajuli. Organic Livestock farming: An opportunity of livestock Production. In: *Proceedings of a first national workshop on organic farming*, 12-14 June 2006. Kirtipur, Kathmandu, Nepal. 2006.

10. YSD. *Physico chemical analysis of bio slurry and farm yard manure for consumption of nutrients contents and other benefits so as to better promote bio-slurry*. Final report. 19 Sept, 2006. Yashoda Sustainable Development (P) Ltd. (YSD), Bakhundole, Lalitpur, Nepal. 2006.

11. S., Jaisy, T.B.Subedi and B. Regmi. *Sustainable soil management: different aspects III rd edition*, Directorate of Soil Management, Hariharbhawan, Lalitpur, Nepal. 2009.

12. SSMP. *Farm Yard Manure Management Guide*. Sustainable Soil Management Programme (SSMP), SSMP document No 40, Nepal. 2000.

13. K.P. Panta. Dung Fuel and imported Fertilizers: Environmental problems tangled with Gender and Poverty. In: *Agriculture and Environment*, Government of Nepal, Ministry of Agriculture and Cooperatives, Gender equity and environment division, Agri- environment and biodiversity section, Singh Durbar, Kathmandu, Nepal. 2006.

14. RSTL. *Annual report and soil and fertilizer analysis report, F.Y. 2069/070*. Government of Nepal. Ministry of agriculture and cooperatives, agriculture department, Directorate of Soil Management, Regional Soil Testing Laboratory (RSTL), Pokhara, Nepal. 2018.

15. RSTL, *Plant Nutrients Problem Study Report, F.Y. 2068/069*. Government of Nepal. Ministry of agriculture and cooperatives, agriculture department, Directorate of Soil Management, Regional Soil testing Laboratory (RSTL), Pokhara. Nepal. 2012.

*** Corresponding author: S. Pandey,**

[2] Soil and Fertilizer Testing Laboratory, Pokhara, Nepal

Online publication Date: 26.12.2018