

# Study on the Relation among Agriculture and Forests of Arunachal Pradesh

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## ABSTRACT

The state of Arunachal Pradesh is the northeastern most state of India. It covers the states of Assam and Nagaland to the south. It also comprises of international borders with Bhutan in the west, Myanmar in the east, and a disputed border with China in the north at the McMahon Line. The state has its agriculture as the main source of livelihood for a majority of the region's rural population. In the last 10 years, the per capita land availability in the region has reduced by 18.4 percent and now remains a meager 0.16 ha. The reduction is attributed to the rapid increase in population and consequent fragmentation of the land. Similarly, per capita, cereal availability has also reduced by 9.4 percent in the last 10 years. The present per capita cereal availability is only 0.16 kg, thus making it very important to ensure food security in the region at any cost. Agricultural productivity in the region is not adequate to produce sufficiently for the increasing population. The average agricultural yield at present is 2.1 tonnes ha<sup>-1</sup> (excluding the Maldives) after an increase of 8.1 percent in the last 10 years. The increase is attributed to increased use of fertilizers (69 kg ha<sup>-1</sup>, which is a 40 percent increase in the last 10 years in the region, excluding the Maldives) and the inclusion of more areas from forests into the agriculture sector. This situation has, in its turn, taken its toll by depleting and threatening the remaining biodiversity of the region.

**Keywords:** Aquaculture, Biodiversity, Livestock, Marine pollution, Monocultures, Shifting cultivation.

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## INTRODUCTION

Arunachal Pradesh is located between 26.28 and 29.30°N latitude, and 91.20 and 97.30°E longitude and has an area of 83,743 km<sup>2</sup> (32,333 sq mi). The state is also known as the Orchid State of India or the Paradise of the Botanists. The highest peak in the state is Kangto, at 7,060 meters (23,160 ft). Nyegi Kangsang, the main Gorichen peak, and the Eastern Gorichen peak are other tall Himalaya peaks. The state's mountain ranges, in the extreme east of India, are described as "the place where the sun rises" in historical Indian texts and named the *Aruna* and with a lookout favored by tourists) and Vijaynagar (on the edge of Myanmar) receive the first sunlight in all of India.

Forests play a vital role in the economy of developing countries. A large segment of South Asia's population depends on forests for its housing, fuelwood, and fodder needs (ESCAP, 1995; Asia-Pacific Forestry Commission, 2012). The demand for forest products and services in Arunachal Pradesh is increasing with the growth in population and economy, even as the forest cover in the region deteriorates. McMahon Line as the border between British India and Outer Tibet, placing Tawang and other areas within British India. The Tibetan and British representatives devised the Simla Accord, including the McMahon Line, but the Chinese representatives did not concur. The rich vegetative region is shown in Fig. 1. A disproportionate withdrawal of forest produce as compared to a forest's carrying capacity leads to this deterioration. Between 1990 and 1995, five countries in the region have experienced a reduction in their forest cover; the exception has been India, where forest cover has increased by 36,000 ha. This increase can be attributed to an increase in commercial plantation and wasteland reclamation activities.

## Biodiversity

The state of Arunachal Pradesh has among the highest diversity of mammals and birds in India. It has approx. 750

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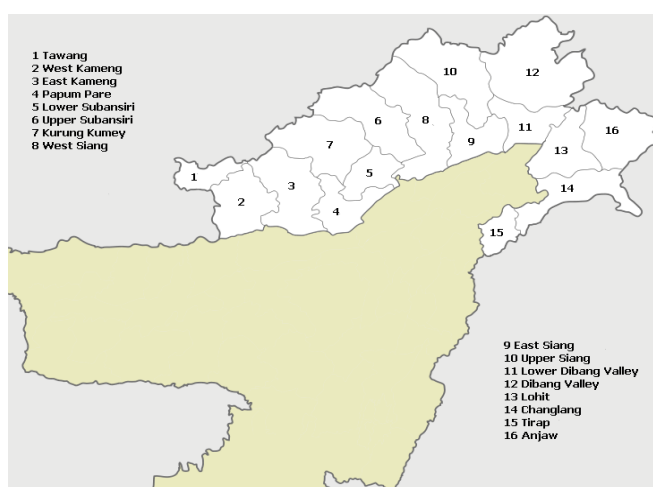
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**Fig. 1:** Showing the different regions of Arunachal Pradesh

species of birds and more than 200 species of mammals in the state (Fig. 2). In the year 2000, the state occupied 60,000 km<sup>2</sup> of tree cover (77% of its land area). The counterparts of forests cover for one-third of habitat area within the Himalayan biodiversity hotspot. Arunachal's forests were studied as part of a vast area of continuous forests (65,730 km<sup>2</sup> or 25,380 mi<sup>2</sup>,

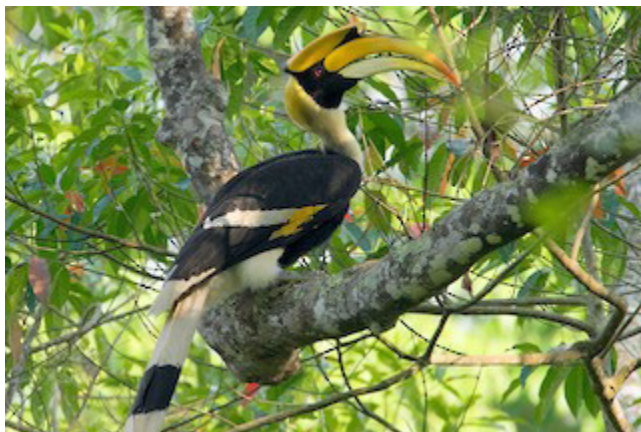
including forests in Myanmar, China, and Bhutan) known as the Intact forest landscapes. It has over 5,000 plants, about 85 terrestrial mammals, over 500 birds, and many butterflies, insects, and reptiles. At the lowest elevations, essentially at Arunachal Pradesh's border with Assam, are Brahmaputra Valley semi-evergreen forests. Much of the state, including the



**Emblem**  
Emblem of Arunachal Pradesh



**Animal**  
Mithun  
(*Bos frontalis*)



**Bird**  
Hornbill  
(*Buceros bicornis*)



**Flower**  
Foxtail orchid (*Rhynchostylis retusa*)



**Tree**  
Hollong (*Dipterocarpus macrocarpus*)

**Fig. 2:** Table showing the state symbols

Himalayan foothills and the Patkai hills, are home to eastern Himalayan broadleaf forests. The northern parts cover Tibet, with an increasing elevation of east and northeastern Himalayan subalpine conifer forests followed by eastern Himalayan alpine shrub and meadows and ultimately rock and ice on the highest peaks. It supports many medicinal plants in the Ziro valley of lower Subansiri district 100 medicinal plants are being used by its inhabitants. The mountain slopes and hills are covered with alpine, temperate, and subtropical forests of dwarf rhododendron, oak, pine, maple, and fir.

The state has Mouling and Namdapha national parks. The subspecies of hoolock gibbon comprises from the state named as Mishmi Hills hoolock *H. h. mishmiensis*. Some new giant flying squirrels were also described from the state during the last one and half-decade. These were, Mechuka giant flying squirrel, Mishmi Hills giant flying squirrel, and Mebo giant flying squirrel.

### Plantations

In order to cater to the increasing demand for fuelwood, fodder, and timber, the area under commercial plantations has increased in five countries of the region (Bangladesh, Bhutan, India, Nepal, and Pakistan) between 1990 and 1995 (Pakistan Conservation Strategy, 1994; Hanson *et al.*, 2000). Forestry has been accepted as a farming practice but has not spread in the region at the desired pace because the rotation cycle of forestry plantations takes time to give returns (Bellamy and Dugan, 1993; McEwan *et al.*, 2019). It, therefore, has become limited to the bigger farmers. The slow-growing indigenous tree species have not been preferred in the commercial plantations, resulting in the introduction of fast-growing exotic tree species, which in turn has changed the composition of the local vegetation to some extent. Plantation forestry has resulted in large-scale monocultures of teak, sal, eucalyptus, Mexican pine, etc. (Davis and Heywood, 1997; Barua *et al.*, 2014). The yield and income data collected from different countries have influenced the developing countries to adopt these species. This has been complemented by the indiscriminate plantation of eucalyptus, even on very dry sites where other species can perform better.

### Shifting Cultivation

Commonly practiced by the hill tribes of India, Nepal, Pakistan, and Sri Lanka, shifting cultivation is considered to be a major cause of deforestation. It is difficult to estimate the exact extent of shifting cultivation in the region due to the dispersed and unorganized nature of the activity, however, it is estimated that it is practiced over an area of 63.57 million hectares by about 22.7 million people in Bangladesh, India, and Sri Lanka (Biodiversity Conservation in Sri Lanka, 1997; Tripathi *et al.*, 2015). In India alone, shifting cultivation is reported to be practiced on 4.37 million hectares, and in Bangladesh, about 800,000 people depend on shifting cultivation in the northern and eastern hills, where land degradation rates are quite high. According to the Forest Survey of India, an important cause of habitat destruction in the eastern Himalayan states of Sikkim and Arunachal Pradesh is slash-and-burn/shifting cultivation practiced in nearly 70 percent of the land area, which has resulted in the loss of nearly 57 percent of forests in the area. However, it is not the practice itself that is faulty; the growing population pressure has led to

a shortening of the fallow cycle, thus, not allowing sufficient time for forest resources to regenerate, which has resulted in this practice becoming unsustainable.

### Livestock Grazing

Forest grazing is also a major factor in the deforestation process. In the region's drier parts, forest grazing is traditional and endemic to agricultural lifestyles. This problem is acute in large parts of India, which suffers from a lack of adequate grazing lands and a mammoth livestock population. Forests, therefore, are the only places where livestock can find any vegetation. Occupying a little over 2.4 percent of the global land area and 16 percent of the human population, India accounts for nearly 20 percent of the world's livestock population. The nation's 12 million hectares of permanent pastures are grossly inadequate for the needs of its 1,896 million heads of cattle. This large livestock population has put tremendous pressure on land, particularly the grasslands. Not only are rangelands damaged by grazing practices, but forests also suffer livestock pressure as branches are cut for fodder, or entire stands are leveled to make way for pastures (Schiltz and Rubenstein, 2016).

In Nepal, lopping is a prevalent practice, with nearly 40 percent of the buffalo feed, and 25 percent of cattle feed is made of logs and leaves, thus putting tremendous pressure on the forests. Besides overgrazing by livestock, conversion to croplands is also a major threat to natural grassland ecosystems and results in decreasing vegetation and exposes the soil to water and wind erosion. In addition, livestock trampling compacts the soil, reducing its capacity to retain moisture. This is estimated to affect 280 million hectares in the region (33 percent of the total degraded land).

### Propagation of Monocultures

Being a primarily agrarian region, agriculture practiced over several thousands of years has led to the building up of a complex gene pool of thousands of crop plants adapted to local conditions. The traditional practice of planting several different varieties of crops in different seasons in an area was intended to minimize risks from crop failure. However, the past years have witnessed the introduction of monocultures of fast and high-yield crop varieties and livestock to increase productivity. The introduction of monocultures has resulted in genetic erosion of domesticated species of plants, animals, and fishes. Thousands of varieties of rice, millets, oilseeds, vegetables, and legumes have been lost, and several breeds of domesticated animals and birds are threatened. The number of threatened breeds includes three breeds of cattle, seven of sheep, five of goats, five of camels, four of horses, and all breeds of poultry. It is estimated that until recently, for the past 50 years, Indian farmers were growing nearly 30,000 varieties of rice. However, Some scientist predicts that by the year 2000 this is expected to reduce to 50 varieties and according to a recent estimate, by 2005, India is expected to produce 75 percent of its rice from just 10 varieties. This is expected to drastically reduce the genetic diversity of staple food crops, posing serious consequences not only for the future plant breeding programs but also for meeting the food requirements of the burgeoning population (Liu *et al.*, 2018).

### Fuelwood and Fodder Extraction

In India, nearly 90 percent of cooking fuel is biomass-based (fuelwood, cow dung, and crop waste). The average annual requirement of cooking fuel in the country is 130 million tonnes, and more than 80 percent of the fuelwood is collected from the countryside. Increased fuelwood needs have been resulting in increased deforestation to the extent that some sacred groves, which were left untouched for several years, have been damaged or cut down. In Nepal, nearly 90 percent of all the energy consumed is still in the form of traditional fuel. Biomass fuel comprises 73 percent of the total energy consumed in Bangladesh.

These subsistence threats have, over the years, led to deforestation and loss of prime habitats of biodiversity. Loss of tree cover has led to erosion, landslides, silting of rivers, and dams and floods downstream, resulting in economic losses. This has put to threat the existence of several species. The introduction of fast-growing monocultures has resulted in genetic erosion and loss of germplasm for evolution (Dhanai *et al.*, 2014).

### Commercial Threats

The past decade in South Asia has been witness to rapid commercial developments with diversification in urbanization and industrialization. There has been an unprecedented spurt in development activities with very little regard for the environment and biological wealth. The increasing demand for and commercial value of the region's biological wealth in markets outside the region has led to increased illegal poaching and trade in biodiversity (Satterthwaite *et al.*, 2010).

### Urbanization and Industrialization

In 1980, the rate of deforestation in South Asia was about 1.7 million ha/annum. The rate of deforestation is analyzed by comparing absolute figures of deforestation with the population figures. The current annual rate of deforestation in South Asia is about 3 m<sup>2</sup>/person. This is due to high populations, limited forest resources, construction of irrigation, hydroelectric projects, mining activities, land settlement programs, and road construction (Groombridge, 1992; Imai *et al.*, 2018). The annual demand for industrial wood in the region is about 28 million cubic meters (mm<sup>3</sup>) against a production capacity of 12 mm<sup>3</sup>. This naturally has serious consequences for the forests in the region. The countries experiencing the fastest deforestation in the region are Bangladesh and Pakistan. Bangladesh, one of the most densely populated areas in the world, has recorded a 94% loss of original wildlife habitat (Lean *et al.*, 1992; Imai *et al.*, 2018). In Sri Lanka, in 1956, the total area under forests was about 44 percent of the total land area; in 1983, it came down to 26.6%, and in 1992, the forest cover stood at 20.2%. Deforestation resulting from the construction of irrigation and hydroelectric projects is also a major problem, especially in Sri Lanka and India. Almost 2.4 million sq km have been lost to deforestation in India.

### Mining

In Sri Lanka, mining for precious gemstones poses serious threats to Peak Wilderness and Horton Plain. A sizeable area of natural forests near Peak Wilderness is reportedly extensively damaged

by soil erosion as a result of mining for precious stones. There is also extensive mining for monazite, ilmenite, rutile, garnet, and zircon along the Tamil Nadu coast in India. It is estimated that there are some 2,000 million tonnes of pure calcareous sand available in the lagoons of Lakshadweep, which could be suitable for a number of industrial purposes (Carvalho, 2017).

### Marine Pollution

This is a problem common to the region resulting in the degradation of coastal areas and resources. The main route of marine transport of oil from the Gulf is across the Arabian Sea, where it passes the southern tip of Sri Lanka across the southern Bay of Bengal, through the Malacca Strait to the Far East and Japan. The sea lane in the southern coast of Sri Lanka carries an annual volume of over 5,000 tankers in ballast or loaded conditions. Dondra Head in the southern tip of Sri Lanka serves as a focal point for ocean transport before ships change course for onward passage. This shipping of oil, coupled with the increasing emphasis on offshore oil exploration in many countries of the region, makes the northern Indian Ocean vulnerable to oil pollution. In addition, effluents from land-based sources (such as refineries) and harbor activities (Garcia *et al.*, 2019).

### Tourism

The climate of Arunachal Pradesh allows variation in the climatic scenario. The low altitude ranges from (200–2,500 m) areas have a humid subtropical climate. The high altitude and very high altitude areas (3,500–5,500 m) have a subtropical highland climate and alpine climate. Arunachal Pradesh occupies 2,000 to 5,000 millimeters of rainfall annually, 70–80% obtained between May and October. Increased tourism continues to be a source of pressure on coastal resources. In fact, coastal tourism is recognized as the most rapidly growing sector of tourism worldwide. In Sri Lanka, between 1970 and 1990, tourism grew by nearly 300% and is expected to increase by another 50 percent by the end of the century. Sri Lanka's coastal resources are expected to come under increasing threat from this economic sector (Dela, 1999). Marine-based tourism is on a dramatic rise in the Maldives as well. It contributes to more than 19 percent of the country's GDP and nearly 30 percent of the government revenues (Global Environment Outlook, 1997). It poses a serious threat of environmental degradation, particularly through the construction of hotels, beach clubs, and marinas, which involves infilling and dredging. Visitor pressures pose a threat to some fragile areas in the Horton Plains in Sri Lanka - especially to a number of rare grassland species. The number of visitors to Adam's Peak has increased dramatically over the last four-five decades. Pressure from tourism has led to the degradation of forests, changes in density and composition of species, and a loss of rare plants. In Sikkim (north-east India), a biodiversity hotspot, unplanned domestic tourism is adversely affecting the biodiversity of the region. Tourists invade ecologically fragile areas such as alpine grasslands, trample, and uproot plants, leaving a trail of destruction behind them. Hotels and lodges in the state consume about 40 kg day<sup>-1</sup> of oak, mahua, and rhododendron bushes for firewood. In several areas in Sikkim, the felling of fir trees for the construction of hotels and lodges

has resulted in accelerated erosion. The growth of trek tourism has resulted in the use of pack animals like yak, which consume nearly 30 kg of fodder, which puts further strain on the forests (Alfred *et al.*, 1998). Unsustainable fishing practices, increasing population pressures, and rising demands for fish and other marine resources have resulted in the introduction of modern fishing methods and technologies, which have completely transformed the industry in the region. Marine catches in South Asia have recorded a constant increase indicating that the maximum exploitation levels have not yet been reached. However, the increased mechanization and destructive techniques of fishing pose a serious concern and threat to the marine biodiversity of the region (Hasnat *et al.*, 2018).

Seven of the 20 edible species of sea cucumbers (Holothuria) found in the Indian Ocean are present in Sri Lankan waters. Till recently, traditional harvesting was limited to the estuarine environment; but to meet the increasing demand, sea cucumbers are being harvested unsustainably in large numbers. Export figures have recorded a decline from 272 metric tonnes in 1997 to 203 metric tonnes in 1998 (Trollvik, 2002). Sea cucumber (beche-ce-mer) catches are entirely exported to Singapore and Hong Kong. The decline is attributed to the declining population in the region.

### Coral Destruction

Most coral reefs in the region are under increasing threat and have been degraded due to causes such as coral mining, fishing with explosives, sedimentation, pollution, removal of reef organisms, anchoring, harbor construction, and removal of coral for curio trade (Martin *et al.*, 1988). However, the latest threat to these reefs is reported to be from the increasing temperatures of the oceans between 1975–1985. Recent estimates are between 200,000 and 100,000 cu m of coral rock annually. Tourism is a major source of income for the Maldivian economy. It also incorporates extensive reef-related activity; tourist resorts in the area have expanded from 2 in 1972 to 74 today. Besides this, corals also face natural threats, which include the large populations of the crown-of-thorns starfish, which causes considerable damage to reefs around Sri Lanka, Maldives, Indonesia, and India. In Sri Lanka, however, most known reefs, particularly the readily accessible near-shore reefs, have been degraded due to human-induced damage (Susiloningtyas *et al.*, 2018).

### Aquaculture

Mangroves and associated lagoons and estuaries which are productive ecosystems, function as nurseries for several species. Loss of coastal habitats includes substantial loss of mangrove forests in South Asia, particularly for making way for the construction of shrimp ponds and paddy rice cultivation, with negative impacts on commercial fisheries that rely on species using the mangroves as nursery areas (IUCN World Commission on Protected Areas, 1998; Ahmed and Thompson, 2018). Fish and shellfish have suffered due to reduced water quality, clearance of mangroves for prawn farming and shrimp ponds, and also the wide use of chemicals in prawn and shrimp farming. Identical problems because of shrimp culture have occurred in Bangladesh, India, and Sri Lanka. One example of

this destructive sequence of events is the Chakaria Sunderbans in eastern Bangladesh, which has been almost completely cleared for aquaculture (World Resources, 1996-97). There are also reports of reduced water quality, Stalination of paddy yields and reduced rice yields (50 percent) due to tiger prawn farming activities in the area—mostly the results of land-fill and reclamation activities for housing and infrastructure.

Thus, In the past few years, the region has witnessed a rapid escalation in incidents of poaching, trading, and smuggling of wild flora and fauna due to increased demand and commercial value of wildlife and their parts.

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