

An Overview of Agricultural Degradation in Nepal and its Impact on Economy and Environment

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Abstract

This paper is a review of agricultural degradation and its impacts on economy and environment in Nepal. It includes an overview of agriculture in Nepal and the changes that have taken place. This paper has basically been applied descriptive cum analytical research design to complete. Agricultural development has been sluggish, and has failed to keep pace with population growth. In recent years the yields of major food crops in Nepal have been lower than other South Asian countries and Nepal is now dependent on food imports. Land holding size per family and field sizes has both decreased markedly during recent years. If hill regions are considered independently, all cereal crops yields have stagnated in the last 30 years and gains in production that have been made. Crop productivity in the hills has declined due to land degradation. Of the 28% of Nepal land that is degraded, 10% is poorly managed sloping agriculture terraces. As yields and production of cereal crops have fallen, many farmers have shifted to growing cash crops, to meet the demands of the increasing urban population and government agricultural policies have encouraged to farm. Nepal's livestock population is one of the highest in Asia and nearly every rural household keeps domestic animals resulting in widespread and serious problems of livestock overgrazing. Changes in agricultural practices (including changes in crops and crop production, impacts of livestock overgrazing) are having major and far-reaching impacts on natural environment.

Keywords: Agriculture, farming, environment, conservation, impact, degradation

1. Introduction

Agricultural development has emerged as a major subject of development discourse in livelihood improvement and environment degradation in Asia. Shifting cultivation,

the first stage of agricultural development was the most widespread agricultural system in South and Southeast Asia until the mid-20th century. It involved basic tools and techniques low level of inputs and subsistence level of production and consumption which was unable to support growing population and their subsistence needs. The food security situation was worse in developing countries where the colonial power invested very little on food production systems. After independence, their situations were much worse. The increasing population¹ combined with government control over common property resources was putting pressure on shifting cultivators to reduce the fallow period. Meantime, shifting cultivators deserve improved lifestyle which was not possible from the low return being provided by their practice of cultivation. Such circumstances forced farmers to seek for more productive agricultural system which otherwise could have brought a hunger and malnutrition situations in Asia.

Nowadays in Nepal, the heavy use of chemical fertilizers and pollutant technologies, the most common farmlands are degraded. These advances including high yielding varieties, more use of chemical fertilizers, haphazard irrigation and other chemical inputs led to a remarkable environmental degradation. The increasing number of livestock and overgrazing over the pasture lands has created environmental deterioration. Growing population has challenged to produce more but because of the traditional production system production has not been increased rather it has been degraded the environment and recorded loss on economy.

2. Review of Related Literature

Contribution of agriculture sector to Gross Domestic Product (GDP) during the people's movement-II in 2005/06 was close to 35 percent. Though various programs were implemented to increase agricultural production in subsequent years, the contribution of this sector to GDP just remained between 32 percent and 36 percent. As per the preliminary estimates, contribution of agriculture to GDP during the current fiscal year 2011/12 will be 35.68 percent against the revised estimate of 37.47 percent in the previous fiscal year. In the current fiscal year, GDP is expected to rise by 4.56 percent at constant prices of FY 2000/01, while the growth rate of agriculture sector is expected to remain slightly higher than this with 4.93 percent. Agricultural production in this fiscal year is estimated to increase marginally higher by 0.46 percent than that of the previous fiscal year (Economic Survey, 2012).

Agricultural sector may be detrimental for environment in many ways. In fact, the growing demand for agricultural products, the increasing domestic food production by fewer individuals because of rural exodus, and the need of nontraditional export products as a means of increasing income, and earning valuable foreign currency for the country lead farmers to look for alternative agricultural methods in order to raise their productivity (Andreatta, 1998). One way to address this problem is the excessive

¹According to National Population Census, 2011 Nepal's population is 2,64,94,504 and population growth rate is 1.35

use of fertilizer and pesticides, and this has adverse effects in terms of environmental degradation. Fertilizers and pesticides are discharged into the ecosystem by drifting, dripping or leaking into areas surrounding the target area. The deposited chemical is then transformed by living systems, heat, light and water to form a pesticide residue (Ghatak & Turner, 1978, pp. 137).

Another important issue regarding the environmental degradation effect of raw agricultural product exports is the comparison of the environmental impacts of primary production and processing (Hecht, 1997).

These residues are dispersed in the ecosystem through natural forces (biologically, physically), and human activities. They can be transported by fluid movements (wind, rain, etc.) in the environment. They can vaporize from falling spray particles and from plant, soil and water surfaces; they can be carried physically as vapor or absorbed in wind-borne particles of soil and dust. Thus, the use of these products in addition to animal feedlots, pastures, dairy farming and aquaculture leads agriculture to provoke soil and water pollution through the discharge of pollutants and residue (phosphorus, nitrogen, metals, pathogens, sediment, pesticides, biological oxygen demand, trace elements) to the soil as well as surface and groundwater, through net loss of soil by poor agricultural practices, and salinization. Agriculture is also responsible for a large amount of methane emission (second most important greenhouse gas) and nitrous oxide emission (third most important greenhouse gas) (Galt, 2008).

Another way to address the problem of high agricultural product demand is the excessive use of water through irrigation, the use of mechanized agricultural methods rather than labor intensive practices and/or extensive use of land. These methods affect physical environment respectively through water shortage, air pollution (CO₂ emission) and deforestation. Agriculture is the single largest user of freshwater resources, using a global average of 70% of all surface water supplies according to Ongley, (1996).

In the specific case of agricultural subsector, some arguments have been developed linking international trade to environmental concerns. The scale, technique and composition effects have been discussed for this sector since agricultural product export obviously leads to economic growth (Antle, 1993). Trade liberalization also modifies the relative price of agricultural inputs such as fertilizer, pesticide, tractors, and thus, has adverse impact on the physical environment. Given that developing countries generally import these inputs, openness to trade leads to pollution haven in agricultural subsector. Because of data scarcity, few studies investigated empirically this hypothesis. Through econometric estimation and simulation, Williams and Shumway, (2000) found that the North American Free Trade Agreement (NAFTA) is expected to increase chemical usage substantially in the United States and lead to greater groundwater contamination. They also showed that in Mexico, the expected effects are a substantial increase in fertilizer use but a decrease in pesticide use.

In the areas of semi-commercialized agriculture, farmers are injudiciously using various pesticides for an increased productivity and risk mitigation in crop production, even though an average application rate of 142 g/ha (Adhikari, 2002) and annual consumption of 176mt a.i. (Palikhe, 2002) of pesticides in Nepal is not considered high. According to Palikhe (2006), more than 60% of the applied pesticide remains in

the soil materials polluting soil environment as a risk to terrestrial as well as aquatic biosphere. The residual effects of some of the chlorinated hydrocarbons like Chlorodane, BHC, DDT and aldrin remain in soil for a period of more than nine years (DOA, 2001). Imprudent disposal of obsolete pesticides is also of serious concern as a considerable quantity of persistent organic pollutants (POPs) stored indifferent warehouses would be detrimental to the prevailing ecosystem in the locality.

Average application rate of fertilizers in Nepal is relatively low. It is estimated in Nepalese situation that a general pattern of major cereals removed 310kg of plant nutrients from soil annually on a hectare basis. Since, on an average, only 29 kg of plant nutrients per hectare is added to soil through various fertilizers, net loss of plant nutrients from the inherent fertility reserve in the soil alarming (MOAC, 2007).

Likewise, various types of agricultural operations and hazardous effluents from agro-industries and processing plants, slaughter houses and veterinary hospitals and clinics, when not collected and disposed safely (Haung, 2004), are subject to water, air and land pollution in the country. Despite being the second richest country in water resources in the world, chronic shortages of water at various places of the country is a common problem.

Farming with no or low use of agrochemicals becomes a strategic destination towards achieving sustainable development of Nepalese agri-businesses. Such would help to create low carbon economy in the country. Promotion of alternative energy sources like biogas, improved cooking stoves and solar energy from photovoltaic system is important also in achieving environment friendly agriculture development. The Alternative Energy Promotion Centre has been working on such promotions through a twenty-year master plan to reduce pressures on forest resources mainly due to fuel wood supply (G.C., 2003).

The issue of accelerated erosion was developed from a number of studies and impressionistic writings, which claimed that Nepal would slide away into Ganges by the year 2000 and that the Nepalese hill farmer was to blame for this situation (Biot, 1995:96).

Soil loss through surface erosion from the agricultural land in hills varies from less than 2 tons ha⁻¹year⁻¹ to highest soil loss of 105 tons ha⁻¹year⁻¹ (Acharya, 2007). Soil losses are found to be higher in Bari1 land on sloping terraces (32 tons/ha/year) than in Khet2 land (less than 1 ton/ha/year) which is directly related to slope gradient and it is cheaper to make sloping terraces than making level terraces (Shrestha, 2004). Thus, the frequent breaking and loosening of soil through regular hoeing and plough had forced soil to erosion. Soil degradation through nutrient depletion is also a serious issue (Lal, 2000). Many studies have shown that soils in mid-hills have very low nutrients especially nitrogen and phosphorous (Shah and Schreier, 1991). In particular, the double and triple annual cropping rotations are more nutrient demanding. Thus in order to fulfill nutrient requirements, increased number of crops per annum has increased the inputs of chemical fertilizers in their farm. As a consequence of increased fertilizer use during intensification process, soils in mid-hills are becoming more acidic (Westarp, 2004).

The intensification also leads to the deterioration of nearby water bodies like rivers. During the monsoon time, heavy rainfall takes away tons of soil with nutrients

from hills to the water bodies. It has been found that water bodies near to the intensification area have higher concentration of nitrogen, phosphorous and potassium. This is due to higher amount of chemical fertilizer use for intensive production of crops and the nutrients have been washed down (Dahal, 2007).

There are some evidences that the climate has been changing in Nepal. The temperature has been increased by 1.8oC during last 32 years and the average temperature increase was recorded as 0.06oC per year. The rainfall pattern is also experienced as inconsistent with higher intensities of rain and less number of rainy days (Malla, 2008). The emission of methane from rice field supplied with 50% nitrogen fertilizer was 49 kg per hectare which is quite high without irrigation facilities (Malla, 2006). The plains (Terai) of Nepal faced a problem of rain deficit during 2005 and 2006 due to early monsoon which reduced the crop production by 12.5% on national basis. Around 10% of the country's arable land was left fallow due to rain deficit where as there was flood in mid-western Terai, that decreased production by 30% in the same year (Rauniyar, 1998). Early maturity of the crops due to increasing temperature helps to increase the number of crops per year. But increasing number of crops lead to increase in agricultural activities like tilling and agro-inputs. This has potential implication on soil degradation and emission of greenhouse gases in the fragile landscape of mid-hill region.

3. Hypothesis

This paper is the review of agricultural degradation and its impacts on environment and economy. Nepal contains significant contribution of agriculture; the contribution of agriculture sector on GDP remains average 33 to 39 percent. More than two third population of the country has been depending upon the labor and production of agriculture sector. But in the recent years the per capita land holding has rapidly been reduced and the production system has been converted from organic to chemical, most of the ignorant farmers of remote rural areas are using chemical fertilizers haphazardly, they don't know either their land has needed particular fertilizer or not. Having this background, this paper contains the following major hypotheses.

- There is inseparable relationship between agricultural degradation, economy and environment.
- Agricultural production has been reduced in comparison to population growth.
- The reduced agricultural production system has negatively contributed to the overall economy of the country.
- Existing agricultural production system has been degraded the quality of environment.

4. Overview of Nepalese Agricultural Production

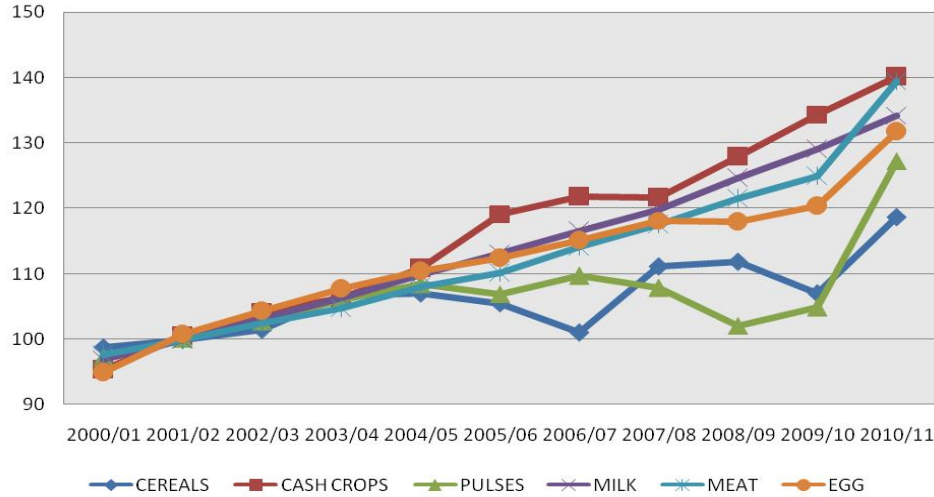


Figure 1: Index of Major Agricultural Production

Source: Statistical Information on Nepalese Agriculture, 2010/2011.

1. Total Area of the Nation (Sq. Km.)	147181
Mountain	51817
Hill	61345
Terai	34019
2. Land Use Statistics ('000 Ha.)	
Agricultural Land Cultivated	3091
Agricultural Land Uncultivated	1030
Forest (including shrub 1560)	5828
Grass Land and Pasture	1766
Water	383
Others	2620
3. GDP at current price (NRs. million), 2010/2011	1261210
Agricultural	449676
Non agriculture	811534
4. GDP at constant (2000/2001 prices) [NRs. million], 2010/2011	608111
Agricultural	212404
Non agriculture	395707
5. Population engaged in Agriculture 2001 (%)	65.6
6. Total Agricultural Holdings No., (2001/02)	3364139
7. Irrigated Area up to 2010/2011 (Ha.)	1254272

8. Area and Production of Cash Crops, 2010/2011

Crops	Area (ha.)	Production (mt.)	Yield (kg/ha)
Oilseed	213706	176186	824
Potato	182600	2508044	13735
Tobacco	1135	1238	1091
Sugarcane	62998	2718226	43148
Jute	10559	14418	1365
Cotton	135	135	1000

9. Area and Production of Pulses, 2010/2011

Crops	Area (ha.)	Production (mt.)	Yield (kg/ha.)
Lentil	207591	206869	997
Chick Pea	9124	8130	891
Pigeon Pea	17469	14107	808
Black Gram	27518	22530	819
Grass Pea	9213	8674	941
Horse Gram	7901	5808	735
Soyabean	293173	28318	966
Others	26248	23924	911
Total	334380	318362	952

10. Fruits

	Area (ha.)	Production (mt.)	Yield (kg/ha.)
Fruits	79184	794184	1003

11. Vegetables

	Area (ha.)	Production (mt.)	Yield (kg/ha.)
Vegetables	244102	3203563	13124

12. Tea	17438 Mt.
13. Coffee	402 Mt.
14. Chilli	27203 Mt.
15. Cardamom	12584 Mt.
16. Ginger	216289 Mt.
17. Garlic	39566 Mt
18. Turmeric	35295 Mt
19. Cocoon	26.10 Mt.
20. Honey	1365 Mt.

Table 1: Area, Production and Yield of Cereal Crops² in Nepal (Paddy, Maize and Millet)*(Area in Hectare, Production in Metric Ton and Yield in Kg. per Hectare)*

Year	Paddy			Maize			Millet		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
2000/01	1560044	4216465	2703	824525	1484112	1800	259888	282852	1088
2001/02	1516980	4164687	2745	825980	1510770	1829	258120	282570	1095
2002/03	1544660	4132500	2675	836190	1569140	1877	259130	282860	1092
2003/04	1559436	4455722	2857	834285	1590097	1906	258597	283378	1096
2004/05	1541729	4289827	2782	849892	1716042	2019	258839	289838	1120
2005/06	1549447	4209279	2717	850947	1734417	2038	261673	290936	1112
2006/07	1439525	3680838	2557	870401	1819925	2091	265160	284813	1074
2007/08	1549262	4299246	2775	870166	1878648	2159	265496	291098	1096
2008/09	1555940	4523693	2907	875428	1930669	2205	265889	292683	1101
2009/10	1481289	4023823	2716	875660	1855184	2119	268473	299523	1116
2010/11	1496476	4460278	2981	906253	2067522	2281	269820	302691	1122

Table 2: Buckwheat, Wheat and Barley*(Area in Hectare, Production in Metric Ton and Yield in Kg. per Hectare)*

Year	Buckwheat			Wheat			Barley		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
2000/01				641030	1157865	1806	28194	30488	1081
2001/02				667077	1258045	1886	27722	30790	1111
2002/03				669014	1344192	2009	27555	31711	1151
2003/04				664589	1387191	2087	27467	28151	1091
2004/05				675807	1442442	2134	26428	29341	1110
2005/06				672040	1394126	2074	26227	27786	1059
2006/07				702664	1515139	2156	26580	28293	1064
2007/08				706481	1572065	2225	26106	28082	1076
2008/09				694950	1343862	1934	25817	23224	900
2009/10				731131	1556539	2129	26600	27587	1037
2010/11	10304	8841	858	767499	1745811	2275	28461	30240	1063

Source: Statistical Information on Nepalese Agriculture, 2010/11

²In Nepal, cereal crops (paddy, millet, maize, wheat and buckwheat) are taken as the major food grains for the subsistence.

Semi traditional to early commercial agriculture³ system of Nepal has now its economic move in transition from agricultural to early industrial track of economic development. An attempt has been made to assess the relationship between the emerging modern agriculture practices and environmental depletion. Some of the developmental challenges of Nepal like small land holdings, weather dependent farming systems, low per capita income, underdeveloped physical infrastructures and inefficient bureaucratic procedures are associated with comparatively higher cost of agricultural production. Natural disasters and human induced environmental degradation are closely associated with improved farming systems. Nepal has preferential ways of producing niche agricultural products by exploiting its inherent diversified climate to cope with the global open market challenges. Competitive agribusinesses along with the adoption of environmental protection measures keeping the strategy of import substitution and export promotion are the ways for sustainable agriculture development in the country.

5. Land-Use Policy 2012

Of the total Nepal's land area, 27 percent is arable, forest covers 39.6 percent, pastures occupy 12 percent, 17.2 percent is covered by snow and rocks and the rest 2.6 percent is covered by water. Due to absence of land-use policy for the proper management of these lands, unplanned residential area and urbanization have continued to grow while the arable land is gradually diminishing. Similarly, the trend to occupy and leaving it barren has also increased while registration and encroachment of government and public lands by squatters have grown in the same way. Likewise, uncontrolled fragmentation of land that led to the decline of agricultural production and productivity consequently providing threat to food security. The National Land-Use Policy 2012 has been enforced as it became imperative to formulate and implement proper policy to get rid of these problems.

Special Features of Land-Use Policy:

Land has been classified into 7 categories on the basis of its use.

1. Agriculture Area
 2. Residential Area
 3. Commercial Area
 4. Industrial Area
 5. Forest Area
 6. Public Area
 7. Other Areas as specified based on necessity
- A Land-Use Council has been formed at the Centre on Chairmanship of Honourable Vice-Chairman of National Planning Commission comprising Secretary of concerned Ministries and Land-use experts for implementation of the Policy
 - Establish a permanent Department of Land-Use Management by permanently

³In Nepal, about 80 percent rural population practices non-commercial or traditional agricultural production system. Only urban and semi-urban areas practice the commercial and early commercial production practices respectively.

restructuring the existing National Land-Use Project under the Ministry of Land Reform Management so as to regularize monitoring and facilitating implementation of land use plan, and to develop basic infrastructure for preparing land use plans to bring the Policy into implementation. The Department will draw the human resource from Agriculture, Irrigation, Forestry, Environment, Housing, Urban Planning, Survey, and Land Management.

- A district level Land-Use Implementation Committee has been established under the Chairmanship of the District Development Committee (DDC) Chair with the representation of various office heads of the districts. Likewise, municipality and village level Land Use Implementation Committees have been established with the representation of office heads of the concerned villages and municipalities.
- Necessary statutory provisions will be developed within two years in order to bring policy into implementation.
- Monitoring and evaluation provisions and risks have also been incorporated in the policy.
- Policy will be reviewed and revised every ten years.
- Government of Nepal, and Ministry of Land Reform and Management has made the provision for the power for removal of road blocks if some problems or difficulties arise while implementing the policy.
- The definition, basis and standard set for specifying areas, details on organization structure and sectoral authority at central, district and local levels are provided in the annexes of the policy (Economic Survey, 2011/12).

6. Nepalese Agriculture and Economy

Agriculture sector plays a critical role in the Nepalese economy as this sector still contributes more than one third to Nepal's GDP, and more than two-third of its population depend on it for their employment and livelihood. Lack of adequate knowledge, skill, technology and entrepreneurship to transform the prevailing traditional farming to commercial farming system not only contained farmers to subsistence farming but also they are suffered by the under employment and disguised unemployment problems. Factors like easy access to irrigation facility on agricultural lands, improved seed and seedlings, chemical fertilizers, pesticides, agricultural loans, advance farming technology, and farmers' access to technology and knowledge play vital role in mitigating this problem and enhancing agricultural production. But according to statistics of the previous years, addition of irrigation facility, supply of agricultural credit, chemical fertilizers, improved seeds and seedlings has not been satisfactory. Due to severe fluctuations on availability of such inputs make farmers remain reluctant to take risk due to the uncertainty on the availability and accessibility of these inputs and this has direct impact on agricultural production.

6.1 Special Programs on Agriculture Sector

- a. Mission Program for Agricultural Production: Promotional programs for production of onions, maize, lemon, fish and oilseeds have been carried out with the objective of substituting imports of these products. These programs

were implemented in Sunsari, Sarlahi, Rauthat, Bara, Kavre, Chitwan, Nawalparasi, Rupandehi and Dang for Maize farming while, onion farming covered Saptari, Sarlahi, Siraha, Dhanusha, Bara, Parsa, Rupandehi, Banke and Bardia, districts, pisciculture covered Sunsari, Saptari, Bara, Parsa, Chitwan, Nawalparasi, Rupandehi, Banke and Bardiya districts. Likewise, Sarlahi, Chitwan, Lamjung, Nawalparasi, Kapilbastu, Pyuthan, Dang, Surkhet, Banke and Bardiya districts conducted oilseeds program while lemon farming program covered Terathum, Dhankuta Bhojpur and Makwanpur districts. These programs have transferred modern farming technology to the farmers thereby bringing positive impacts on the agriculture production and productivity.

- b. Cooperatives run Poultry and Pig Farming Program: This program, which was started from 4 districts in FY 2008/09 targeting Dalits, socially downtrodden and back-ward communities, janajatis, women, squatters, marginalized and bonded labourers and landless farmers, has now been extended to 26 districts including Kailali, Bardiya, Banke, Dang, Saptari, Jhapa, Morang, Sarlahi, Udaypur, Ramechhap, Dhading, Sindhupalchowk, Syangja, Dolakha, Kavre, Dhanusha, Bhaktapur, Nawalparasi, Lamjung, Parwat, Sindhuli, Parsa, Makwanpur, Mahottari and Banglung. Such program has helped instil the sense of cooperative among the farmers associated with this program together with the rise in their incomes.
- c. One Village, One Product Program: One Village, One Product Program, based on the Public-Private Partnership approach, has made remarkable achievement after reaching the second phase with completion of 5 years of its execution. Under this program, betel nuts production in Jhapa, turmeric farming in Sunsari, ginger farming in Salyan and Palpa, rural agro-tourism scheme in Lamjung and Szechwan pepper farming in Myagdi are being conducted in the current fiscal year. Similarly, Jarailo and Basmati Chamal farming in Doti, banana farming in Chitwan and Kanchanpur, fish farming in Dhanusha and Mango farming in Saptari are also included in this program.

6.2 Status of Imports and Exports of Agro- Products

Exports of food items, live animals, tobacco and beverages according to Standard International Trade Classification (SITC) group had increased by 17.2 percent with a total worth of Rs. 10.5 billion in the first eight months of FY 2010/11 as compared to the corresponding period of its previous year. Export of such items during the corresponding period the current fiscal year is estimated to total Rs. 10.12 billion only with a decline of 3.58 percent as compared to the previous fiscal year. Food items and live animals worth Rs 14.54 billion and tobacco and beverages worth Rs 1.7 million were exported in the fiscal year 2010/11. Likewise, food items and live animals worth Rs 29.27 billion and tobacco and beverages worth Rs 2.17 billion were imported in FY 2010/11. In the first eight months of the previous FY 2010/11, food items, live animals, tobacco and beverages worth Rs. 20.49 billion were imported while imports of such commodities has increased by 30.38 percent and reached Rs 26.71 billion in the same period of current fiscal year. Likewise, in the first eight months of the

previous fiscal year 2011/12, beverages worth Rs. 1.42 billion were imported while Rs. 1.83 billion has increased in the imports of such item in the same period of the current fiscal year. During the review period, on agro-products (food, live animals, tobacco and beverages) side, last year's trade deficit of this group rose by 66 percent reaching Rs. 16.59 billion.

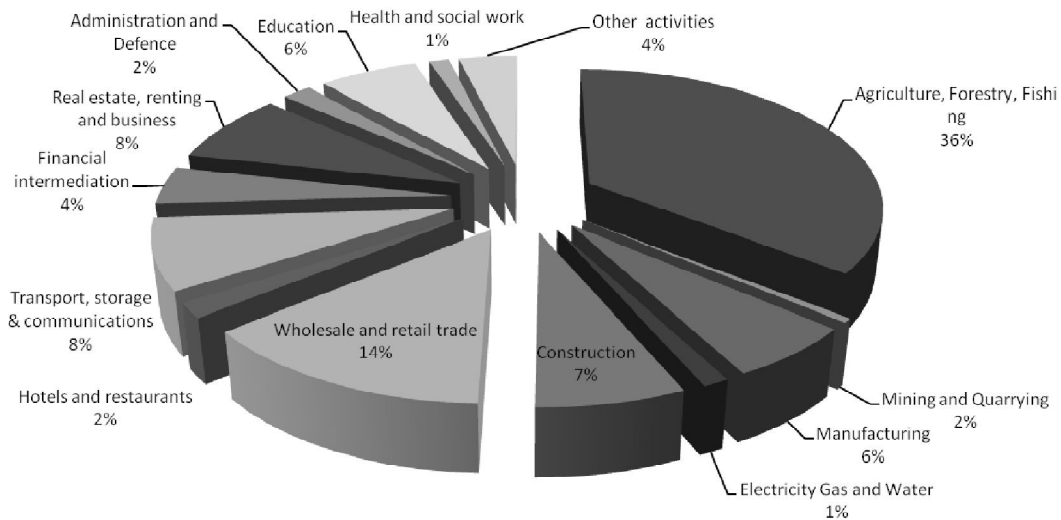


Figure 2: Percentage Contribution to GDP by Sectors

Source: *Statistical Information on Nepalese Agriculture, 2010/2011.*

7. Nepalese Agriculture and Environmental Degradation

Two third of Nepalese people are involved in farming business exploiting only 21% of cultivable land for their livelihood. Majority of the farm families are semi-literate or illiterate and scattered in rural settlements. An increase in population by 2.2% annually is producing additional labor force in the national labor market. Average size of land holding is small (0.5 ha) fragmented in scattered parcels of three thus limiting agriculture commercialization.

Forty five percent of the farmers, having less than 0.5 ha, share only 13% of total land (CBS, 2010). Owing to modern sophistications and ever-increasing population, meeting people's increasing and changing needs and aspirations, on one hand, is a major burden to the country. On the other, crop profitability (particularly on cereals) is declining due to aforementioned agri-business related challenges. The consequence is over exploitation of natural and land resources.

Such resulted in degradation of environment deeply connected with permanent loss, depletion or pollution of natural resources, adverse weather, changing microclimates and unbalanced situations in the components of inherent chain in the ecosystems. Excluding adverse physiographical, ecological, geological and meteorological factors resulting in common natural hazards such as floods,

earthquakes, droughts, cold and hot waves, hailstones, windstorm and cyclone, landslides, disease epidemics, glacial lake outburst flood (GLOF), avalanches, thunderbolt and fires, the environmental degradations are basically caused by human intervention in various aspects of modern technology adoptions. Ever increasing surplus labor forces are compelled in general to cultivate mountain slopes and other marginal lands in the country in meeting their employment and day-to-day basic needs.

The consequence of such practice in long run is land resources and environmental degradation. There is a high and increasing pressure on the forest area because of rapidly growing population and their dependence on fuel wood for major share (77%) of energy required. Besides, encroachment of forest area for cultivation and settlements and thus human induced landslides, floods and water erosion have resulted in massive depletion of forest and agricultural land. The annual deforestation rate is highest in Nepal (1.8%) among the South Asian Countries, and more than 100 thousand hectares of forest were reported deforested within a short period of 1997 to 2000. However, forest regeneration to an appreciable level is reported recently upon coming of community forest user groups (CFUGs) into forest management.

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Likewise, various types of agricultural operations and hazardous effluents from agro-industries and processing plants, slaughter houses and veterinary hospitals and clinics, when not collected and disposed safely (Haung, 2004), are subject to water, air and land pollution in the country. Despite being the second richest country in water resources in the world, chronic shortages of water at various places of the country is a common problem. Impurities in water increase with its scarcity and introduction into water sources of various pollutants because of agricultural operations such as drainage from agricultural lands and processing units. Deforestation, agricultural mechanization, processing plants and crop production such as paddy are responsible for emitting air polluting suspended particles such as CO₂ into the atmosphere. Carbon dioxide (CO₂) is considered as a very important green house gas (GHG), increasing concentration of which in the air is the threat to

maintaining the country with Low Carbon Economy (LCE). The aim of a LCE is to integrate all aspects of manufacturing, agriculture, transportation and power-generation with technologies that produce energy and materials with little GHG emission. Recently, most of the scientific and public opinions have concluded that there is an unreasonable accumulation of GHGs (especially CO₂) in the atmosphere; over-concentrations of which in the atmosphere would fundamentally change the earth's climate adversely affecting resource bases and lives in the foreseeable future. For which only humankind is blamed, and LCE is globally proposed as a mean to avoid catastrophic climate change and as a precursor to an ideal zero-carbon economy to maintain everlasting cycle of nature. Therefore, LCE is now considered as the necessary condition for modern agriculture as well.

7.1 Strategies for Environment Friendly Agriculture

Nepal, a country of villages and townships, is a dwelling of people making their livelihood largely from agriculture. Having a mountainous geography, very little area is cultivable with poor farming facilities. Because of the economic challenges Nepal is facing, its products cannot compete directly with the commodities of the international trading partners. Presence of plenty of resources with great diversities can be valuable assets to the country for producing agricultural unique products to exploit markets in the international trading arena. In view of the agricultural development situations in the country and environmental concerns aforesaid, Nepal can strategize its agri-businesses promotion and environmental protection through harnessing comparative advantages of diversified agro-ecological areas and microclimate there in producing niche products for the potential niche markets especially in India, China and other south Asian countries. Organic products, popular products associated with specific geography and the products with distinct uniqueness are the possible areas of production promotion for export. Some commodities such as honey, cardamom, tea, coffee, zinger, vegetable seeds, off season fresh vegetables and citrus fruit (especially mandarin) are the areas where Nepalese farmers can exploit the opportunity. In such view, Nepal has agri-business promotion policy with import substitution and export promotion instruments. However, agriculture sector in Nepal, though mentioned getting top priority in each of the periodic plans and fiscal years, is subject to low budgetary disbursement. Actual budgetary disbursement does not indicate the above stated scenarios. The state has provided the sector with less than 5% of its total annual budget in every year, while the sector is contributing more than 33% to national GDP. This does not coincide with the mission of attaining high economic growth through the intensive and accelerated growth in agriculture sector.

Niche products identification, promotion of such productions in value chain approach and quality assurance and certification are prerequisites for an assured international market of such unique products. In the value chain management, quality standards, timely and sizeable supply and competitive prices are also important as basic requirements of the products' movement into the global market system. Regular production of such products and their competitive disposal in the export markets also needs maintenance of consumer-friendly environment, and assurance of no or low creation of environmental (air, water, soil and/or other) pollution in their production

and processing, and thus necessitates very low emission of carbon into the surrounding biosphere. Quality concerns of them are also connected with good agricultural/manufacturing/hygienic practices (GAP/GMP/GHP), sanitary and phytosanitary requirements and good record keeping of such practices for the products' quality assurance and proving them free of pesticides and other harmful chemicals residues, certification by an internationally accredited laboratory and free movement to trans-border markets.

Thus farming with no or low use of agrochemicals becomes a strategic destination towards achieving sustainable development of Nepalese agri-businesses. Such would help to create low carbon economy in the country. Promotion of alternative energy sources like biogas, improved cooking stoves and solar energy from photovoltaic system is important also in achieving environment friendly agriculture development. The Alternative Energy Promotion Centre has been working on such promotions through a twenty-year master plan to reduce pressures on forest resources mainly due to fuel wood supply. Peoples and different devices in use can utilize the energy sources efficiently and recycle the wastes in a way to have a minimal GHGs output. Furthermore, it has been proposed that to make the transition to an LCE economically viable, we should cost on GHGs production through an approach such as emissions trading and carbon taxation based on natural and social justice.

7.2 Possibility for export

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8. Critical Assessment

The relationship of agriculture with environment is even more pronounced in case of Nepal, as the agriculture is the major economic activity of Nepal and this sector contributes around one third percent of total GDP. Despite some increase in agricultural production over the years, the population growth in Nepal has outstripped agricultural production resulting into a growing concern about sustainability of agricultural production system. Although the environmental consequences of agriculture in Nepal have not been alarming, there has been some reporting on the negative environmental impacts due to agriculture sector. Some of the issues of environmental implication reported are environmental effects due to excessive use of pesticides including use and disposal of Persistent Organic Pollutants (POPs) (Rizal and unbalanced use of chemical fertilizers improper agricultural practices in the uplands overgrazing of livestock and methane gas emission by livestock indiscriminate use of veterinary medicine and feed supplements in livestock, erosion of agro-biodiversity. These environmental issues indicate that there is a need for some policy/legal framework to govern such environmentally sensitive activities so that environmental effects of such activities can be minimized and ensure adoption of suitable mitigation measures. The provisions relevant to agricultural sector in the Environmental Protection Act (EPA), 1997 and the Environment Protection Rule (EPR), 1997 are supposed to address these concerns. This paper has attempted to examine the provisions in the EPA, 1997 and the EPR, 1997 and provisions related to agriculture and environment in relevant policy documents of GON such as National Agricultural Policy, 2004; and Tenth Plan, 2002. The paper has also discussed preparedness of Ministry of Agriculture Development (MOAD) to implement such legal and policy provisions. Finally, this paper has discussed mechanisms to facilitate the implementation provisions of EPA under MOAD.

9. Conclusion

As agriculture is closely linked with environment, the environmental consequences due to agriculture need to be regulated. In case of Nepal, the environmental consequences due to agriculture sector though not that alarming, some negative implications have been reported. The Environment Protection Act (EPA), 1997; Environment Protection Rule (EPR), 1997 and other policy documents of GON have provided framework for governing agricultural activities in order to minimize its environmental consequences. The provision of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) in EPA, 1997 provide basis for environmental assessment of activities related to agricultural sector in Nepal.

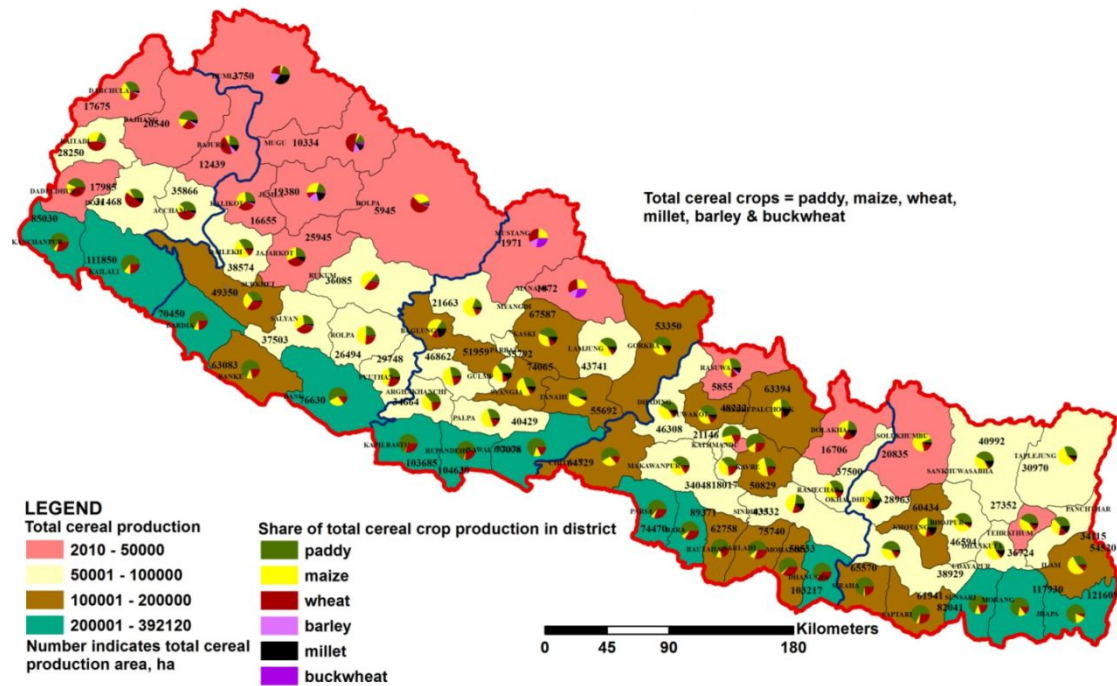
However, the implementation of the provision of IEE and EIA has not been that effective under Ministry of Agriculture Development (MOAD). Various policy and implementation constrains are impeding the functional implementation of EPA under MOAD. Some of the anomalies in EPR, 1997, lack of explicit 'agro environment policy and procedural guidelines for agriculture sector' and inadequate capability development of human resources under MOAC in environmental issues are the major constraints identified.

The intensive use of inputs with green revolution has not only polluted soil, water and environment causing slow degradation but also affected human beings and animals. With this realization, organic agriculture emerged since late eighties as an alternative to reduce such hazards. At present, world market for organic produce is increasing and people are ready to pay the premium for foods raised without the use of chemicals. As majority of farms in Nepal are still in traditional farming, there is a good prospect to adopt organic measures. However, as per the world regulatory functions, Nepal still face challenges in terms of product certification and other relevant infrastructures and policy framework. In the context of WTO, Nepal needs to re-examine existing policies and formulate policies that support for wider adoption of organic agriculture for which research on technological aspects of organic farming relevant to Nepalese context needs to be carried out.

Organic agriculture can be a sustainable alternative to mitigate the adverse effects of chemicals on human health and environment. Contrary to traditional farming, where farmers use local and indigenous resources, limited organic agriculture with the use of bio fertilizers and pesticides, favors greater production. However, for a developing country like Nepal, lower production in organic farming in the initial years need to be compensated with assured supply of organic manures, pesticides and market assurance. Programs and policies need to support the production and use of organic manures and researches on use of bio-pesticides and other inputs needs to be strengthened.

Appendix-1

Map On Distribution, Production and Share of Total Cereal Crops Production, 2010/2011



Bibliography

- [1] Acharya, G. P., (2007). Nutrient losses from rain-fed bench terraced cultivation systems in high rainfall areas of the mid-hills of Nepal. *Land Degrad. Develop.*, 18: 486-499.
- [2] Adhikari, P.R., (2002). A Review of Integrated Pest Management Program for Sustainable Agriculture Development in Nepal. *Agriculture and Environment Journal*, MoAC, Kathmandu.
- [3] Andreatta, S.L., (1998). Agrochemical exposure and farm worker health in the Caribbean: a local/global perspective. *Human Organization* 57 (3),350-358.
- [4] Antle, J. M., (1993). Environment, Development, and Trade between High- and Low-Income Countries, *American Journal of Agricultural Economics*, 75(3), 784-788.
- [5] Biot, Y.,(1995). Rethinking research on land degradation in developing countries. *World Bank Discussion Papers*, pp. 96.
- [6] CBS, (2010). National Living Standard Survey, Central Bureau of Statistics, NPC, Secretariat, Kathmandu, Nepal
- [7] Dahal, B. D., (2007). Effects of agricultural intensification on the quality of rivers in rural watersheds of Nepal. *Journal of Food, Agriculture and Environment*, 5(1): 341-347.
- [8] DOA, (2001). Annual Report of Soil Science Program, Crop Development Division, DOA/MOAC, Kathmandu, Nepal.
- [9] G.C. K., (2003). Environment, Agriculture and Nutrition. *Agriculture and Environment Journal*, MoAC, Kathmandu, Nepal.

- [10] Galt, R.E. (2008). Pesticides in export and domestic agriculture: Reconsidering market orientation and pesticide use in Costa Rica. *Geoforum* 39, 1378–1392.
- [11] Ghatak, S., and Turner R.K., (1978). Pesticide use in less developed countries. Economic and environmental considerations, food policy, May, 136-146
- [12] Haug, M.A., (2004). Good Garbage: A Review of Organic Waste Recycling Practices in Kathmandu, Nepal.
- [13] Lal, R., (2000). Controlling greenhouse gases and feeding the globe through soil management. The Ohio State University, Columbus, Ohio.
- [14] Malla, G., (2006). Effect of different fertilizers in reducing Methane gas emission from rice fields. Summer crop workshop proceedings.
- [15] Malla, G., (2008). Climate change and its impact on Nepalese agriculture. *The Journal of Agriculture and Environment*, 9: 62-71.
- [16] MOAC, (2004). National Agriculture Policy, Ministry of Agriculture and Cooperatives, GoN, Kathmandu, Nepal.
- [17] MOAC, (2010/2011). Statistical Information on Nepalese Agriculture . ABPSD/ MOAC/GoN, Kathmandu, Nepal.
- [18] MOAC, (2007). Statistical Information on Nepalese Agriculture . ABPSD/ MOAC/GoN, Kathmandu, Nepal.
- [19] MOF, (2011/012). Economic Survey. Ministry of Finance, GoN, Kathmandu, Nepal.
- [20] Ongley E. D., (1996). Control of water pollution from agriculture. Food and Agriculture Organization of the United Nations, Burlington, Canada.
- [21] Palikhe, B.R., (2002). Pesticides and the Environment. *Agriculture and Environment Journal*, MoAC, Kathmandu, Nepal.
- [22] Palikhe, B.R., (2006). Pesticides as Water Pollutants. *Agriculture and Environment Journal*, MoAC, Kathmandu, Nepal.
- [23] Rauniyar, G.P., (1998). Adoption of management and technological practices by fishpond operators in Nepal. *Aquaculture Economics and Management*, 2 (3): 89-99.
- [24] Shah, P. B. and H. Schreier, (1991). Soil fertility and erosion issues in the middle mountains of Nepal. Workshop Proceedings. Kathmandu, Nepal.
- [25] Shrestha, D. P., (2004). Modeling land degradation in the Nepalese Himalaya. *CATENA*, 57 (2): 135-156.
- [26] Westarp, S.V., (2004). Agricultural intensification and the impacts on soil fertility in the Middle Mountains of Nepal. *Canadian journal of Soil Science*, 323-332.
- [27] Williams Shon P., Shumway C. Richard, (2000). Trade Liberalization and Agricultural Chemical Use: United States and Mexico. *American Journal of Agricultural Economics*, 82(1): 183-199.

Abbreviations/Acronyms

EIA	-	Environmental Impact Assessment
EPA	-	Environment Protection Act
EPR	-	Environment Protection Rule

FY	-	Fiscal Year
GAP	-	Good Agricultural Practices
GDP	-	Gross Domestic Product
GHG	-	Green House Gas
GHP	-	Good Hygienic Practices
GMP	-	Good Manufacturing Practices
GNP	-	Gross National Product
GON	-	Government of Nepal
IEE	-	Initial Environmental Examination
LCE	-	Low Carbon Economy
MOAD	-	Ministry of Agriculture Development
Rs.	-	Rupees
WTO	-	World Trade Organization