HORTICULTURE AND ENVIRONMENT PROTECTION

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ABSTRACT

Agro-ecological characterization of districts is a pre-requisite to plan and programme for horticultural development in Nepal. Natural vegetation, indigenous trees, and traditional knowledge may be used as environmental indicators for horticultural extension and planning. Perennial crops (fruit trees) contribute to safeguard land stability of fragile mountain ecosystem and livelihood sustainability of peasant population. Nepal's wealth of agro-diversity and genetic resources has not yet been harnessed for commercial use. However environmental management should remain integral in orders to address isolated but upcoming issues like pesticidal pollution, excessive use of chemical fertilizers, loss of vegetal cover and biodiversity, loss of indigenous crops and traditional knowledge, emerging weather problems like the winter cold wave and the ground water poisoning with arsenic chemicals, and possible problems of biosafety due to genetically modified organisms. Environmental management should emphasize to effectively applying Integrated Pest Management (IPM) system and Integrated Plant Nutrient System (IPNS) while the production system could well promote biotechnology for micro propagation and quality standardization. Horticultural development has to be synchronized with infrastructure for transport and communication to access markets and market networks.

BACKGROUND

Nepal is generally described as a country of diverse casts and creeds, diverse climate and physiography, diverse flora and fauna, and above all diverse mountain ecosystem and habitats. However, Nepal is largely homogenous in terms of its people being the farmer. Most people (over 85%) make their living through subsistence farming and over 65% of farming system is dependent upon monsoon. As such Nepal's environment is largely determined by the dynamics of men, mountains and the monsoon.

Horticultural development don't have an extensive history specially in relation to fruit crops, floriculture, and herbal cultivations. The psyche of Nepalese farmers is guided through an annual cycle of sow and reap. Therefore, annual cropping is more prevalent and popular than farming perennial crops of fruit trees. Environmental benefits of establishing perennial tree orchards especially on vulnerable mountain slopes have not yet been realized to any considerable extent.

Problems associated with fragmented farming systems, fragile mountain ecosystems, inaccessibility to deliver goods and services, and weak market linkages have been contributing to low productivity and poor economic returns. The imbalance in farm and forest relationship, unsustainable farming practices on steep slopes and vulnerable places, impoverishment of farm soils and nutrients, and excessive use of chemical pesticides and fertilizers are some of the key issues on environmental management for horticultural development. Besides, the frequent occurrence of winter cold wave

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over the Tarai and the reported groundwater poisoning with arsenic chemicals have added new dimensions to the agricultural environment of Nepal.

The Agricultural Perspective Plan (1995) envisages to make farmers withdraw from environmentally fragile land and concentrate on stable farm-land through commodity crops of high market value. This would lead to a paradigm shift from subsistence oriented farming to market oriented farming through a land use system based upon sound ecological principles and conducive agricultural policies.

Environmental priority for Nepalese agriculture should go towards safeguarding the quality of soil, water, air and vegetation cover on one hand, and uplifting the quality of life for farmers on the other. This would mean to capitalize the comparative advantages of natural diversity and the competitive advantages of highly adaptive Nepalese farmers. Horticulture stands at the crossroad of environment protection and livelihood improvement.

AGRO-ECOLOGICAL ZONATION

Agricultural activities take place on the soil at the grass-root level of social strata. Addressing to the diversity of agricultural niche remains to be a serious challenge for planners and decision makers. Over simplification and generalization of agricultural environment pose serious risks of failures and frustrations.

Current use of agro-ecological classification of Nepal has to be further fine tuned on the basis of altitude, latitude, slope aspects, rainfall pattern, wind-ward or rain shadow side, soil and bed-rock geology, and so on. Unfortunately adequate data on those parameters are not available to be useful for field application. One could, however, use quick indicators such as altitude, vegetation type and farmer's traditional knowledge to characterize farmland for horticultural use.

Nepal lies in the geographical subtropics of the globe. However, most of its area lying below 1000 m altitude enjoys tropical bio-climate (over 35% of Nepal's land area). As such the tropicality is spread into 68 districts of Nepal. There are only 7 districts that do not have any tropical region lying below 1000 m. These districts are Kathmandu, Lalitpur, Bhaktapur, Humla, Jumla, Dolpa, Mugu and Manang. Even the High Himal district like Sankhuwasabha has over 10% of its area in the tropical zone. The Middle Mountain district Tanahu has over 80% in the tropical zone. Thus the vertical agro-ecological zonation (Tropical, Sub-tropical, Warm temperate, Cool temperate, Sub-alpine and Artic) proposed in the MPHD has to be refined and fine-tuned while applying in the horizonal classification denoting the Tarai, the Siwaliks, the Middle Mountains, the High Mountains and the High Himal. An analysis of the 12 Crop Diversification Project (CDP) districts of the Mid-Western and the Far-Western Development Regions has revealed that Dandeldhura district has 34.7% of its area under upper tropical zone (300 m - 1000 m) and 0.6% under the lower tropical (below 300 m) conditions as well. Thus 35.3% of the district has to be planned for tropical crops. It has 55.8% in the sub-tropical, warm temperate and cool temperate zone. Surkhet which is usually identified as a hill district has over 64% in the tropical zone and Dang, identified as a Tarai district has 88% in the tropical zone. Therefore, agro-ecological heterogeneity of Nepal should be considered rather seriously in agricultural/horticultural development. The Ecological Map of Nepal (1:250,000) produced by the Tree Improvement and Silvicultural Component (TISC 2002) of Natural Resource Management Support Assistance Programme (NARMSAP) would be helpful to determine agro-ecological zonation of various districts. Such a map will readily distinguish the

trans-himalayan region (Dolpa & Mustang) from other High-Himal districts like the Darchula and the Taplejung district. Similarly, it will project different potentiality for the High Mountain districts of eastern Nepal (Sankhuwasabha) and those of western Nepal (Jumla and Kalikot).

Natural vegetation, indigenous forests and trees may be prescribed as ecological indicators for horticultural developments. Sal trees indicate tropicality whether at the flat lands of Kanchanpur or at the foot-hills of Kanchanjungha. The *chilaune* tree (*Schima wallichii*) helps to determine the citrus zone for eastern and central Nepal while the Chir pine may do the same for western Nepal. The blue pine may indicate an agro-climate suitable for apples and apricots while Cyress trees and Cedars indicate the suitability for saffron and olives. Nepal's diverse ecosystem would be understood from site specific indications of differing flora and vegetation.

TREND OF HORTICULTURAL DEVELOPMENT

Nepalese culture and tradition suggests that the history of horticulture in Nepal goes back to antiquity but commercial production of fruit has a recent history only. However, horticultural products have a share of 15.39% in the Agricultural Production Index of Agri-business Promotion and Statistics Division (APSD 2004) of the ministry. Data from APDS illustrate that the production area for fruits and vegetables stand at a ratio of 1:3.5 for the year 2002/03. As such the vegetable production is increasing by 5.86% and Fruit production is decreasing by 2.5% for the period 2003/04 compared to last year because this year mango production lies on off-year. However, the trend of horticulture crops production is increasing by 4.63% from the year 2000/01 to 2003/04. Thus geographical coverage of environment friendly perennial crops (fruit trees) is superseded by annual crops (vegetables), which need intensive care for soil and demand high inputs of chemical fertilizers and pesticides.

The trained of agriculture, livestock and fishery productions is an increasing. The table 2 and Annex: 1 shows that horticultural crops is increased by 4.63 percent annually and reached 3956 thousand metric tones in the year 2003/04. However, food and cash crop is increasing by 2.44 and 2.03 percent respectively.

Table 1: Production of Agricultural Crops and Livestock

Crops/Livestock	2000/01	2001/02	2002/03	2003/04 TF	Growth %
Cereal crops (mt.)	7171782	7247289	7344197	7710607	2.44
Cash crops (mt.)	2607720	2653103	2745381	2769794	2.03
Horticultural crops (mt.)	3454022	3684464	3816571	3955793	4.63
Livestock (milk, meat) in mt.	1318390	1357683	1399717	1439452	2.97
Eggs "000 nos	507323	538420	557361	575501	4.29
Fishery (mt.)	33270	35000	36528	38286	4.79

Source: MOAC/ABPSD

Note : TF (Tentative Forecast)

In the Eight Plan period, total fruits area and production was estimated 197 thousand hectare and 1962 thousand metric tones respectively. The fruits production will be 2903 thousand mt. at the end of the Tenth Plan period. Similarly, the tentative forecast of vegetable and potato production will reach up to 9399 thousand mt. and 6906 thousand mt. Thus, the total horticulture crop production will reach 19208 thousand mt. in the Tenth Plan period as increase of 3.88 percent

annually since the Eight Plan period (Table 3). The share of horticulture in AGDP is estimated 15.39 percent with contribution of fruits by 6.39%, Vegetables by 4.37%, potato by 2.83% and others by 1.8%, which is increasing year after year (Annex: 1).

Table 2: Total Area and Production of Horticultural Crops in the Plan Period

Crops	Eighth Plan		Ninth Plan		Tenth Plan TF	
	Area (Ha)	Prodn. (mt)	Area (Ha)	Prodn. (mt)	Area (Ha)	Prodn. (mt)
Fruits	197056	1961540	233292	2279761	276451	2902735
Vegetables	712371	6272736	757396	7672769	806627	9399142
Potato	491168	4216895	621065	6031872	785958	6906493
Total	1400595	12451171	1611753 (1.68 %)	15984402 (3.15%)	1869036 (2.39%)	19208370 (3.88%)

Source: MOAC/ABPSD

Note : TF (Tentative Forecast)

A summary of current projects in agriculture quickly suggests that horticultural activities are spread over several projects such as Crop Diversification Project (CDP), Japan Fund for Poverty Reduction (JFPR), Seed Sector Support Project (SSSP), Hill Agriculture Research Project (HARP), and so on (Annex: 2). Focused programme for horticulture has yet to be developed to comply with the national long-term policy of promoting fruit crops in the mid-hills of Nepal (MPHD, 1991). Declaring specific areas like Sindhuli-Ramechhap for specific fruit like *Junar* (Sweet Orange) has made visible impact in horticultural development. Implementation of MPHD with focused programmes would bring about direct environmental benefits to the fragile mountain ecosystem and economic benefits to the marginalized people. However, it should be cautioned here that access of road transport and access to market network should not be neglected. Lessons of Karnali zone and Mustang region live vivid in Nepal's horticultural development.

AGRICULTURE AND ENVIRONMENTAL POLLUTION

Pollution by definition is the accumulation of substances that do not assimilate in the ecosystem. Substances used for plant protection (pesticides, herbicides, etc.) and soil fertility may persist in soil, water and air causing pollution. In an aggregate and on national basis, pollution due to agricultural activities is negligible in Nepal (Padma B. Singh, 2000). However, excessive use of chemical fertilizers and indiscriminate use of pesticides in accessible agriculture areas have already surfaced warning messages for adopting precautionary measures. The APP objective to transform the subsistence-based agriculture into a commercial one would encourage heavy consumption of agro-chemicals. Therefore, the concept of Integrated Pest Management (IPM) and Integrated Plant Nutrient Management (IPNM) should be firmly implemented in all identified production pockets. Pocket identification should not only be a production function but also be a part of environmental sustainability.

A series of papers included in "Agriculture and Environment" published on the occasion of World Environment/Population Day 2001 (Padma B. Singh; Lohini & Kishore K.C.; Sushma Upadhya; Bhakta Raj Palikhe; 2001) provide excellent materials to deal with the issues related with environmental pollution. These materials led us to plan for strengthening our basis of generating

scientific information on chemical pollution of air, water and soil. Regional laboratories should be equipped to deal with pollution matters specially in monitoring the environment. Meanwhile, researches should be promoted to identify indigenous means and methods of crop protection and soil nutrient management. A number of biological indicators (earthworms, leech, spiders, birds, and butterflies) are available to monitor environmental health of an ecosystem. Place specific information would be more applicable than more general type of information. Researches should be geared towards generating information that are readily applicable.

AGRICULTURE AND LAND STABILITY

The dynamics of Nepal's environment is best seen during the downpour of rain in the monsoon. Mountain terrain of Nepal is largely terraced for soil and water management, and the features of hill slopes and mountain topography is fundamental to make choices for farmers. Cultivating trees (fodder and shade) in farmlands, planting cash crops (cardamom, ginger) in community forests, slash and burn cultivation of herbs (*Chiraito*) and crops (maize, millet, potato, etc.) and converting croplands into timber plantation (*Sisso*) are all but choices of farmers. It is, therefore, very important to concentrate on an objective analysis of the evolution and trends of development in Nepal's farming system in order to prescribe methods for switching over to marketable horticultural commodities. Subsistence farmers are vulnerable to new experimentations and their risk absorbing capacity remains at a very low level. Therefore, subsistence farming system of hills and mountains need added support to keep their land stable. It has been observed in many parts of Nepal that abandoned terraces give way to heavy landslides and soil erosion.

Mountain farming system has been a focus of study programme of ICIMOD since 1988 and the HMG's community forestry is a overriding issue in hills and mountains. More productive areas such as the Inner Tarai, the Tarai and the Valley "Tars" are often overshadowed in the environment debate. The APP strategy of bringing about "a technology-based green revolution in agriculture" should have a strong focus on these geographically defined ecosystems. Crop diversification through horticulture (fruits, vegetable) has gradually been taken up by farmers but technical support (plant protection) and market facilities are not yet adequate and they hinder the growth. Trans-boundary trade with India and China needs to be reviewed seriously before venturing into mass production.

Some of the prevailing perceptions on land stability, soil erosion and desertification are notional rather than factual (Harka Gurung 1986 — Nepal: Environment & Development; Jack Ives and Messerli 1986; Shrestha T.B. 1986). There is no scientific evidence to support increasing desertification (H. Gurung 1986); the popular image of the "hill farmer" as the cause of mountain degradation has proven totally wrong (Ives and Messerli 1989) and the notion of "*Ban Mara*" weed (*Eupatorium* sp.) as the cause of deforestation no longer holds true. Therefore, it is very important for agricultural development to understand what are the causal factors and what are the effects in the dynamics of soil and slope stability, farming practices and the weather system. Nepal's time tested wisdom on farming practices and environmental perceptions must be respected first. For example, the two districts on either side of the Sapta Koshi have names depicting two extremes of a spectrum. The district Sunsari denotes a district which is gold-like, while Saptari implies that it is a district of seven enemies i.e. seven Koshi rivers. Scientific evidences have proved that the Koshi made a 100 kilometers westward shift (towards Saptari) in past 250 years (Carson 1985).

AGRICULTURE AND BIODIVERSITY

Nepal's wealth of wild fauna and flora has been highlighted elsewhere and as such it claims 2.2% of the world's flowering plants, 4.2% of mammals, 8.5% of birds, 4.2% of butterflies, 2.2% of freshwater fishes and 1.4% of reptiles and amphibians. This is also a direct indication that it is bound to be very rich in agro-biodiversity and ethno-agriculture. While over half of the human nutrition is provided by three plants of grass family i.e. rice, wheat and maize. Nepal itself claims about 1800 landraces and cultivars of rice, including the highest altitude record of *Jumli Marshi*. Similarly, 50 landraces of maize have been characterized and 121 landraces of wheat have been evaluated (Adhikari *et.al.* 1995 NARC/IPGRI). Upadhyaya (1999) reported that altogether 3049 accessions of agricultural commodity have been characterized and evaluated through the National Commodity Research Programme at NARC. The commodities include Rice (1180 Accessions), Soya bean (216 Accessions), Lentil (146 Accessions), Broad bean (35 Accessions), Colocassia (48 Accessions), Barley (522 Accessions), Buckwheat (184 Accessions) and Finger millet (718 Accessions). Horticultural crops have not come into priority and prominence.

Nepal wealth of wild relatives of cultivated crops, fruits, and vegetable may be estimated quite high. A systematic study on agro-biodiversity is still awaited. This would help to add a new dimension to agriculture in the process of capitalizing Nepal's comparative advantages genetic diversity. Marketing genetic resources of Nepal should not be taken as a distant proposition. The role of gene bank especially at farm level has a great global relevance as repository for future security and also as resources for genetic engineering. The Convention on Biological Diversity (1992) after its coming into force since 1993 has shifted the rights over genetic resources from universal acclamation to state sovereignty. Thus every state has to prepare claim document or national registers of genetic resources. In this context, a large number of horticultural crops and their varieties have special identify often based upon geographical indications such as Ilam tea, Sindhuli *Junar*, Dailekhe *Suntala*, Pyuthane *Mula*, Bhaktapure *Kankro*, Kathmandu *Cauli*, Salyane *Aduwa*, Pharpinge *Naspati*, Hong-gong *Alu* (Sankhuwasabha), Helambu *Shyau* (apple), and so on.

HORTICULTURAL CROPS OF HERITAGE VALUE

Nepalese culture and tradition demand a large number of horticultural fruits, cereals, legumes and vegetables to observe religio-cultural rituals and festivals. The *Bel* fruit in Newari *Ihi*, the *Bhai Pooja* fruits (*Okhar, Katus, Bimiro, Bhogate, Kanthe Jyamir, Amala,* etc.), fruits of sacred rites like *Shrada* (*Bayer*), fruits of auspicious *Sagun* (Banana), root crops of *Maghe Sankranti* (*Tarul yams* and *Colocasia Pindalu*) and the pulse soup "*Kwati*" at Kathmandu may be cited as crop related cultural heritage. A number of land races and wild species of rice have specific uses in cultural events.

Nepalese farmers cultivate a number of wild fruits for domestic use (*Lapsi, Timur, Jamuno, Kafal, Katahar*, etc.) in their farms. Rural populaces also use quite a number of fruits from wild resources (*Ainselo, Chutro, Jamanemandro, Timur, Sil-timur, Bayer, Amala, Sati-bayer, Mayal*, Wild cheeries, wild rose fruits, etc.). The wealth of wild edibles and medicinals is highlighted in a number of ethno-botanical literature (Manandhar, Rajbhandari, Bhattarai, Regmi). However, there has not been a policy declaration for the conservation and development of heritage crops for *in-situ* conservation. It is to be recommend here that the government should identify and declare important horticultural crops as heritage crops of Nepal. It would be a first step towards safeguarding genetic diversity.

CONCLUSION AND RECOMMENDATION

- Horticulture is one the most environment friendly activities in Nepal's farming system. Investment on perennial crops of fruit trees and shrubs not only brings about economic as well as environmental returns which are rarely accounted for.
- Agro-ecological zonation of districts based upon natural indicators like vegetation, flora, fauna and traditional knowledge would add value to sustainable horticulture development in Nepal. It would help to identify potential crops for specific regions.
- Prospects of organic farming, application of IPM and IPNM, promotion of biogas and biofertilizer, use of biopesticides and advanced technology should be examined through applied researches and field studies.
- Government should undertake programmes to strengthen chemical laboratories (central and regional) for pollution monitoring, phyto-sanitary certification and standardization of nutritional values of horticultural crops.
- Government should form a policy to declare traditional/indigenous fruits, vegetables and crops as national heritage crops with geographic indications not only for conservation and development of genetic resources but also to establish intellectual property rights (IPR) for Nepalese farmers.

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