

Status of Agrobiodiversity in Upper Arun River Valley, Shankhuwashabha

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ABSTRACT

Availability of numbers of different plants species has attracted several animals and birds in Arun River Valley. Due to increased population pressure exerted on forest environment, there are 11 mammals and numerous plant species either endangered or threatened globally are found in this area. An exploratory research was carried out on agriculture biodiversity of Num, Pawakhola and Hatiya VDCs of Upper Arun River Valley adjoining Makalu-Barun National Park. Very little influence of the modern agriculture technology has been observed in these VDCs following traditional agriculture. Wide scale slash and burn agriculture practised for cereals cultivation deteriorated inherent soil fertility and large numbers of indigenous vegetation. Indigenous varieties of cereals, legumes and vegetables are cultivated including indigenous fruits. Recent introduction of cardamom may be one of the causes of threatening wild rock bees that was indigenous to Pawakhola area. Extension of tea has negative impact on native plants, animals and birds species. Among the endangered cereals Anadi and Jademarshi varieties of rice and Kauno (bajra) millet has been already extinct. Among the fishes Jalakapoor is no more available in the Koshi river in this area.

Key words: Agricultural biodiversity, slash and burn agriculture, traditional farming

INTRODUCTION

Biodiversity is important to local community since it provides soil regeneration, nutrient cycling, plant pollination, and provision of clean water and maintenance of the functioning of ecosystems, which yields harvestable resources. It is also potential sources of genetic materials for commercial crops, provides natural enemies for biological control of crop pest and diseases including wild relatives of domestic plants and animals that can thrive severe drought and floods (Joshi and Rasali 1998, Joshi et al 1998). Out of the 9000 species of vascular plants reported in Nepal 370 are the endemic to this country sowing richness of biodiversity (Upadhyay 1998).

Arun River Valley covers wide biological diversity and hence, said this area to be rich in biodiversity. There are 11 mammals and numerous plant species either endangered or threatened globally found in this area (Bhandari 2002). Because of wide spread rainfall through out the year that promoted numbers of different plants species in this valley has attracted several animals and birds (Gurung and Gurung 2001, Kuwar et al 2001, Kuwar 2000). These days there has been disturbance in the bio-diversity of this region due to increase in poverty led by increased population pressure, lack of knowledge in sustainable use of natural resources, such as slash and burn agriculture, bush fires, timber logging, construction-wood and fuel wood extraction including unsustainable honey harvesting and hunting (Shrestha and Gupta 1993). At present the rate at which the forest is denudating by the rate of 1.7% per anum in Nepal, indicate biodiversity of this region are endangered (Jha et al 2001).

Numbers of study in general biodiversity of this region have been already conducted but no information regarding agricultural diversity, which supported the livelihood of the local community directly, is available. Therefore, an exploratory research on this area was conducted so that some of the endangered crop varieties could be preserved.

METHODOLOGY

Desk study to collect relevant information regarding the agro-biodiversity was conducted. Library of The Mountain Institute, ICIMOD, IUCN, NARC and KMTNC were visited. Based on the information a checklist of the information to be collected in the field was developed. An exploratory field research was conducted during the month of July/August 2002. In the field, farmers were collected in one place and information that we needed were discussed and collected following Rapid Rural Appraisal. Women members were invited to contribute in gathering information and participated in discussion. After the field work (verification of information collected during desk study) the information were discussed among the team members and analysed logically. Maps of study site are given by Joshi and Karki (2004, in this proceedings).

FINDINGS

Geographical distribution and climate

This study was conducted in Num, Hatiya and Pawakhola Village Development Committees (VDCs) of Sakhuwashabha District of Koshi zone in Eastern Development Region of Nepal. The area lies between 27.30° to 27.40° N latitude and 87.15° to 87.27° E longitude. It was the extreme north of the district that is close to the Tibetan boarder. Altitude ranges from 837 m above mean sea level (asl) to 4000 masl. The highest settlement Bhotegaun of Pawakhola in the study lies at an altitude of 2472 masl (Figure 1.).

This region enjoys cool temperate type of climate with very high rainfall that is regarded highest next to the Annapurna region. Kuwar (2000) reported 6000 mm of rainfall in some years. The rainy season is warm and humid. Precipitation pattern indicates the wide distribution of rainfall during the whole years and enough humidity and temperature is available especially in summer and rainy season, promoting good vegetation growth, promoting diverse animals and bird species. Winter temperature in lower altitude is chill with occasional frost and snow at higher altitude.

Natural vegetation

Altitude plays a major role in the temperature control of this region. Since the study area ranges from 838 m Phaksenda of Num to 4200 m Gojure Danda of Pawakhola, natural vegetation also ranges in the same way. Based on the vegetation composition and climate they are categorised in five different groups. They are as follows:

- a. Tropical belt (<1000 masl), Gorge forest: The dominant forest vegetation are *Bombax cieba*, *Schima walichi*, *Castanopsis* spp, *Albezia* spp, *Bauhunia* spp and *Alnus* spp. Among the shrubs *Maesa chisia* and *Eupatorium adenoforum* are observed.
- b. Subtropical belt (1000-2000 masl), Castanopsis forest: The dominant species of forest plants are *Castonopsis indica*, *Schima wallichii*, *Eurya acuminata*, *Persea odoratissima*, *Quercus semecarpifolia*, *Quercus lanata*, *Macaranga indica* and *Maesa chisia*. Among the shrubs observed in this area are *Eupatorium adenophorum*, *Maesa macrophylla* and *Artemisia dubi*.
- c. Temperate belt (200-3000 masl), Schima-Castanopsis forest: Other species found in this forest type are Oak forest, *Alnus*, *Castonopsis*, *Macaranga*, *Pinus roxburghii* mixed with *Schima wallichii*, *Eurya acuminata*, *Engelherdtia spicat*, *Quercus lamellose*, *Castanopsis hystrix*, *Persia* spp, *Alnus nepalensis*, *Betula alnoides*, *Michelia*, *Lithocarpus spicata*, *Lindera pulcherrima*, *Lyonia ovalifolia*, *Rhus succedanea*, *Cinnamom* spp, *Rhododendron arboreum*. Shrubs available in this region are *Eupatorium*, *Maesa macrophylla*, *Viburnum erubescens*, *Berberis asiatica*, *Daphne bholua*, *Hymenodctiona* spp, *A. naphalis*, *Helwingia himalaic* and *Elscholzia*.
- d. Sub-alpine (3000-4000 masl), Fir forest: The main species of natural vegetations are *Tsuga dumosa*, *Betula utilis*, *Rhododendron hodgsonii*, *Juniperus recurva*. Lower vegetations are *Berberis* spp, *Neelia* spp, *Rhododendron* spp and *Abies spectabilis*.
- e. Alpine belt (>4000 m), Juniper forest: *Rhododendron* scrub, *Juniperus recurva*, *Myricaria* sp, *Berberis* sp, *Caltha*, *Fragaria*, *Anaphalis*, *Potentilla microphylla*, *Potentilla nepalensis*, *Senecio*, *chrysanthemoides* and *Arisaema griffithii*.

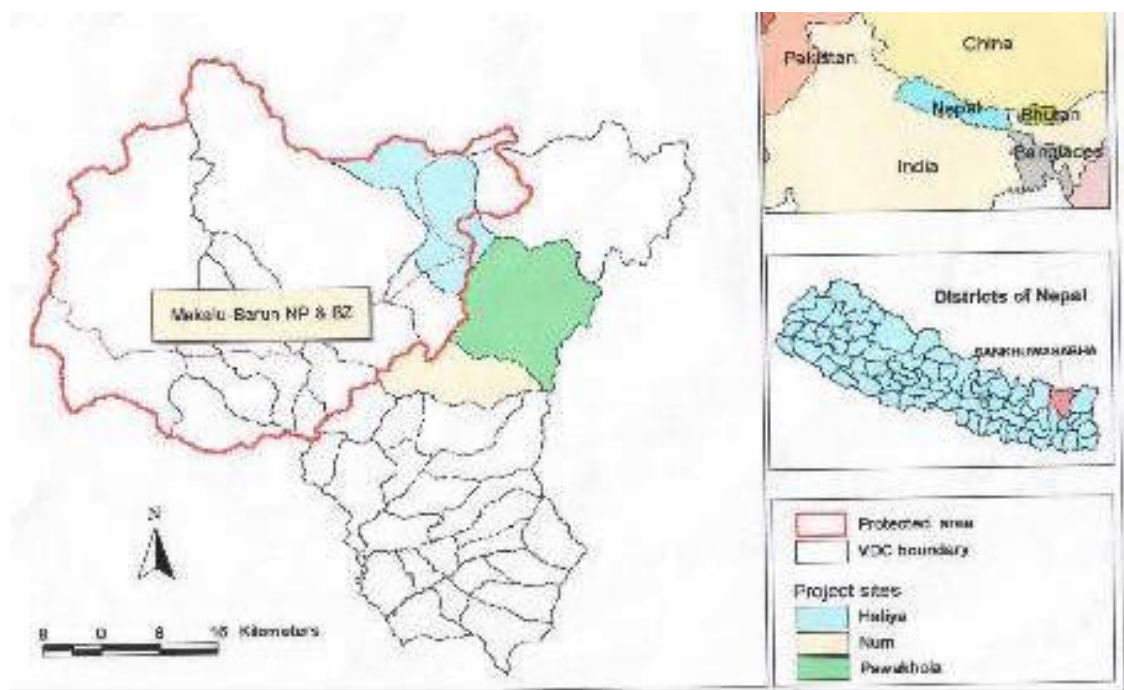


Figure 1. Location of study sites.

Soil and soil fertility

The high mountain physiographic region tends to have highly metamorphic rocks such as gneiss and garnetiferous mica schist (LRMP 1986). All valleys in this region are from the glacial deposits. Due to the glaciations and cooler climate soil weathering is very limited. Comparatively older soils are observed in the gentle knolls and ridges at mid elevation through out the area. Soils developed on glacial till is common but colluvial action has greatly altered the till matrix. In general soils developed on schist and gneisses are observed. They are shallow, coarse textured soils with acidic in reaction. Three subgroups of soils as described by LRMP (1986) such as Dystrochrepts, Eutochreptd and Ustorhents are observed in this study area, which is presented in Table 1.

Table 1. Soil and soil characteristics of the study areas

Soil	Parent materials	Available areas	Fertility
Dystrochrepts	Acidic gneiss, mica schist, concalcerious	Upper part of Num VDC Mostly sloppy anthropogenic terraces	Low pH, high organic matter medium in texture and medium in fertility
Eutochrepts	Alluvial deposit, phyllites, schist and quartzite	Lower part of all the three VDCs,	Highly erosive, shallow depth, low fertility
Ustorhents	Colluvial, variable parent materials	Slopes >35°, recent river deposits and landslides scars of all the three VDCs	Very low in fertility and only tree crops are recommended

Wherever possible the fields are terraced to maintain soil fertility and conserve soil erosion. Farmers cultivate even the steep slopes of 52° using slash and burn practice. This accelerates the soil erosion and due to burning soil humus is also burnt reducing the soil fertility. Farmers collect dry litters and *Eupatorium* from the forest that is used as bedding materials for their cattle to increase the amount of FYM. In situ fertilisation from the cattle and sheep in the winter is a common practice. Green manure with high nitrogen containing vegetations such as *Titepati* (*Artemesia* spp), *Eupatorium* spp, *Khirro* and *Siris* that are widely available in the areas are not practised. But mulching of the standing maize crops during Shraavan is found in Hatiya and some parts of Pawakhola VDC. This helps in addition of organic matter and nutrients recycling. It also helps in reducing kinetic energy of raindrops and conserves soil from erosion.

It is so unfortunate that even in such an inaccessible area chemical fertiliser has penetrated up to the remote parts of Hatiya VDC. Farmers those having excess to Khandbari transport small amount of urea are applied to the maize crops.

Population and agricultural production situation

These are sparsely populated areas. Num VDC has only 3172 people whereas Hatiya and Pawakhola further remote areas have 3112 and 3095 respectively. Average population growth rate is only 1.16% per annum. Lowest rate being in Hatiya (0.93%).

Land use in these 3 VDCs shows much variation. Although there has been enough land suited for agricultural crops, only a part is cultivated. Comparatively cultivated land in Num VDC is much larger than the other two VDCs but pasture area is largest in Hatiya VDC (Table 2). Similarly food production in Num is also higher ie 142.80 t. Hatiya and Pawakhola have comparatively lower 16.53 t 27.33 t of food production respectively. Large amount of grain is fermented for local alcohol production.

Table 2. Land use in Num, Pawakhola and Hatiya VDC

VDC	Agriculture	Pasture
Num	2.04	0.27
Pawakhola	1.97	1.05
Hatiya	2.07	4.32

The district as such is food deficit and needs to import from outside. Usually, food is supplied from the Tarai and distributed to other region of the district. Highest amount of rice (25200 kg) is produced in Num VDC (Table 3). The other two VDCs produce very little amount of rice because of limitation of suitable land for rice cultivation. Hatiya VDC is famous for potato cultivation. Most of rice and edible oil is supplied from Kahndbari market. The other grains are balanced in exchange from the neighbouring VDCs. Data regarding finger millets, maize and wheat production is not available and these grains production is sufficient to meet the local demand.

Table 3. Food situation in the study areas

Crop	Food production and requirement in kg					
	Num		Hatiya		Pawakhola	
	Production	Import	Production	Import	Production	Import
Rice	25200	20,000	748	3300		24650
Wheat	13	500	NA	2360	NA	
Maize	25,800	1000	NA		NA	
Finger millets	17,700	1000	NA		NA	
Potato	745		15,000		10,000	
Mustard	500					
Soybean	222		250		220	

Source: District Development Committee, Shankhuwashabha.

Crop diversity

Due to wide range of altitude in this study area all crops can be grown. In the lower altitude rice is grown where as in the higher altitude wheat, maize and potato are common. Buckwheat, wheat and other legumes are also cultivated. Regarding the varieties, many varieties are unidentified and they are only known as local varieties. However, improved rice varieties like Khuma 1 4 and Malaya (might be Masuli) have been recently introduced and gaining popularity. Some of the varieties grown in these areas have been mentioned in Table 4. Most of the crop varieties grown in this locality could be important gene pool for further study. Legumes mostly soybeans and black gram are grown but not for commercial purpose. Potato seed is famous in Honghong village of Hatiya, which is exported to other VDCs as well. Though, there has been huge potential for fruits and vegetables growing, farmers have not paid much interest on these cultivation. Local varieties of guava in the lower altitude, citrus in middle and pears and peaches in higher altitude have been noticed. For vegetables improved varieties of Kentucky beans, cowpeas and radish have been introduced by some NGOs. Among the domestic animals all of them were local and low yielding breeds.

Rice is grown only where irrigation is available and mostly as mono crop with no additional manure. In a small area it is rotated with wheat and some times with garlic in winter. The succeeding crops (winter/spring) get enough manure mostly FYM. Maize is relayed with finger millets. In slash and burn practices solo crops of

maize and finger millets are also practised. Maize is generally rotated with wheat, barley, potato and finger millets in all the study areas.

Table 4. Crop diversity and their varieties in the study areas of Sahkuwashabha

SN	Crop	Crop varieties		
		Num	Hatiya	Pawakhola
1.	Rice	Atte, (medium-fine), Takmare, Jademarshi	Atte, (medium-fine), Takmare, Jademarshi	Belbote, Madale, Takmare, Yangsare, Jademarshi
2.	Maize	Seto, Panhelo, Teen Maha (three months)	Seto, Panhelo	Seto, Panhelo
3.	Buck wheat	Tite, Mithe	Tite, Mithe	Tite, Mithe
4.	Potato	Red, white, oblong	Red, white, oblong	Red, white, oblong
5.	Soybean	Small, and bigger	Small, and bigger	Small, and bigger
6.	Cow peas	Tane Bodi, Boda, Mashyang	Tane Bodi, Boda, Mashyang	Tane Bodi, Boda, Mashyang

Cash crop diversity

Chiraito (*Swertia chiraita*) has been available as indigenous to this locality. It has been harvested since the farmers knew it as medicinal plant and had been exported to Tibet to the North India to the South. Since domestication of this crop has recently been started exact amount of area under this crop and production is not yet known.

Highest amount of cardamom (137500 kg) was produced in Num VDC. Chilly, ginger and turmeric are also produced as cash crops but the amount was for local consumption only. Tea has also been popularly grown in these DVCs but exact area under this crop is not known. Cardamom and tea in these areas have been recently introduced. These crops cultivation needed clearance of forest. This has led to the extinction of the indigenous species of fauna and flora. Some of the species that has been exogenous might have allelopathy effect on other indigenous species that disappear slowly. During the course of introduction of new crop varieties, very important local gene pool has already disappeared. Some of the disappeared species are as follows:

1. Among the cereals Anadi, a blast resistant variety, and Tademarshi, locally popular dark variety are extinct. The same is the case with Kauno (bajra), and Junelo, local sorghum are no longer available.
2. Rock bees (*Apis mellifera*), indigenous to Pawakhola have been extinct and blame cardamom cultivation for this extinction.
3. Local species of shrub especially grasses have been disappearing due to Eupatorium invasion.
4. Lokta (Danphne), Allo (Nettle), Nigala (small bamboo) have been already threatened.
5. Jalkapoor, a popular fish is not available at all in the rivers.

CONCLUSION

Agriculture diversity in this area is still in infant stage. There is lot to be done. A short study revealed plenty of information regarding availability of local crop varieties and their cultivation practices. Introduction of improved crop varieties have threatened local germplasms. Characterization of these locally available species were very important before introduction. Locally available chicks seems to be very important gene pools for breeding poultry birds if not taken care it could also be disappeared before something is done. Lack of local knowledge on biodiversity conservation has been the main cause of threat. Therefore, awareness creation is necessary.

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