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AN INVESTIGATION INTO THE VANISHING BIODIVERSITY: IMPLICATIONS FOR RURAL EXTENSION

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Abstract

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Being rich in biological diversity, Pakistan represents at least three distinct bio-geographical regions, namely Pale-arctic, Ethiopian and Oriental. The country is blessed with a varied climate, dry and cold regions, tropical, subtropical, plains, deserts, estuaries and marine ecosystems. A huge variety of flora and fauna exist in their preferred habitats. However, the country has witnessed many ecological changes due to several factors, which include heavy biotic pressure, unsustainable use of biological resources, urbanization, deforestation etc. These pressures and exerting factors have resulted in the loss of suitable habitats and consequently extinction of several valuable species. The article presents an account of the factors responsible for the current losses of biodiversity. A review of the conservation measures is also presented in the article. However, the greater emphasis has been placed on the great potential role of extension

Key words: **c**limate change, habitats destruction; anthropogenic activities; awareness creation; capacity building

Introduction

Pakistan with the highly diversified landscapes and relief comprises of the majestic high mountain ranges of the Himalayas, Karakoram, and Hindu Kush; the snow-covered peaks and eternal glaciers; the inter-mountain valleys in the north, the vast rich, irrigated plains in the Indus basin; stark deserts; and impressively rugged rocky plateaus in the southwest of Baluchistan as seen in Figure 1. It is a land of great rivers; large dams, such as the Tarbela and Mangla; and high mountain peaks K2 (8611 m) and Nanga Parbat (8126 m). The Indus basin river system is the world's largest contiguous irrigation system. Indus and its tributaries - the Kabul, Jhelum, Chenab, Ravi, and Sutlej are the rivers irrigating the Indus plains. The country is quite rich in a variety of fauna, flora, wetlands, and other wildlife habitats and landscapes. Biodiversity includes

Fig. 1. Map of Pakistan indicating its location

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all the wilderness areas and scenic landscapes in the country, together with their associated fauna and flora. It also includes protected areas with spectacular scenic attractions, particular communities of plants, and habitats that support animals, birds, reptiles, and insects. On a larger scale, compatible associations of such habitats are referred to as ecosystems. These, in turn, can be grouped into broad ecological zones or types. Pakistan has 9 major ecological zones and 21 out of 22 of the recognized Asian wetland types, providing winter habitats or resting stations for millions of migratory birds (NCS, 1992).

Despite all of the prevailing wide variety of landscapes, ecosystems, climate and four distinct seasons of the year, biodiversity is still on the decline and some species are on the verge of extinction. Several factors are responsible for the loss of biodiversity. It seems imperative to enlist the factors responsible for the loss of biodiversity and take necessary measures to conserve and promote the levels of biodiversity in the country. The article is an endeavor in this direction. An effort has been made to identify the factors responsible for the loss of biodiversity. The article discusses some possible conservation measures to improve the situation. The possible role of Extension and education and capacity building programs in the conservation and promotion of biodiversity has also been briefly touched upon.

An overview of the status of biodiversity in Pakistan

Pakistan is rich in biodiversity due to its diversified landscapes and ecology. It has relatively low national rates of endemism for some species (about 7 per cent for flowering plants and reptiles and 3 per cent for mammals) and higher rates for others (15 per cent for freshwater fish) (GOP, 1999; BAP 2000; GOP 2009). The proportion of "restricted range" species is much higher. For many of these species, Pakistan contains the majority of the global population (BAP, 2000). A high percentage of Pakistan's birds are migratory; over 30% of recorded species are Palaeartic winter visitors (Roberts, 1991). The Sulaiman Range, the Hindu-Kush and the Himalayas in NWFP and AJK comprise part of the Western Himalayan Endemic Bird Area. This is a global center of bird endemism with 10 restricted range species found in Pakistan (GOP 1999; GOP 2007). Pakistan comprises a remarkable number of the world's broad ecological regions and includes four biomes: the desert biome, temperate grassland biome, tropical seasonal forest biome, and mountain biome. Pakistan fauna includes 668 birds (25 threatened), 198 freshwater fishes (29 endemic, 1 threatened), 177 reptiles (13 endemic, 6 threatened), and 174 mammals (6 endemic, 20 threatened). About 5,700 species of flowering plants have also been identified (Roberts, 1997; GOP, 1999; BAP 2000; GOP (2007). The number of endemic species and those considered as threatened with extinction are presented in Table1.

Factors Responsible for the Loss of Biodiversity

Pakistan is experiencing an ecological declining trend. The country is suffering from continuing loss, fragmentation and degradation of natural and modified habitats. The biodiversity loss is due to shrinking forest area, fragmenting and reducing fertile lands and degrading natural resources; most rangelands are suffering further degradation; and many freshwater and

Table 1
Species richness and endemics for major plant and animal groups

Species/Group	Total reported in Pakistan	Endemic	Threatened
Mammals	174	6	20
Birds	668	N/a	25
Reptiles	177	13	6
Amphibians	22	9	1
Fish (freshwater)	198	29	1
Fish (marine)	788	-	5
Echinoderms	25	-	2
Molluscs (marine)	769	-	8
Crustaceans (marine)	287	-	6
Annelids (Marine)	101	-	1
Insects	>5000	--	-
Angiosperms	5700	380	N/a
Gymnosperms	21	-	N/a
Pteridophytes	189	-	N/a
Algae	775	20	N/a
Fungi	>4500	2	N/a

Source: Government of Pakistan (GOP), 2009

marine ecosystems have already been lost or are threatened with further destruction (GOP, 2007). Also of great concern in Pakistan is the continuing decline in many native species of animals and plants. Some species are already extinct and many are threatened. The degradation of agro-ecosystems and the accelerating loss of domesticated genetic diversity also constitute issues of serious concern in Pakistan (Baig and Ahmed, 2007; Baig and Al-Subaiee, 2009). Some of these threats to biodiversity are discussed below.

Declining Forests and Increasing Deforestation

Pakistan is a forest deficit country where forests spread over an area of 4.2 million ha and cover about only 4.8 percent of the total surveyed area of 87.98 million ha. Vegetation in these forests is thin, sparse and patchy and area under the forests as compared to the other country is significantly low. Deforestation rate and felling of trees in the country are very high (Baig and Ahmed, 2007; Baig and Al-Subaiee, 2009). Forests resources are meager and shrinking due to commercial logging and overexploitation for fuel, fodder, building materials, resin, food, and charcoal; combined with livestock grazing, which hinders or prevents forest regeneration. Pakistan's woody biomass is declining at a rate of 4 to 6% per year (GOP 1992). Consumption (primarily for household firewood) exceeds production in all provinces except in the relatively sparsely populated Northern Areas; consumption is expected to increase in line with human population growth at about 3% per year. Pakistan's woody biomass could be totally consumed within the next 10 to 15 years (GOP 1992). However, the deforestation has led in the decline of biodiversity because, with the disappearance of trees, shrubs, and associated ground flora, the vertebrate and invertebrate fauna they normally depend upon get vanished (GOP, 1999; GOP, 2007).

Grazing of Livestock More Than the Carrying Capacity of the Rangelands

Over 60 per cent (51.3 mha) of the total area of Pakistan is rangelands. Trends in biodiversity in Pakistan's arid and semi-arid rangelands, and to some extent in Pakistan's northern alpine grasslands, are no less disturbing than those in Pakistan's forest ecosystems. Pakistan has some 28.5 million ha of rangeland (GOP 1992). These lands are important as a resource base for livestock rearing as well as for water catchments. Livestock numbers exceed 90 million heads and are increasing by 20 per cent every seven years. Most of these animals graze on these rangelands for forage. Some ranges support livestock that are three times their carrying capacity, and there is serious overgrazing, with ranges producing 50 per cent or less of their capacity. Overgrazing makes the soil vulnerable to wind erosion and ultimately to desertification. Serious and severe degradation of rangelands reduces the diversity of flora and changes the vegetation composition by removing palatable species (GOP, 2007).

Loss of Habitats and Their Degradation

Loss of habitats is the principal cause of the present high rate of global extinctions, and poses a severe threat in all biomes (UNEP 1995). Disappearance of habitat and competition with domestic grazing animals are greater threats to wildlife than hunting. The closed canopy forests of the country are shrinking at the rate of approximately one per cent a year. Pressures stem from commercial logging and livestock grazing. The cleared areas, if they are going to remain as forests, soon develop succession species attractive to wildlife. The subsistence farmers bring more significant changes in the forests. Their damaging operations include the felling of trees through lopping, burning, and tapping; the development of small agricultural plots among the trees; and the excessive grazing of domestic animals (GOP, 1999).

Disturbance of Natural Habitat and Ecosystems

Disturbing the natural habitats and ecosystems can cause more pronounced and severe consequences on biodiversity. The increase in the number of wild boars (Sus scrofa), jackals, and porcupines (*Hystrix indica*), for example, is directly attributable to the elimination of their predators, particularly the large cats. A greater number of wild boars have led to the trampling and

uprooting of crops and a reduction in the numbers of snakes, which in turn has led to an increase in the number of rats, responsible for large post-harvest grain losses. The loss of birds of prey has led to an increase in undesirable bird species. More birds can destroy undergrowth but their droppings, in turn, can lessen the ability to resist water erosion, an ever-present threat in Pakistan (NCS 1992).

Illegal Hunting and Pouching

Illegal hunting, the most common hobby of feudal and big landlords of the country has caused a great damage to the biodiversity of the country. Wild animals such as the lion (*Panthera ceo*), tiger (*Panthera tigris*), cheetah (*Acinonyx jubatus*), one-horned rhino (*Rhinoceros unicornis*), and chausinga (*Cervus duvauceli*) have been hunted to extinction. Currently, the ibex, snow leopard, wild ass, and houbara bustard all face extinction from hunting pressure. All types of falcons are being trapped to satisfy the demands of the Middle Eastern markets and their rich. Various lizards and snakes are killed for their skins, as are crocodiles and larger mammals (GOP, 1999).

Agricultural Practices in the Forests

Agricultural practices affect biodiversity conservation through changes in land use, cultivation on steep sites and marginal lands, increased use of pesticides and fertilizers, mechanization, Irrigation in arid and semi-arid areas, and cropping patterns. Irrigated agriculture is one of the main threats to the fast disappearing riverain and mangrove forests of Pakistan. Riverain forests were rich in a wide variety of plants and animals (GOP, 1992).

Dams and Irrigation

The construction of three dams (Mangala, Tarbela, and Chashma) and 16 barrages in the Indus basin to control flooding and to store water for irrigation has greatly increased the amount of wetland habitat in Pakistan. This has been of benefit to birds, especially wintering waterfowl (GOP, 1992).

Soil issues - Waterlogging and Salinity

Pakistan's agro-ecosystems are experiencing a number of trends damaging to biodiversity. These include soil loss, water logging, salinization, intensification of production, and the increased use of pesticides. Soil degradation, water logging, and salinization all reduce the productivity of agricultural lands, reducing the capacity of these lands to sustain soil microorganisms, invertebrates and higher tropic levels, and indirectly placing greater human demand on natural biodiversity resources. Salinization reduces floral and faunal diversity in crops and field margins (GOP, 1999; GOP, 2007).

Water Pollution

Freshwater and marine ecosystems of the country are threatened due to water pollution. It poses a direct threat to and has broader negative effects through contamination of the food chain. Industrial wastes containing chemical pollutants in the streams and rivers may also damage or destroy agricultural land and, in the end, threaten groundwater systems. Similarly, untreated sewage and agricultural and industrial wastes enter watercourses (only Karachi and Islamabad have sewage treatment works) and finally reach the sea. Domestic and industrial sources, discharges from a nuclear power station, and offshore oil spills cause marine pollution especially in Karachi, mainly originating in the Persian Gulf. This pollution is affecting the coastal mangrove forests and marine biodiversity in coastal waters, as well as threatening the finfish and shrimp fisheries (GOP, 2007; GOP, 2009).

Climate Change in Pakistan and its possible effects on the biodiversity

The country has witnessed significant changes in climate and important climate change threats have been imposed. For example a considerable increase in frequency and intensity of extreme weather conditions, coupled with erratic monsoon rains causing frequent and intense floods and droughts. Melting of Hindu Kush-Karakoram-Himalayan (HKH) glaciers due to global warming has caused threatening water inflows into Indus River System (IRS). Climate change can result an increase in temperature that in turn could result in heat and water-stressed conditions particularly in arid and semi-arid regions and this phenomenon could lead to reduced agriculture productivity. Similarly an increased intrusion of saline water in the Indus delta,

could adversely affect coastal agriculture, mangroves and breeding grounds of fish. Climate change may cause threat to coastal areas due to sea level rise and increased cyclonic activity due to higher sea surface temperatures.

In fact, these threats may lead to major National Security concerns for Pakistan in terms of its Water Security and Food Security and these two alone or in combination can adversely affect biodiversity. Increase in deforestation; and risks to other vulnerable ecosystems (e.g. rangelands, degraded lands, mountainous areas and wetlands) are prime concerns related to climate change observed in Pakistan. This all means that Pakistan is vulnerable to climate change and could experience a severe decline and the complete loss to biodiversity (Mallick, 2010).

The climate change is likely to have multi-facet adverse effects on the ecosystem as a whole, particularly on the already vulnerable forestry sector in Pakistan. Consequently, the most likely impacts of climate change will be decreased productivity, changes in species composition, reduced forest area, unfavorable conditions for biodiversity and higher flood risks etc, as portrayed in the Planning Commission's Task Force on Climate Change (TFCC) report 2010. Many national flora and the development plans stressed the state to the restore, endure sustainable and achieve enhancement of its forests and biodiversity under sustainable forest management and conservation respectively, with particular focus on their relation to climate change. This will not only benefit the state forests but the forest dependent communities and the society as a whole. Focused efforts are needed to develop policies and plans with national spirit to adopt adaptive measures for biodiversity and forestry sector to withstand the present and possible future impacts of climate change.

Damages Caused by the Locals

Until recently, the locals were viewed as a major threat, causing harm to the biodiversity of their areas and were seen as a part of the problem, but now they are being made part of the solution. The capacity of local organizations is being strengthened to conserve and make sustainable use of their natural resources. Through awareness creation programs, they have joined hands with the government and NGOs for management of the protected areas and community conservation areas. In the past, conservation was seen as the sole responsibility of the government. However, it is encouraging to report that all stakeholders have joined hands to undertake conservation measures as their national responsibility. Both public and private sector partnerships (local communities, NGOs and corporate sector) are striving for the conservation of biodiversity and environmental rehabilitation (GOP, 2009).

Measures Adopted for the Conservation and the Strategy for Improvement of Biodiversity

Pakistan has attempted to protect its biological resources for posterity as well as for more immediate functional benefits. The country is making significant attempts to protect biodiversity and the natural capital through the countrywide conservation strategy. National parks are large tracts of land having outstanding scenic merit and of national interest. Parks are set up to protect landscape, flora, and fauna in their natural state. Public can have an access to these parks for recreation, education, and research, but no hunting or trapping of animals or destruction of flora are allowed. Forest products can be collected, provided the original national park values are not affected. The necessary measures for the wildlife conservation, development of national parks, and ecosystems' preservation are:

- Wildlife sanctuaries are areas set aside as breeding grounds. Public access is prohibited or closely controlled. Most importantly, human settlement and livestock grazing are not permitted.
- Game reserves are areas in which controlled hunting is permitted with a license but not of protected species.
- Pakistan has 14 National Parks (1.03 million ha), 89 Wildlife Sanctuaries (4.36 million ha), and 98 Game Reserves (3.54 million ha). The total protected area of 8.9 million ha is about nine per cent of the total area of the country.

The country has also developed "Biodiversity Action Plan (BAP, 1999)" to conserve and promote biodiversity in the country. The plan has a strategy primarily focuses on:

- Planning and policies; legislation;
- Strengthening of institutions and introducing institutional reforms;
- Ensuring in-situ conservation; ex-situ conservation initiatives;
- Monitoring and evaluation of on-going programs;
- Maintaining a reasonable balance between sustainable use and vigilant harvesting;
- Incentives for conserving and promoting biodiversity and adoption of control measures to stop the violators of laws;
- Conducting environmental impact studies;
- Exchange of information at the national, regional and international level;
- Making financial resources available to organizations and professionals engaged in biodiversity in an efficient manner and devising mechanism for their proper appropriate utilization.

Implications for Rural Extension and Need for Capacity Building Programs

Since the creation of Pakistan, numerous multipurpose extension methods strategies and programs have been launched on the high potential areas in the Indus valley blessed with the world's biggest system. Primarily those extension programs were aimed at addressing agricultural issues, bridging the yield gaps and enhancing agricultural production and none of them focused on the biodiversity conservation aspects in the underprivileged harsh areas due to their less importance, although they were rich in biodiversity. However, all these efforts would be of no use unless they are backed and supported by awareness creation; extension and education; and capacity building programs. Technical programs should go hand in hand with educational programs. Important steps are:

- Launching of training capacity building, public education and awareness creation programs;
- Devising means and ways for ensuring an active participation and support from local communities for in-situ conservation;

Framework for Extension

Extension Education has great potential and strong role to conserve and promote biodiversity. It is anticipated that extension service should undertake activities that could focus on the subject by employing holistic approach. Extension Education has many implications in the overall process of development and conservation and a brief account is as presented as under:

- Due to the low literacy rates in the rural areas particularly in the deserts and mountainous areas, the locals are unable to understand the importance of the subject, so do not attach much importance to biodiversity and its conservation, therefore most often do not readily embrace the conservation programs. In the scenario it seems appropriate to adopt pictorial extension modes for disseminating the desired information to educate the rural;
- Today electronic media has emerged as a very strong instrument in transferring new ideas. There is a need to increase the number of telecast, disseminate the importance of biodiversity and its multiple roles in nature and environment.
- Most of the mountainous dwellers and desert occupants are illiterate or less educated and at the same time operate below the poverty line so they have no idea that ruthless harvesting of species would make them disappear one day. Their villages are still without the electricity facility. In the situation, they may not have television sets but they can afford to have Radio sets. Extension Service can educate them on the conservation and developmental endeavours untaken by the government by using Radio.
- Extension must play a pivotal role in capacity building to elevate the awareness levels of locals, development professionals, members of the civil society, and NGOs working in the area, through trainings.
- There is a need to shift top to bottom approach with bottom up one for the success of any extension program.
- Community participatory approaches involve people in the planning implementation monitoring and evaluation of various activities that affect their lives directly.

Conclusions and Recommendations

Pakistan is one of the most fortunate countries for having been blessed with its rich biological diversity due to its location in three distinct bio-geographical regions, namely Palaearctic, Ethiopian and Oriental. The

country's landscape consists of all types of habitats representing dry, cold, tropical, subtropical, plains, deserts, estuaries etc. Correspondingly, a variety of plants and animals are present in these areas. As can be expected from worldwide statistics, hardly 10-15% of the biodiversity has yet been known in this country. There are relatively very few organizations, which are involved in the collation, collection, preservation, and identification and carrying out research on the biodiversity of this country. During last few decades, Pakistan has undergone quick ecological changes due to heavy biotic pressure, unsustainable use of biological resources, urbanization, deforestation etc. These have resulted in the loss of suitable habitats and consequently extinction of several valuable species.

The current losses of biodiversity have been resulted due to direct as well as indirect causes. Many environmental and social problems face us in the new century. Building a just, stable, harmonious world for our children and ourselves should be the central organizing principle for civilization. How we might do this is the overarching question for every one of us. Sustainable development is a way of meeting the needs of the present without destroying resources that future generations will need. It promises a new era of economic growth and an assurance that the poor get their fair share of the benefits of that growth (Hassan, 2003).

Over grazing and deforestation in all terrestrial biomes of the country is major threat to the loss of biodiversity. The main driving forces are high population growth rate, increasing poverty and wide gap between the supply and demand of the natural resources. The population pressure has increased on the marginal lands for subsistence agriculture.

There is a need for greater collaboration among all the stakeholders including government agencies, local communities, civil society, planners and policy makers; and NGOs. They must join hands as partners in biodiversity conservation. The role of Extension and Education cannot be ignored and underestimated. The challenging task of biodiversity conservation and its promotion would remain impossible to accomplish unless supported by the strong and vibrant extension education and capacity building programs.

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