

EDITORIAL

Nepalese Agriculture in the pretext of climate change and sustainability

B. P. Chaulagain and B. P. Rajbhandari

Nepalese Journal of Agricultural Sciences (NepJAS), Kathmandu, Nepal
<http://njas.hicast.edu.np/>

Nepalese traditional agriculture is characterized by subsistence oriented mixed farming with crop and livestock as major components. Due to lack of improved technologies, required inputs, poor communication and extension services in the pretext of climate variability and global warming both of these major components have been facing challenges in increasing productivity and sustainable yield. This issue of the Nepalese Journal of Agricultural Sciences (NepJAS) has a good collection of 24 original articles, 3 research notes, 4 case studies and 1 review article to address various questions, limitations and challenges. We have made a brief review of these articles and summarized hereunder.

Livestock and poultry production and health management

Nepalese traditional livestock and animal husbandry is facing problem with low productivity. In this issue, Tiwari et al. have worked on the performance of milk production by dairy cattle through bypassing the protein supplementation. They have taken into account a total of eight lactating cattle for calving date and milk production during the experiment. Comparing the supplementation with modern feed formulations as case to the traditional basal diets straw/stovers and grasses grazing, the case group significantly ($p < 0.001$) improved the milk production. Thus farmer's investment in livestock is hampered by limiting factors like essential amino acids and protein supplies with their lesser knowledge on livestock nutritional management.

Adhikari and Storebakken have studied the effect of different levels of starch gelatinization in feed for omnivorous fish *Nile tilapia*. In their study, wheat, as the source of starch, was extruded with different moisture addition (20%, 25%, 30% and 35%), to obtain different degrees of starch gelatinization. It is interesting to note from their work that at little addition of moisture around 20 percent in maximum and less than it is the best in extruding wheat for complete gelatinization. The work has significance as advancement in engineering in the field of feed manufacturing technology, which can be beneficial to feed producer and farmers.

There are many enhancer molecules that can bring changes in metabolism of living system. Brining positive changes in quality of livestock produce like meat and milk has significance in economy and consumer health through low cost and high quality. Tiwari et al. studied the lemon grass oil (LGO) feeding in relation to growth and carcass characteristics of broiler chicken. Their findings suggested that inclusion of LGO improved the weight gain, reduce mortality and reduced the period of broiler harvesting. However, further studies needed to be carried out for precision level of oil inclusion and impact on cost benefit ratio.

Livestock is an important component of subsistence farming in the crop livestock mixed agricultural system in Nepal. It occupies third place after rice cultivation and [poultry. But the source of livestock diet is usually of traditional types and mostly composed from green grasses, crop residues, crop byproducts and tree foliage with little or no concentrate feed and without or least supply of dietary requirements. Thus the livestock feeding only with cellulose and starch rich feed and expecting returns as protein and lipid rich meat and milk is not justifiable as well as scientific. Upreti and Devkota have analyzed the nutrient composition and nitrate content of top ranked fodder tree species in the hills and mountain of Nepal in this regard. If farmers are heavily reliant on foliage and fodder feed, those plant based sources must be high in functional nutrients required by livestock. They found in the study that variation among the top ranked fodder tree in nutrient content which also indicated to explore the best fodder species. They reported here crude protein content of Badahar tree was higher but lower in energy and calcium content indicating that considering only one parameter for feeding animal might cause misleading in nutrient

balance. Feeding mixed fodder is safe guard in energy and other nutrients requirements as nutrient content of the selected fodder did not differ significantly with respect to the age and species considered, and findings of this study clearly revealed that commonly grown and popular fodder tree are safe against nitrate toxicity reflecting the need to continue such fodder species in feeding management.

Oat (*Avena sativa* L.) is a valuable fodder crop available in winter and has excellent growth habit, quick recovery after cutting and good quality herbage. It is a palatable, succulent and nutritious crop. Oat can be grown all part of Nepal from Terai to high hill contributing for forage/fodder to reduce the feed deficient for ruminant animal. Khanal et al. have evaluated different varieties of oat at high hill of Rasuwa district of Nepal. Among ten oat varieties cultivated at highland of Rasuwa district, significantly the highest plant height, leaf area, green mass (GM) and dry mass (DM) was obtained from 83INC19G3 followed by Awapuni. The study showed that 83INC19G3 and Awapuni are suitable varieties for higher GM and DM production at highland of Nepal. The study also revealed that plant height and leaf area affected on amount of green matter and dry matter production.

Similarly, Pandey et al. have worked on forage conservation and its feeding effect on growth performance of sheep in the mountain region of Nepal. It can be concluded from their work that quality hay from Cocksfoot and Rye grass and good silage from maize can be made a good feed stuff in mountain regions like Jumla condition and the quality hay and silage could be recommended for sheep feeding in winter feed scarce period. Sapkota et al. (a) studied the genetic parameters and effect of non-genetic factors on weight and reproductive traits of goat from Central Terai region of Nepal. The study showed the importance of non-genetic factors on growth traits and for newly established commercial farm, it can be suggested that selection based on the weaning weight could be beneficial for genetic improvement in its initial phase.

Goat meat is much popular among Nepali people but Nepal is not self-reliant on goat meat production. Nepal is also doing poor performance on improvement of local breed and their management. In this issue, Sapkota et al. (b) studied on comparative performance of Boer cross breed goat over other local and cross breeds in mid-hills of Nepal. This study is focused to find out the comparative performance of Boer cross goat with other Nepali indigenous breed and improve cross breeds of goat. The potentiality of Boer goat and its crossbred to meet the national demand of goat meat through upgrading of indigenous goat breeds will improve the situation. The result highlights the importance of cross breeding since the growth performance and growth rate of Boer crossbreed was highly significant than local and other crossbreeds of goat found in Nepal.

Acharya et al. did assessment of farmer's perspective on backyard poultry production and impacts of vaccination against Ranikhet disease in a district of Eastern Nepal. This study showed that vaccination against Ranikhet disease in backyard chicken together with extension campaign targeting women farmer's group might be an effective tool for poverty alleviation of rural women involved in backyard poultry farming. Their result suggests for extension of similar approaches in other farmers group and other districts of Nepal might be helpful to reduce poverty in Nepal.

Crop production, management and marketing

Rice

Ghimire et al. did screening of rice genotypes against leaf and neck blast disease. They have screened one hundred two rice genotypes against leaf and neck blast under natural condition. The quantitative resistance in rice against blast was assessed based on area under disease progress curve. Out of 102 rice genotypes, 72 were found resistant to leaf blast, and 29 as moderately resistant to neck blast, while 27 rice genotypes were moderately resistant to both leaf and neck blast. In their report, none of the genotype was found immune to both the blast. Thus, the study revealed rice genotype 11100-B-B-3-3-2 as potential genetic resource of resistance to both types of blast in field condition. Furthermore, it revealed that genotypes e.g. Taichung-176, NR 11165-B-B-22 and NR 11165-B-B-24 were observed highly susceptible, which may be used as susceptible check for leaf and neck blast research in Nepal. Shrestha et al. studied the impact of climate change in rice yield trends in Western Nepal. They have summarized the meteorological data from 1995 to 2016 recorded at weather station in that region and have analyzed its influence in rice yields. The work revealed that the average rainfall during the monsoon months over 16 years was not consistent. Among the monsoon months, June rainfall significantly related to rice yield. Years with higher rainfall in June had higher rice yield. Average maximum temperature increase in September was found significant whereas

sudden increase in maximum temperature caused significant decline in rice yield. They also carried out field study simulation experiment on impact of temperature and drought in rice with open top chamber (OTC). The study was carried out with three types of OTC and four rice cultivars during the rainy season in 2016. The important point to note in the context of global warming and climate change from this experiment is that the drought tolerant varieties were able to cope with the increase in average daily temperature within 1 to 3°C but could not cope with the temperature rise above 4°C. The result was in line with the modeling studies conducted using Decision Support System for Agro-technology Transfer model. It gives a signal for search for drought and heat tolerant varieties in future to adapt with climate change.

Maize

Maize is not an indigenous crop to Nepal but with its popularity it has occupied the second most important staple food in terms of area and production in the high hills to lower basin and Terai region with rain fed system and irrigated lands as well. The varied topography and climatic differences of Nepal has forced to adapt different strategies for farmers of different agro-ecozones to cultivate this crop. Kandel et al. has done variability studies in yield attributing traits of early maize genotypes in western hill of Nepal. They have studied to determine various parameters of genetic variability, broad sense heritability and genetic advance estimations in early maize genotypes. The study observed high to moderate phenotypic coefficient of variation and genotypic coefficient of variation for grain yield, ear height, plant height, 1000-kernel weight, and number of kernels per row, ear length, ear weight, ear aspect and ear per plant suggested prevalence of sufficient variability that offered scope for selection. The significance of the study is that traits were less influenced by environmental factors. These traits can therefore be used for crop improvement program by concerned agencies in future to cope with changing climate due to global warming and varied eco-climatic conditions of Nepal which is ranked on 24th position in Global Climate Risk Index. Similarly, Sharma et al. studied the agro-morphological performance of maize inbreds. The agromorphological performances were estimated for plant height, ear height, tasseling days, silking days, ear length, ear diameter, number of kernel rows per ear, number of kernels per row, test weight and grain yield. The study found highly significant variations among the tested genotypes for grain yield and other agro-morphological traits which indicated presence of high magnitude of genetic variations. They had manifested superiority in all agro-morphological, yield and yield attributing traits. Inbreds were can regarded as ideal candidates for hybrid, synthetics and composite varieties development.

Minor crops

There are many crops which have higher nutrients content, adaptability to local conditions and helpful to maintain local agrobiodiversity and ecosystems but still are neglected by local people and mainstream producers and sellers. Sweet potato is among them and it is the World's most important but underexploited food crops. It is regarded as marginalized farmer's crop because of its low input requirements, ease of production and ability to produce under adverse soil and weather conditions. Bhattarai et al. worked on collection and morphological characterization of sweet potato genotypes of Nepal. They collected thirty eight local sweet potato germplasm and characterized their traits using morphological descriptors. They noted a large variation in foliage and tuber characteristics. The majority of genotypes exhibited longer vine as they showed spreading nature of growth habit. Variation in tuber shape ranged from round to long or medium long and long irregular. The skin color of tuber varied from white to red, light yellow and purple. Variation was found in flesh color from white to creamy white and milky white. The results obtained will serve as a guide for the basis germplasm management and improvement in Nepal.

Fruit production and processing

Nepal has problem not only in mass scale productions of fruits but it also lacks professionalism in handling to maintain the freshness and quality of perishable items during transport, processing and storage. Apple is grown in remote mountains of Nepal with lesser or no access to electricity, market infrastructures and automobile transportation. Similarly, Subedi et al. did evaluation of packaging materials for transportation of apple to address the issue. They attempted to identify appropriate packaging materials for transportation of apples.

Pineapple is a fruit crop that can be grown in land 0-1600 meter above sea level and the altitude has great role in its flavour. Adhikari and Amgai studied the prospects of pineapple based micro-enterprise in Sindhuli district of Nepal.

This report highlights the status of pineapple cultivation, postharvest management and pineapple based microenterprise developments in Sindhuli district and similar topographies. The study found that in Sindhuli district pineapple was grown in 148 ha with the productive area 100.64 ha. The total production of pineapple was 1557.78 mt. Out of total production 25-30 % pineapple was used as home consumption and rest was found to be sold in the market. Nearly 10-20 % of pineapple that was reached to market was used for processing and rest was consumed as fresh fruit. According to the paper, cultivation, processing and marketing practices for pineapple based micro-enterprises were found rapidly developed in the Sindhuli district. Similarly Amgai et al. reported a case study of Mustang district of Nepal about the importance of local innovation documentation. Underground apple storage, apple core remover, glass solar drier and plastic solar drier were major innovation related to apple industry were found in that district.

Veterinary and Public health

Nepali farmers living in close connections with livestock bear threat of zoonotic diseases. Poor awareness among farmers, lack of veterinary health education and service to local level has posed threat to farmers as well as health problems for livestock. Sah et al. studied risk factors associated with *Toxoplasma gondii* seropositivity in goats of eastern Nepal. They randomly collected a total of 159 caprine sera samples from some parts of eastern and samples were tested for the detection of *T. gondii* antibodies. All the sampled goats were taken from herd history of abortion. The study showed that seroprevalence in goats was found 29.56%. Female, older goats (above 18 months old) and pregnant goats showed high seropositivity. From their result, it is suggested that this assay is highly useful as a serodiagnostic tool for *T. gondii* infection. As this parasite has zoonotic importance, research works on isolation, identification of toxoplasma species is a must as well as the knowledge should be disseminated to the people and animal raisers so that precautions can be taken in time. In a case study R. Shrestha from HICAST Veterinary Teaching Hospital reported the wound healing activity of honey dressing. The honey dressing took up to 88 days to complete healing of the fractured open wound of a dog. The result on efficacy of honey is very impressive, and it could be used as an alternative medicine in future for wound healing, particularly in the shortage of veterinary medicine.

Threats to public health do not come only from heavy pesticides uses, deteriorating urban environment and degrading village ecosystem but also poses great threats from negligence in food processing protocols. Industrialized world is heavily dependent upon processed food while least developed countries do not follow the strict rules and regulations in clean and sterile products, work place safety and health hazards management. The food borne diseases and the consequent illnesses are some of the major challenges that lead to high mortality and economic loss in both kinds of society. In the industrialized world, food borne disease is one of the major cause of illnesses that heavily affect healthcare systems. Food borne diseases are occurred from ingestion of infectious microbes, toxins and other metabolites produced by microorganisms present in food (Clarence et al., 2009).

In this issue, P. Thapa has assessed microbial hazard based on HACCP module on chicken sausage production plant in Kathmandu Valley. Materials like raw meat, batter, ingredients, casing, water and finished product were analysed for total viable count, *Staphylococcus aureus* count, coliform count and *Clostridium* count. Highest microbial load in increasing order from raw meat, batter to after stuffing samples were observed which can be attributed to contamination during slaughtering, rough handling of meat and cross contamination from water and equipments. Thapa reported the problem of poor hygienic, sanitation and operating condition in the food industry related with the insufficient knowledge among owners, employee, and lack of safety training, proper facility, and irregular microbiological analysis of samples and lacking of treated water in industries. Similarly, Paudel and Thapa reported the prevalence of brucellosis in goats in Dolakha district of Nepal. They reported and suggested that as caprine Brucellosis agent was most invasive and pathogenic and of zoonotic significance, attention need to be paid regarding the effect on goats and impact on human health.

Soil fertility and health

Nepali soil has different physical, chemical and biological characteristics because of varied topography and micro climatic conditions. Crop choices of farmer and changing farming practices have added another dimension in soil parameters changes. In this regard, soil fertility status of vegetable growing areas in an area of Surkhet, western Nepal was carried out by Kharel and Ojha. This study is focused in assessing nutrient status of vegetable growing area. The fertility status of the study area was medium to low, due to the imbalanced use of chemical fertilizers,

mono-cropping, and use of lower amount of organic fertilizers. People of this area are suggested to apply fertilizer only to maintain soil fertility. In one area the pH is found acidic. The paper highlights that environmentally and socially acceptable integrated plant nutrient management (IPNM) practices like agro-forestry systems, crop rotation, use of organic inputs (compost and farm yard manure), and chemical fertilizers, vegetable should be grown with legumes intercropping and improved crop varieties that can be adapted to local farming situation in the study area is important and recommendable. Rauniyar et al. has studied the growth, yield and soil nutrient status of broad leaf mustard (*Brassica juncea* var. *rugosa*) under integrated nutrient management. The experiment was conducted to evaluate the effect of integrated plant nutrient management (IPNM) on the growth, yield and soil nutrient status of broad leaf mustard (*Brassica juncea* var. *rugosa*) in the farmer's field located in South of Kathmandu district.

Marketing

Sharma and Shakya in a short note reported the production practices, marketing and problems in broad leaf mustard cultivation in Bhaktapur district of Nepal. The report summarized that the major problems faced by the respondents were lack of irrigation, technical support, unavailability of inputs, efficient market, collection center; disease and pest problem and involvement of middle men.

Pest management

Insect pest and diseases have been posing substantial threat to increased crop yield. Joshi et al. have assessed occurrence and management of *Tuta absoluta* in Kathmandu valley and Kavre, and have reported integrated safe chemical plus bio-pesticides along with use of netting and different traps as the most effective management practice to reduce damages of the pest substantially. Similarly, Bhusal et al. have worked on pest and disease surveillance of vegetable crops and farmer's pest management practices in Banke and Surkhet districts of Nepal. They found that majority of the farmers (75%) were using chemical plus traditional agricultural practice, 18 percent were using biological plus chemical pesticides and few (5%) were using chemical pesticides alone for insect pests and diseases management in both districts. In another work, Oli et al. reported the efficacy of integrated pest management (IPM) practice over farmer's practice in cauliflower in Kathmandu Valley. The study reports maximum number and type of beneficial insects including Ladybird beetles, predatory wasp, spiders, and dragonfly were observed in IPM practice as compared to farmer's practice. Maximum number of Aphids (14 insects per plant) and diamond black moth (DBM) (5 insects per plant) were observed in IPM practice whereas in farmer's practice, maximum number of aphids were reached to 45 insects per plant and that of DBM reached to 6.5 insects per plant.

Sustainability

While talking about sustainability, the growers / entrepreneurs should be made aware of the importance of paying due consideration to social acceptability, ecological sustainability, economic feasibility as well as technological appropriateness and its wider adaptability. Very few studies have been conducted with such holistic system approach in Nepal. In this issue Basnet et al. have presented negative impacts and coping strategies of chemical inputs at Karpok and Godak VDCs of Ilam district. Farmers have been experiencing negative impacts on their health, soil health and environment health. Despite the low level of production, farmers were getting higher price for the organic products at market. The demand for organic products is also increasing day by day at Ilam municipality due to health consciousness among the consumers. The farmers were motivated towards organic farming but the number of such farmers was very few. In order to transform Ilam into an organic district there is a need of immediate action plan on organic farming both from the government as well as non government organisations with a holistic and sustainability-based approach. Sharma et al. have presented review on the issue of conservation biocontrol in agricultural system with their limitations and prospects.