

# **Integrated Plant Nutrient Management System (IPNS) In the Context of Nepalese Farming System: A Discussion Paper<sup>1</sup>**

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Nepal is an agrarian country with subsistent production in nature in which 66% of the total populations rely on agricultural activities. In the recent years, the country has recorded very poor progress in the agriculture sector since the average annual growth rate during the tenth plan period remained at 2.67% only (NPC, 2007). Therefore, food and nutrition security is still an important issue to be addressed. In addition, the age old subsistent agriculture has to be transformed into commercial for the improvement of livelihood of the people.

Problems pertinent to agriculture production in the country as indicated in the three year interim plan of the government (NPC, 2007) are: prevalence of small land holding size, fragmented land, and an unplanned land management systems; inadequate supply of basic agriculture production inputs such as improved seeds, chemical fertilizers, improved breeds and animal feeds; inadequate irrigation and poor coordination between agriculture and irrigation, and decline in pasture lands due to the expansion of community forests. These factors are the root causes for low production and productivity in general. In this regard, soil fertility improvement is one of the key issues.

The Nepalese farming system is strongly interlinked among livestock, forestry and agriculture. The traditional agriculture is based on organic source of input and largely depends upon the forest resources and livestock raising practices. The organic inputs are gradually being supplemented by inorganic sources. However, resources are constrained and the majority of farmers also can not afford to buy the expensive fertilizers. Therefore, management of external sources of plant nutrients is crucial to sustain the productivity and to keep the environment healthy. Efforts have been made to develop research and development programmes both by public and private institutions that would address the problems related to soil fertility, however, achievement is not upto the expected level. In this paper attempts have been made to review the pertinent constrains and policy issues concerning Integrated Plant Nutrient Management System (IPNS) in the context of the Nepalese agriculture system. In addition, some recommendations have been drawn to improve the efficiency of IPN system.

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## **POLICY GAPS AND ISSUES**

It has been realized that technology option alone does not help much to adopt agriculture or soil related technologies to benefit the majority of farmers. Therefore, this paper tries to review some of the relevant governmental policy issues and gaps concerning the IPNS in Nepal. The important documents available for developing agricultural programmes in the country are: Agricultural Perspective Plan (APP, 1995 to 2015), National Agriculture Policy (2005), and Three Years Interim Plan (2007-2009).

### **Fertilizer and IPNS policy:**

There are broad policy statements for soil fertility improvement in APP and the Interim Three Year Plan (NPC, 2007) but no detail operational guidelines and strategic action plans have been drafted and implemented by both research and development agencies to carry out guided policy into the action. Fertilizer policy has been developed but Fertilizer Act has not been promulgated to regulate quality control of chemical fertilizers. Fertilizer subsidies have been withdrawn in 1997 (NARMA, 2006). As a result, price of chemical fertilizer has increased and it has become beyond the reach for many of the resource poor farmers living in remote hills and mountains to supplement their organic source of crop production. Currently, incentives (e.g. information, farmer-training, subsidy on fertilizers and organic source of plant nutrients, technological support etc.) for IPNS, soil conservation and sustainable agriculture are lacking. Therefore, IPNS and green technologies such as green manures, cover crops, hedge-row plantation and legume crops are not widely adopted at farm level. Many of the present economic and agriculture policies formulated and implemented for agricultural development (e.g. credit, price, research, extension etc.) favor on soil depleting cropping practices such as monoculture of major cereal crops at the expense of diversified farming systems and soil conserving crops and practices. Similarly, credit, institutional support and other incentives are directed towards high external chemical-based external inputs in agricultural production.

Current research and extension services are not addressing specific information on fertilizer recommendations and related technical services due to lack of adequately required qualified human resources. In addition, there are limited Research and Development (R&D) programmes for developing and promoting location-specific technologies based on existing soil fertility domains. The present fertilizer recommendations are also not in tune with the diverse soil fertility regimes, cropping systems and ecological domains in the country.

### **Land use and tenancy policy:**

Land use policy virtually does not exist in the country. As a result, productive agriculture land has been converted into settlement and instead, the marginal and fragile land is used for cultivation. However, the government does have law on land ceiling or land holding which is based on physiographic regions. In the hills and mountain, people can hold only 3.56 Ha (70 *ropany*) whereas in the terai 6.76 Ha (10 *bigha*) can be held which is not scientific at all. Major factors for low productivity of land have been found due to fragmented land holdings and dual ownership (NPC, 2007). Fragmentation of land requires higher management cost. Right to claim parental properties by sons or daughters

forces fragmentation of land which is a continuing process in the society. In the country, various kinds of land tenure systems are being practiced that have strong impact on land management and vis-à-vis productivity. The fixed term contract discourages the dwellers or tenants for the long term investment to improve the land productivity. Similarly the grains products sharing system also does not favor the tenants. Another system is ownership sharing (*Mohiyani*) of an agriculture land which only favor the owner. The landless farmers do not have credit facility to buy agricultural inputs like fertilizers. Therefore, challenges are: ensuring land right to the landless people and equitable distribution of agriculture land (NPC, 2007). Therefore, there is an opportunity for strong political commitments and implement scientific land reform policy that can empower the tenants.

### **Policy on Forest Resources:**

Contributions from forest in protection of environment, soil conservation and agriculture production have been applauded. Conflict, political instability, and amendment or implementations of new government policy in the past have adversely affected forest resources in the country and its access to common users. It has been experienced that there is lack of revision of operational plan of the community forest, lack of coordination in management of community and leased hold forest and unclear policy as well as lack of policy between the near and distant forest user groups (NPC, 2007). These issues are directly going to affect the soil fertility management systems for agriculture production and action in favor of farmers would help greatly to enhance agriculture production.

## **INSTITUTIONAL SET UP**

Institutional set up plays an important role in the agricultural production and plant nutrient management systems. Both public and private institutions have been directly or indirectly involved with various types of roles and responsibilities for the promotion of IPNS in the country.

### **Department of Agriculture (DoA):**

The DoA has a very strong networking in the country. It administers Five Regional Directorates and 75 Districts Agricultural Development Offices to look after the agricultural development activities. In addition, the Directorate of Soil Management provides exclusive soil testing services through five regional soil testing laboratories and carries out soil improvement activities in the target areas. Five Regional Training centres under the Department of Agriculture also organize regular training modules for farmers and medium level agriculture professionals for improving their capability, skill and knowledge. Agriculture Information and Communication Centre under the Ministry of Agriculture and Cooperatives is responsible to organize various activities through radio, TV and publishes printed materials to bring awareness among farmers and clients' information about agriculture technologies and related matters.

### **Department of Livestock Services (DLS):**

Livestock is the prime source of organic fertilizers. Research has indicated that the feeding regime determines the quality of organic manure. However, no efforts have been

taken in this aspect. The major role of the Department is distribution of improved breeds for milk and meat production and also provides veterinary services. Poultry manure is a new source of plant nutrients which is at increasing demand mainly by the farmers growing potatoes. Currently, DLS has given increased emphasis in the promotion of nutritious fodder trees and crops for improved livestock raising which will ultimately enhance production of quality manures for crop fields.

#### **Bi-lateral Project:**

Swiss Development Corporation (SDC) has been funding Sustainable Soil Management Project (SSMP) in the selected hill districts since 1999 and it is currently working with collaborating institutions, Community Based Organizations, District Agriculture Development Offices and farmers. The SSMP project has initiated a number of innovative activities and approaches to enhance soil productivity and farmers income. There are also other donor supported projects in the country which are being run at various capacities and with objectives where an indirect role to address the soil fertility management issues can be found.

#### **Research Institutions:**

NARC is the only national public institution that has been mandated to carry out quality agriculture research in the country to solve the problems on agriculture and livestock. Its research stations are spread all over the country covering wide range and diverse agro-climatic conditions. Research on soil fertility improvement is one of its priority areas. NARC does have strong functional relationship with its stakeholders; public, private and farmers. Universities or academic institutions such as Institute of Agriculture and Animal Science, Himalayan College of Agricultural Science and Technology (HICAST) and national level NGOs are also carrying out limited activities on soil fertility improvement. However, their current course curricula are not in line with IPNS which is a major set back in the development of human resources required for sustainable management of soil fertility programme in the country.

### **IPNS TECHNOLOGY DEVELOPMENT**

Research works that are being carried out on IPNS technologies in the country have been reviewed by a number of workers (Tripathi and Shrestha, 2000; Bhattarai and Maskey, 1987; Sherchan, 1989; Weber et al., 1999 and Sherchan and Karki, 2005). Considering the resources constraints, progress made should be appreciated. However, the adoption of IPNS technologies is not up to the level of expectation. The most potential technologies identified are; to improve the compost preparation and application techniques, combined use of organic and inorganic sources of plant nutrients on the basis of cropping system, balance application of major plant nutrients based on soil test values, inclusion of leguminous crops in the cropping system, emphasis is on the use of bacterial fertilizers mainly N fixing microbes, and green manure wherever the system is feasible. In addition, crop residues management, cover crops, minimum tillage technologies, hedge row planting along the edge of terraces have also been developed and recommended.

A number of factors that eventually affect the soil fertility management to increase the productivity are outlined below:

**Labor availability:**

Unavailability of agriculture labor is the most crucial problem because they are paid very low wages. Preparation and transportation of huge bulk of compost or farm yard manure requires huge number of labor. Similarly, livestock raising is also low paid labour intensive activities. Labor migration from the villages to the urban areas and abroad for better opportunities has been affecting soil fertility management and agriculture production.

**Declining forest resources:**

Materials for preparing compost is decreasing due to decline of forest resources and also increasing trend towards management of community forest. Binding rules and inequitable management of community forestry have reduced incentives for livestock raising. As a result, there is a reduction in the recycling and transfer of plant nutrients to crop fields through livestock. Management of community forest varies from group to group. Distance between the homestead and forest is also increasing that again requires longer time for collection and recycling of forest resources to crop fields.

**Rural energy:**

Over all, the rural areas are facing energy crisis. Animal dungs are being used for fuel in the rural areas particularly in the terai. Similarly, crops residues are burnt for the control of pests. However, these practices have reduced supply of plant nutrients. In the recent years, biogas plants are coming up as an alternative source of energy specifically in the warmer areas but there is an adverse effect on the production of compost and farm yard manure since animal dung are used for bio gas plans. The bio gas slurry is considered to be better quality in terms of nutrient content. But there are two factors to be considered; firstly, total quantity of manures production has been reduced significantly and secondly handling and application slurry is not an easy operation. Farmers' perception is to apply huge amount of farm yard manures and compost and they are not convinced that the total amount can be reduced if the quality of compost is high.

**Livestock raising:**

There has been a trend to keep smaller number of high quality animals than poor quality of breeds in higher number. An increasing trend for winter crops and increasing number of community forest has reduced the grazing and open pasture land. Livestock production is constrained by the availability of fodder and feed especially during the winter and dry seasons. Similarly, livestock raising is constrained by the low labour wage and availability of family labour.

**Farmers' knowledge and new practices:**

In the past, inadequate attention was given to increase the local knowledge and wisdom of the farmers and a new technology that has not yet been fully accepted was tried to impose on them. Farmers do modify the recommended practices to suit their condition and local context. Therefore, a complete package of recommendation often does not imply. An innovative technology that combines both farmers' knowledge of soil fertility

management and new practices and technology would benefit for sustaining agricultural production.

### **PARTICIPATORY TECHNOLOGY DEVELOPMENT AND DISSEMINATION:**

NARC tests and validates technologies generated from the research station at the Outreach Research sites following participatory on farm trials. Each Outreach Research site represents distinct biophysical and socioeconomic characteristics that allow participatory technology development (PTD) and scaling up or replicating technologies to similar domains and covering of wider areas in relatively shorter time.

Participatory research methodologies vary with the type of technology. Participatory on-farm research can be conducted in the form of Mother or Baby trials. Participatory Variety Selection (PVS), Minikits (a small packet of improved seeds), IRD (Informal Research and Development), and FAT (Farmers' Acceptance Test) are other forms of PTD and extension tools for wider dissemination of technologies. Diamond field technique is a convincing method for farmers in which farmer's variety and improved varieties are compared with farmers' practice of soil management and with improved practices. The improved practices would be quality compost, balanced chemical fertilizers or an IPNS package.

District-based extension agencies, NGO and INGO are following Farmers Field School (FFS) approach, which has been found quite effective in plant nutrient management. Besides IPM, the FFS has also been applied in other agriculture programmes. The FFS allows farmers to design, implement, observe and evaluate the technologies. The participating farmers can also discuss on the spot and exchange experiences resulting enhancement of their capacity in plant nutrient management.

#### **Farmers to Farmers (FTF) Diffusion of Technologies**

FTF is another successful approach adopted by SSMP in association with collaborating institutions and partners to its projects districts. A leader farmer is trained extensively in agriculture and the leader farmer act as Experienced Leader Farmer (ELF) for the extension of a potential technology. It has several advantages over the traditional approach in the management of soil fertility programmes (Pulami 2006). The FTF is very efficient in the rapid farmers to farmers dissemination of agricultural technologies.

#### **Inclusion of disadvantaged group, *dalit* and women farmers in on-farm activities:**

In the past, usually technologies was tested with the resourceful farmers and economically deprived and socially excluded categories of farmers have been neglected. Their opinion and feedbacks are not taken into consideration. Women who play significant role in agriculture are also ignored. Therefore, to enhance the adoption of a technology and to benefit all categories of farmers in the society, their participation must be strengthened. Recent government policies and programmes of Nepal have focused towards the issue of their inclusion.

**Strengthening of the coordination:**

Currently, coordination and linkage among R & D actors has been weak. Therefore, recently DoA, DLS and NARC have jointly developed an implementing operational guideline for linkages and coordination at local, regional and national levels. These important R & D actors have agreed to improve the Regional and National technical working group meetings where the problems are discussed in depth and solutions are sought. New programmes and projects are developed as directed by the regional and national meetings. It is hoped that this strengthened linkages and coordination will help promote adoption of IPNS program and related technologies in the country.

**RECOMMENDATIONS**

Following recommendations are suggested to enhance technology development and promotion of sustainable plant nutrient management programmes in the country.

**Participatory Action Research**

Specific focus should be given to participatory on-farm research on IPNS for developing location specific IPN recommendations in relation to specific cropping systems, target ecological domains (land types), soil fertility status and socioeconomic status of farmers and local communities. The technologies to be developed and promoted must be productive, acceptable to farmers and adapted to their needs and circumstances, and environmentally sound. Characterization of existing fertility domains in various farming systems is essential to develop appropriate fertilizer recommendation packages. Participatory action research need to be encouraged and strengthened on integrated plant nutrition systems that place greater emphasis on biological processes and recycling for the supply of nutrients, to avoid waste and minimizing nutrient losses that may otherwise pollute water resources.

**IPNS extension Advisory support services**

Management of soil fertility is a dynamic process and the problems change continuously. Hence, government of Nepal, particularly through DoA, needs to develop regular IPNS extension support service units in each district and Agriculture Sub Centres ASCs. This is essential to educate, facilitate and monitor farmers and farming communities to deliver IPNS services for the use of appropriate mix of organic and inorganic sources of plant nutrients as per the type of domains, target crops and cropping systems. Regular training, supervisions and information flow need to be provided to farmers through its offices as well as through various local partners (NGOs, CBOs). Quality control and monitoring of fertilizer could also be part of its activities. Emphasis need to be given to demonstrate the benefits of IPNS technology for rapid dissemination to the farmers through extension professionals, local NGOs and CBOs. Advice on plant nutrition management should include assistance in decision-making at plot and farm level, to optimize the use of local resources and the capacity for intensification of farming according to production objectives and the economic environment.

### **Implementation of Farmer Field School (FFS) concept in IPNS**

Since IPNS is a knowledge intensive and inter-sectoral and inter-disciplinary activity, it requires continuous interaction and local community actions for sustainable capacity enhancement of local community for the management of plant nutrients. Regular FFSs are needed to identify soil nutrient status and improve plant nutrient management. The FFS model as employed in IPM in Nepal and elsewhere in the world can be adopted in IPNS in Nepal. The FFS needs to be promoted to enhance networking among farmers within and outside the villages for sharing experiences and resources between and among the farmers, and also encourage close cooperation among them for mutual benefit.

### **Incentives and Policy support**

Government of Nepal needs to strengthen agricultural policy measures and provide incentives so that farmers get proper support, encouragement and guidance to switch from conventional chemical based agriculture towards sustainable agriculture focusing on integrated plant nutrient management systems. Incentives measures may include subsidies for the use of balanced source of plant nutrient, special training facilities for research and extension staff as well farmers, and public information support for its promotion. In addition, incentives are also needed to recycle organic wastes into crop nutrients and adoption of legumes and green manures in cropping systems. Provisions of credit support are also important to increase balanced use of quality fertilizers. Appropriate actions are needed to define policy alternatives for various domains to promote fertilizer use efficiency and minimize imbalances in distribution and support systems.

### **Investment in Research**

Currently, investment in agricultural research particularly in the IPNS is very low considering its potential in improving crop productivity and sustaining the natural base in the country. To end this, continued investments in agricultural research are needed along with the creation of an environment conducive to innovation by farmers. Allocation of resources more towards the successful development and adoption of more productive and sustainable technologies are utmost essentials to improve the efficiency and sustainability of farm production through IPNS approach.

### **Provisions for alternative sources of household energy in Terai**

Alternative energy sources such as installation of biogas and adoption of fast-growing fuel wood trees are suggested for the places in Terai where dung burning is a common practice. Since soil is very poor in organic matter in the Terai due to intensive cropping and poor transfer of animal manure in the crop fields, appropriate biological measures are needed to sustain the crop production systems. Furthermore, there is a need to integrate legume in the current cereal based cropping options for better soil fertility augmentation and provide better livelihood options to resource poor farmers.

### **Capacity building of R& D Workers and Farmers**

The current technology development and transfer program in Nepal need to be integrated with human resource development focusing on R& D workers including farmers to ensure that the introduced IPNS can solve their productivity problem and being socially

and economically acceptable. Strengthening of national R& D capacities for the sound and accurate plant nutrition management is essential for increased crop productivity and profitability of the farming systems.

### **Inclusion IPNS Curricula in the training and academic institutions**

Farmers training centres in the country should adopt IPNS programme as a regular activity by including IPN in the curricula. Similarly, agriculture academic institutions also follow the same policy. It would give a new sight to the young university graduates.

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