International Journal of Agricultural Science, Research and Technology *Available online on: www.ijasrt.com*

Ethnic Communities Own Agrobiodiversity Richness (A Case of Triyuga Municipality of Udayapur District In Nepal)

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The study was conducted in two settlements of ethnic communities in Triyuga municipality of Udayapur district, Nepal. The main objective of the study was to prepare an inventory of cultivated diversity of plants and animal species by the ethnic communities in the research site and their use in farming and in sustaining the livelihoods. The study has been based on data collected through personal interview with the farmers, focus group discussion, non-participant observation as primary source and also on secondary data collected from related publications of various organizations. The study has revealed that farmers grew and maintained different varieties and landraces of cereals, vegetables, fruits, fodder crops and livestock species and were found utilizing different species of plants and animals in farming and in sustaining their livelihoods. This justifies that the traditional ways of managing the natural resources have often resulted in landscapes of relatively high biodiversity value, compared with those associated with modern practices. **[Pawan Singh Bhandari. Ethnic Communities Own Agrobiodiversity Richness. International Journal of Agricultural Science, Research and Technology, 2012; 2(1):9-16].**

Key words: Agrobiodiversity conservation, Ethnic communities, Varieties, Traditional knowledge, Identity

Received: 9 June 2012, Reviewed: 5 July 2012, Revised: 6 July 2012, Accepted: 31 July 2012

1. Introduction

Biodiversity is an important property of ecosystem for sustained production of services and resources. The erosion of biodiversity weakens the ecosystem and pulls down its capacity for consistent renewable of natural resources as well as its economic value (Rengalakshmi et al, 2002). Genetic resources of plants and animals play an important role to ensure a sustainable production and improved livelihoods of poor and vulnerable communities. However in recent years Nepalese agriculture is shifting from subsistence to commercial farming especially in the relatively accessible areas and in the vicinity of urban centers. The government in its policies and programs has been emphasizing to make the agricultural production system further commercial and competitive. With the introduction of pocket areas and the farmers' group approach for commercialization of agriculture, there has been a transition from subsistence to market economy and from low-input organic farming to high-input agriculture.

Nepal's accession to World Trade Organization has offered new opportunities of wider access to global market. In their quest for higher yield and profits the progressive farmers have started intensifying their farms aided by the introduction of the high yielding varieties of different crops. Evidences from various researches shows that farm intensification has altered the existing ecological balance and resulted in the emergence of new pests and diseases and a reduction of soil fertility (Gyawali 2003). To reduce the production risks, farmers have been using inorganic fertilizers and pesticides in a rather indiscriminate way. This has lead, on the one hand, to an overuse of chemicals and the associated environmental and health problems, while on the other, to an increased dependence on external inputs and higher costs. Eventhough some of them may have succeeded in achieving short-term gains, the large majority are loosing.

It is the farmer who ultimately decides what to grow. The role of farmers in the conservation of biodiversity in agriculture is thus crucial. However, changes in people's values, attitudes and behavior towards conserving and managing natural ecosystem have been observed due to the changes in cropping patterns and the crop variety selection for commercial agriculture. These changes have caused the erosion of important local agricultural knowledge of valuable plant and animal varieties. Local crop varieties and livestock breeds are gradually being replaced by a small number of high yielding food as well as new cash crops. Hence, agricultural biodiversity is not being properly utilized and agriculture is being less productive year by year in those areas. Together with

the disruption of the ecosystem and gradual loss of biodiversity, came new threats to farmers' health and the introduction of millions of tons of poisonous substances to the field, waterways, food and homes of rural people (FAO, 2011).

2. Materials and methods

The study covered only Triyuga Municipality of Udayapur district. Purposive sampling method has been used to select the district and the settlements within the municipality. The study population is the total households (HHs) of the two ethnic communities Danuwar and Chaudhari, in the Rajabas area and HH is the basic sampling unit for this study. In order to identify the respondents from the HHs for in-depth interviews, the study has employed snow-ball sampling method. The sample size of respondents for in-depth interviews was fixed at 25 in each community. The study has been mainly based on the primary sources of data collected by organizing personal interview with the farmers, Focus Group Discussion and Non-participant observation through transect walk. Secondary data were collected from government line agencies (DADO[1], DLSO[2] and DFO[3]) in Udayapur, NARC[4], WOREC[5] and international agencies like FAO[6], IUCN[7] and IPGRI[8]. The collected data were carefully edited for missing and incomplete information. It was then processed in computer using statistical and non-statistical software tools.

3. Results and discussion

3.1. Status of Agrobiodiversity in the Respondent's farm

Different field crops and livestock species in-situ conserved by the farmers in the study area is listed in Table 1.

3.2. Use of Agrobiodiversity in Farming and Livelihoods by the Respondents

Farmers were found utilizing different species of plants and animals in farming and in sustaining their livelihoods. Some of the common uses of such biodiversity are discussed follow.

[1] District Agriculture Development Office
[2] District Livestock Services Office
[3] District Forest Office
[4] Nepal Agriculture Research Council
[5] Women Rehabilitation Centre
[6] Food and Agriculture Organization of United Nations
[7] International Union for Conservation of Nature
[8] International Plant Genetic Resources Institute

3.2.1 Use of Agrobiodiversity in Soil fertility Management

Organic manure was the chief source of nutrition for crops in the study area. Weeds commonly occurring in the farm were used to prepare the compost to manage the soil fertility (Table 2).

3.2.2 Use of Agrobiodiversity in Plant Pest Management

Some of the botanicals used by the farmers for pest management are presented in Table 3**.**

3.2.3 Use of Agrobiodiversity in Animal Feed

A list of plant species used as animal feed by the communities is presented in Table 4.

3.2.4 Use of Agrobiodiversity in Household Energy Sources

Energy is basically used in lighting, heating, cooking purposes in the households. Common sources of household energy in the study area is presented in the Table 5.

3.2.5 Use of Agrobiodiversity in Handicraft Making and Off-farm Activities

Handicraft making is an age-old practice in Nepal. Women member of the household in the study area used to make various handicrafts. The main raw materials for such handicrafts came basically from forests, farm by-products and other natural areas. A list of such handicrafts and the source of the raw materials is presented in the Table 6.

3.2.6 Use of Agrobiodiversity in Traditional Health Care including Animal Health

Farmers in the study area were found curing various diseases and wounds by utilizing the locally available biodiversity which is presented in the Table 7.

3.2.7 Use of Agrobiodiversity in Socio-Cultural, Religious Feasts and Festivals

During the survey, respondents were found celebrating various socio-cultural and religious festivals. List of some agrobiodiversity commonly employed in these events is in the Table 8.

3.2.8 Use of Agrobiodiversity in Product Diversification

Female member of the households in the study area used to prepare different edible products from the cultivated agro-bioviversity. A list of some common products is given in the Table 9.

Table 1. Diversity of Crops and Livestock Species

Crop	Species Diversity	Varieties
Cereals	Rice	Bhale Muslim, Pothe Muslim, Saren Dhan, Rambilas, Aasu Dhan, Baula Muslim, Masino, Bhotange, Basmati, Mala Dhan, Jhuthe Andi, Hardinath
	Maize	Pahelo Makai, Seto Makai, Rato Makai
	Wheat	Sonalika, Seto Gahu, 2. NL-45
	Barley	NA1
Legumes	Lentil	Musure
	Black gram	Kalo Maas, Hareyo Maas
	Pigeon pea	Reher
	Grass pea, Broad bean, Mung bean	NA
Oil seed	Tor	Bikase Pahelo Tor, Local
	Mustard, Linseed, Yellow Sarson, Filunge, Sesame	NA
Vegetable and Spice	Chilli	Sahele Khorsani, Jire Khorsani, Madhese Khorsani, Surya Khorsani, Bhaisakha, Pahade Khorsani
	Ginger	Pahade Aaduwa
	Turmeric	Pahade Besar
	Potato	Raato Aalu, Seto Aalu
	Pumpkin, Bottle gourd, Sponge gourd, French Bean, Cow pea, Snake gourd, Bitter gourd, Broad leaf mustard, Cress, Spinach, Amananthus, Pea, Vegetative mallow, Genare saag, Sun saag, Mununga, Mustard, Okra, Fenugreek, Cucumber, Broad bean, Potato, Yam, Brinjal, Tomato, Ash gourd, Cabbage, Cauliflower, Dasheen, Radish, Dongare saag, Lamb's quarter, Pigeon pea, Coriander, Fennel, Garlic, Onion, Ajowan Lovage, Naaf saag, Rai saag, Indian Spinach, Ghauka saag, Khera saag, Baigan saag, Elephant foot yam, Aaruwa, Mushroom, Ginger	NA
Fruit	Mango	Maldaha, Sindhure, Kalkatte, Aamrapali, Bege Aap, Bombay, Krishnabhog
	Banana	Jajhi, Chille Jhabre, Aatheya Kera, Sete Kera, Kadale, Beelaitee, Ban Sipat
	Litchi, Papaya, Lime, Lemon, Halfa, Arecanut, Guava, Sugarcane, Peach, Pomegranate, Coconut, Pineapple, Jack fruit, Jujube, Custard apple, Monkey's Jack fruit, Indian Date, Mulberry, Aonla,Grapes, Pummelo, Aata	NA
Fodder Trees	Malay bush beech, Epil-Epil, Camel's foot tree, Trumpet flower, Cinnamom leaf, Aonla, Kadam, Mulberry, Monkey's Jack fruit, Mununga	NA
Livestock	Cow, Ox, Buffalo, Goat, Swine , Poultry, Duck , Pigeon	NA

Table 2. Diversity of Weed Species and their Management

Name of the weeds	Management of weeds
Mothe, Matrush, Ulte Jhar, Pidale Jhar, Karkale Jhar, Makure Jhar, Bermuda grass, Suere Jhar, Runche Jhar, Khursane Jhar, Karaute Jhar, Kane Jhar, Julpe Jhar, Madero, Baase Ghas, Saune Ghas, Kutulkosa, Nakata Jhar, Sirke, Jhyamte, Shama millet grass, Gaane Jhar, Nakata, Dib, Jhiro, Debhari, Barnyard millet, Harra Khar, Paanaapati Khar, Bathuwa, Chamar	Directly incorporate into soil, Feed the animals, Prepare FYM/Compost, Burn after drying, Use in biogas plant after chopping

[1] Not Available

Table 3. List of Botanicals used in Pest Management

Botanical used	Part used	Target pest
Neem	Leaf, Seed	Aphid, Bug, Mite, Larva
Tobacco	Leaf, Stem	Aphid, Flea beetle, Larva
Stinging neetle	Leaf, Stem	Aphid, Flea Beetle, Larva
China berry	Seed	Green hopper, Aphid, Cabbage butterfly
Sweet flag	Rhizome	Fruit fly, Cabbage butterfly
Malabar Nut	Leaf	Weevils
Mugwort	Leaf	Aphid
Black pepper	Seed	Weevils
Sweet basil	Leaf	Aphids
Water pepper	Leaf	Aphids
Camphor	Fruit	Aphid, Cut worm
Turmeric	Rhizome	Fruit fly, Aphid, Cabbage butterfly
Garlic	Cloves	Ticks
Chilli	Fruit	Fruit fly, Red ant, larva

Table 4. List of Fodder Species

Livestock species	Main Fodder
Cattle	Daale Ghas : Sal tree, Khirro, Lourel tree, Chebulie, Belleric myrobalan, Haade, Cutch tree, Papev, Thakaule, Aaule, Axle wood, Camel's vine, Fire-flame bush, White Silk Cotton, Wodier wood, Archal, Satisal, Siris, Piyaree, Jamuna, Gaayo, Maple, Sandan, Laati Kath, Mallotus, Chinese sumac, Nepalese elephant apple, Australian blackwood, Safflower, Garuga, Monkey's Jack fruit, Kadam, Khamari, Cinnamom leaf, Nigger's curd, Bamboo, Banana leaf, Aonla, Mununga, Mulberry, Epil-Epil, Pink bauhinia, Trumpet flower Bhue Ghas : Saune Ghas, Kaane, Baase Ghas, Siru Grains and Concentrates : Maize flour, Rice husk and Dhuto
Goat	Grains and Concentrates : Maize grain, Maize Flour
Swine	Grains and Concentrates : Rice husk and Dhuto, Boiled Gava mixed with Dhuto and husk
Poultry	Grains and Concentrates : Maize Flour, Chayakla

Table 5. List of Botanicals used as Energy Source

Areas of energy use in the household	Source of energy
Lighting	Electricity thorough national grid, Wax candle, Kerosene lamp, edible oil lamp
Cooking and heating	Biogas Commercial LPG Traditional Stoves using dry branches and twigs of Sal tree, Kadam, Pyare, Axle wood, Haade, Nigger's curd, Lourel tree, Dhap, Careya, Thakaule, Ashna, Lati Kath, Chinese sumac, Tamarind, Khirkire, Wodier wood, Papev, Jemna, Daare, Satsaal, Siris, Pajan, Behara, Katahari, Telai, Karmin, Kerea, Chebulie, Belleric myrobalan collected from the community forest

Table 6 List of Botanicals used in Handicraft Making

Handicraft items and Off-farm Activities	Materials employed	Source of the material
Dhakki	Leaf of Russian thistle, Kasen and plastic	River bank
Broom stick	Kash, Khari	"
Chapani	Cat-tail	"
Gundri	Rice Straw, Cat-tail, Russian thistle	Own rice cultivation as bio-product, River bank, Community forest
Pera	Maize khosta, Rice Straw	Own rice and maize cultivation as bio-product
Dhadiya	Solid bamboo	Own cultivation and community forest
Paple, Doko, Ghauwa, Thithra, Dhadiya, Mandro, Perungo, Fan, Mohala	"	"
Fish catching net	Plastic	Purchase from market
Plough/Juwa	Wood of Sandan, Malay bush beech, Trumpet flower, Sal tree, Saatisal	Community forest
Chatae	Russian thistle	"
Cart wheels	Wood of Padan tree and Sandan tree	"
Dhaki	Gavha, Khari, Kasyan	"
Pateya	Rice Straw	Own rice cultivation as bio-product
Dhokse	Solid bamboo	"

Table 7. Use of Botanicals in Health Care

Plant species	Part of the plant	Cure	Source
Grinded garlic	Rhizome	Headache	Own cultivation
Mustard	Grinded seed	Headache	"
Basil	Leaf	Headache, Soar throat, Cough	"
Chaff flower	Juice of Stem and Leaf	Soar throat, Typhoid, Fever	"
Guava	Young Leaf and Bark	Diarrohea	"
Pereya Bis	Leaf	Wound healing	"
Neem	Leaf	Gastric, Allergy	"
Henna	Leaf	Hair, Wound healing due to mud	"
Chebulie	Fruit	Gastric	Community forest
Belleric myrobalan	Fruit	Gastric	"
Belleric myrobalan	Fruit	Gastric	"
Padamchal		Stomach ache	"
Harila	Seed	Fever, Cough	"
Mula paate	Grinded root	Cough, Soar throat	"
Mununga	Root	Soar throat	"
Mugwort	Leaf	Stomach ache	"
Trumpet flower	Flower, Bark	Jaundice, Diarrohea	"
Devil's apple	Fruit	Gout	"
True hemp	Leaf	Corrects bowel movement	"
Nepal pepper	Fruit	Corrects bowel movement	"
Turpe Jhar	Young shoot	Soar throat, Fever	"
Chiretta	Stem	Deworming, Fever	"
Kutke		Stomach ache	"
Kalapnaap	Grinded leaf	Fever, Loss of appetite, Gastric	"
Khyar		Wound healing	"
Bhelaure	Fruit, Juice of young fruit	Headache, Wound healing	"
Harro	Fruit	Indigestion	"
Barro	Fruit	Indigestion	"
Tetepati	Leaf	Stomach ache	"

Table 8. Use of Agrobiodiversity in Feasts

Occasion	Name of the food item	Use of agro-product
Baishakhe purnima/ New Year	Meat, Sel Rote, Pakauda, Aalu chap	Buffalo, Local poultry, Goat, Pig, Rice, Wheat, Onion, Potato
Saune sankranti	Meat	Buffalo, Local poultry, Goat, Pig
Krishna aastami	Beaten Rice, Curd, Fruits	Rice, Cow milk, Banana
Dashain	Beaten Rice, Meat, Jadh, Chyang, Raksi	Local poultry, Goat, Buffalo, Pig, Rice, Maize, Finger millet
Tihar	Sel Rote	Rice, Wheat
Chaite Dasai	Beaten Rice, Meat, Jadh, Chyang, Raksi	Local poultry, Goat, Buffalo, Pig, Rice, Maize, Finger millet
Jitiya	Beaten Rice, Curd, fruits, Fish, Meat	Rice, Cow milk, Goat, Local Poultry
Maghe sankranti/ Tila Sankranti	Jadh Raksi, Meat, Bhuja, Ghur, Beaten Rice	Duck, Local Poultry, Pig, Rice, Finger millet, Sugarcane
Chaath	Bagiya Rote, Thekuwa, Ghur, Fruits	Rice, Sugarcane, Banana, Apple
Chaite dashain	Meat	Buffalo, Local poultry, Goat, Pig
Judsital	Rote	Rice

Table 9 Use of Agrobiodiversity in Product Diversification

Name of the product	Use of agro-product
Gundruk (Silage of green vegetables)	Mustard, Tor, Radish leaf, Rayo, Onion leaf, Cauliflower leaf, Dongare Saag, Rai Saag, Cabbage, Aaruwa
Chana (Dried vegetable)	Radish, Ash gourd, Cauliflower, Spongegourd, Tomato, Deule mushroom, Bottlegourd, Grass pea, Okra
Sinki	Radish, Onion leaf, Rai Saag, Mustard, Cabbage, Cauliflower
Pickle	Mango, Halpha, Lime, Radish, Tomato, Potato, Ash gourd, Tufted bamboo, Cabbage, Cauliflower, Lemon, Bottle gourd, Pumpkin, Chilli
Dry meat	Buffalo, He-buffalo, Pig
Maseura (Nuggets)	Potato, Blackgram, Yam

3.3. Discussion

Mixed farming system with the integration of crop, livestock and forestry components was the prevalent agriculture system in the study area. Rice-based cropping pattern was dominant and accounted for the major portion of agricultural production. However, the diversity and area under cultivation of vegetables was in increasing trend. The common cropping pattern was Rice-Lentil-Maize, Rice-Wheat-Maize, Rice-Vegetables-Maize, Rice-Mustard-Maize and Rice-Fallow-Maize. Mixed cropping system was also prevalent in the study area, that constituted varieties of vegetable, pulse and oil seed crops integrated with major cereal crops. This was a proven practice for household food security as well as against unprecedented loss of the main crop. A study conducted by Sustainable Soil Management Programme in Dolakha district has also found that local farmers have been practicing mixed farming systems to increase productivity of their crops and to mitigate against the climatic changes (SSMP, 2010).

Farmers were using different species of plants and animals in farming and in sustaining their livelihoods. Use of chemical fertilizers was at minimum and plant and animal based organic manures were used to manage the soil fertility. On an average 5-14 doko/kattha of compost was applied in the farm while Urea, DAP1 and MoP2 as chemical fertilizers were used in rice, wheat and maize only. Weeds commonly occurring in the farm were utilized as compost manure after proper decomposition. This had been crucial in reducing the household expenditure on chemical fertilizers and in environmental protection. Farmers were found well aware about the harmful effects of chemical pesticides and practiced eco-friendly tactics to manage the pests. Local plant species with pesticidal properties were used to make botanical pesticides. It is interesting to note that farmers have been investigating combinations of varieties of plant species and judging their efficiency in various crops against varieties of insect pests. Similar findings were obtained by Sapkota et al (2005) from the baseline study conducted among small and marginal farmers in Kaski and Tanahun districts in which farmers were naturally inclined towards organic farming. Animals in the study area were generally fed with green fodders collected from the community forest, government managed forest and the crop by-product available from the farm.

Farmers were utilizing various local biodiversity either collected from the forests or from their own cultivation to meet various energy needs in their households. Due to the closer proximity of the study areas to the district headquarter, farmers were also using commercial sources of energy. Women farmers used to make handicrafts to serve various purposes in their daily household chores, the main raw materials for such handicrafts came basically from forests, farm by-products and other natural areas. These handicrafts not only curbed the outlay of money which otherwise had to be spend to buy similar materials from the market but are also were the symbol of identity of these communities which is manifested in various arts embedded in these handmade crafts. Similar studies conducted by Rajbhandari and Thapa (2005), also found that rice was helping to conserve the indigenous knowledge and technology of straw mat-knitting for income generation, *chyura* and *bhuja* processed food making which had promoted self-employment opportunities for women. Farmers basically relied on locally collected herbs which are generally the roots, shoots, leaves of various medicinal plants as well as other medicines of animal origin to cure their own as well as animal illness. These materials were used either in their original form or processed to best fit the purpose. Farmers celebrated various socio-cultural and religious festivals. A single festival contained various activities in it and each activity involved use of biodiversity in one way or other. Women members in the households prepared various edible products from the cultivated crops and livestock. However, these products were primarily intended for household consumption and sharing with relatives and neighbours and not generally sold in the market.

4. Conclusion and Recommendations

4.1. Conclusions

Rural, ethnic communities use and manage biodiversity according to knowledge derived from their personal experiences and thoughts, as well as information from outside sources. At the farm level, biodiversity is basically maintained by farmers for purposes of direct use in their everyday life. The study revealed that mixed cropping of varieties of vegetable, legume and oil seed crops with cereal crops has greatly contributed to the household food security as well as against unprecedented loss of the main crop. Role of livestock especially the small animals in instant cash generation during the time of emergency was not less important. However, farmers basically depended on the forests for fodder and cultivated fodder trees supplied only a portion of the total green materials fed to the animals.

Crop residue and livestock manures were found chiefly used to maintain the soil fertility. This is also evident from the fact that farmers were practicing variety of environment friendly pest

[1] Di-Ammonium Phosphate
[2] Muriate of Potash

management strategies to manage insect pests and diseases of their field crops. Weeds although considered to be the menace for agriculture was been wisely utilized by farmers in maintaining the fertility of the soil which had also been crucial in reducing the household expenditure and environmental protection.

Along with the use of commercial sources of energy, farmers were found highly depended on forest resources and crop by-products to meet various energy needs in their households. Handicraft making especially by female members in the household was common in almost all households, the raw materials for which came basically from forests, farm by-products and other natural areas. This had not only served various purposes in their daily household chores but also curbed the outlay of money which otherwise will have to be spend to buy similar materials from the market.

The traditional method of curing various diseases and wounds by utilizing the locally collected herbs was still in practice. These herbs, which are generally the roots, shoots, leaves of various medicinal plants as well as other medicines of animal origin were being used either in their original form or processed to best fit the purpose. Female members of the households in the study sites were also found involved in local level processing to prepare different edible products. Nonetheless, socio-cultural and religious festivals were yet another events where biodiversity was being adequately utilized.

All these findings justifies policy interventions to explicitly recognize the potential of traditional knowledge of biodiversity conservation and incorporate them in development plans and policy making that affects the livelihoods of such ethnic rural inhabitants. Thus provisions for rewards for biodiversity conservation either in terms of direct compensation payments or establishing market-like mechanisms for agro-biodiversity conservation must be made.

4.2. Recommendation

Based on this conclusion of the study, following recommendations have been made.

Rural, ethnic communities use and manage biodiversity according to knowledge derived from their personal experiences and thoughts, as well as information from outside sources. Traditional ways of managing the natural resources have often resulted in landscapes of relatively high biodiversity value, compared with those associated with modern practices. This justifies policy interventions to explicitly recognize the potential of traditional knowledge of biodiversity conservation and incorporate them in development plans and policy making that affects the livelihoods of such ethnic rural inhabitants.

At the farm level, biodiversity is basically maintained by farmers for purposes of direct use in their everyday life. However in recent days, farmers' decisions to invest in agro-biodiversity as an asset lie in the incentives offered by current markets. Thus provisions for rewards for biodiversity conservation either in terms of direct compensation payments or establishing market-like mechanisms for agro-biodiversity conservation must be made.

A biodiversity based paradigm for sustainable agriculture is a potential solution for many of the problems associated with intensive, high input agriculture, and for greater resilience to the environmental and socioeconomic risks that may occur in the uncertain future. Thus reform in the development thinking favouring diversification in land uses is necessary.

Partnerships between farmers, researchers, and other development stakeholders must be established and strengthened to help integrate and evaluate the ecological and socioeconomic trade-offs of different resource management scenarios, for recognition and rewards for provision of biodiversity conservation and associated ecosystem services.

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