Land degradation, environment and FOOD SECURITY

In developing countries like India, land degradation has been hastened in recent times due to burgeoning population and the amplified exploitation of natural resources. Land degradation undermines livelihood opportunities - triggers poverty, migration and food insecurity.

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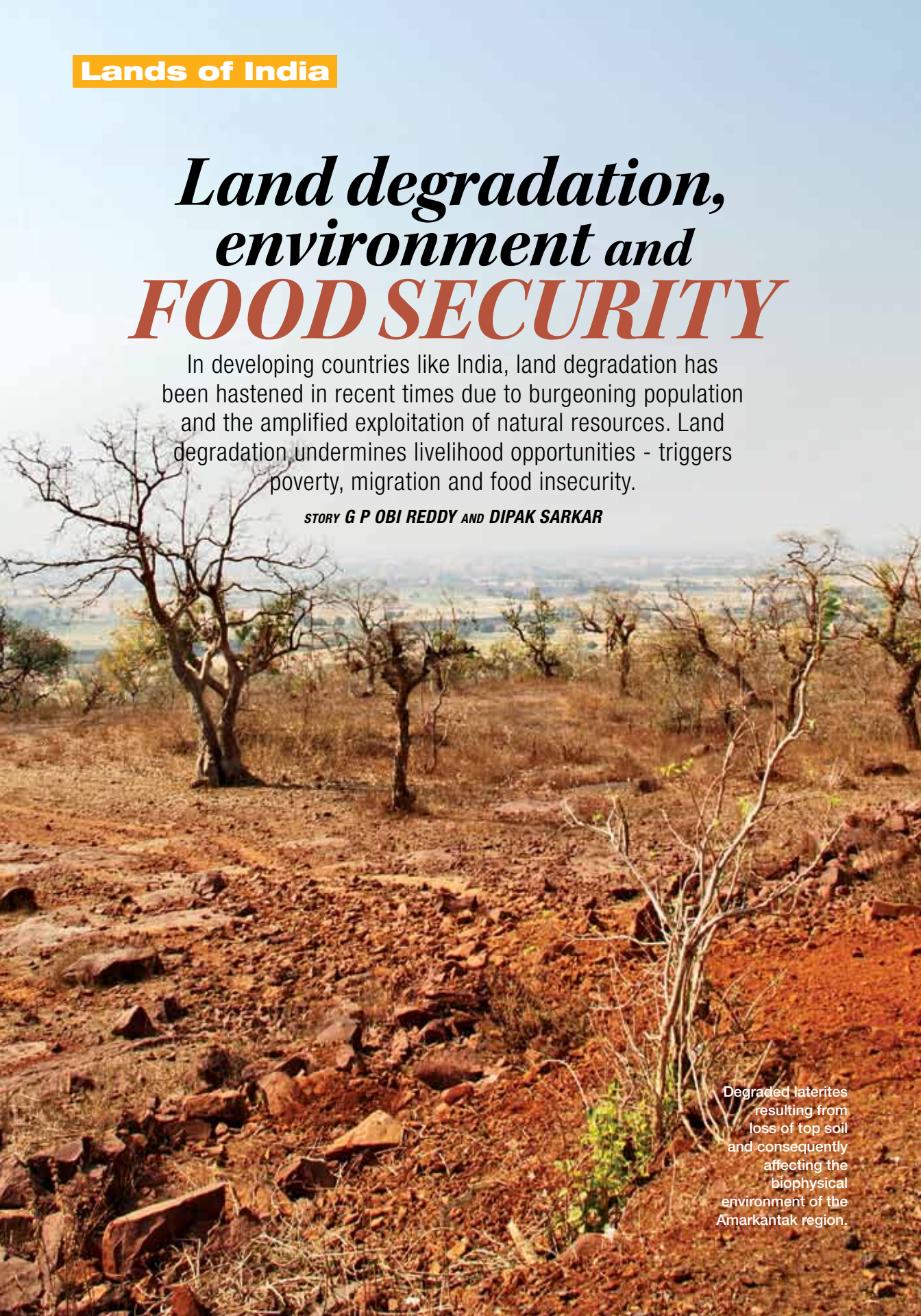

Degraded laterites resulting from loss of top soil and consequently affecting the biophysical environment of the Amarkantak region.

In a recent computation NBSS&LUP integrated spatial data sets using GIS and reported that 120.72 mha in India are under dif erent categories of degraded lands.

Land degradation indicates temporary or permanent long-term decline in ecosystem function and productive capacity. It may refer to the destruction or deterioration in health of terrestrial ecosystems, affecting the associated biodiversity, natural ecological processes and ecosystem resilience. It also considers the reduction or loss of biological/economic productivity and complexity of croplands, pasture, woodland, forest, etc. Land degradation has both, on-site and off-site effects. On-site effects are in terms of reduced/increased outputs (crop yields, livestock yields). Off-site effects on the other hand, are related to water erosion through changes in the water regime, including decline in river water quality and sedimentation of river beds and reservoirs. Land degradation undermines many of the fundamental processes especially nutrient, water and carbon cycling, which underwrite the integrity of ecosystems. Land degradation results from natural or anthropogenic causes, the former often determining the inherent capacity of the ecosystem to provide goods and services. Anthropogenic causes are determined by land use/changes and economic factors.

The physical processes, which contribute to land degradation are primarily water and wind erosion, compaction, crusting and water logging. There are various modes of erosion by water such as splash, sheet, rill and gully erosion. The splash erosion results from the impact of raindrops on the soil surface. Splash erosion also causes soil disintegration (destruction of soil structure). Maintenance of vegetative cover can reduce the impact of splash erosion. Sheet erosion results when rainfall intensity is greater than the infiltration - a layer of water moves across the soil surface, transporting a layer of soil. This layer typically contains fine particles and a significant proportion of the nutrients and organic matter. Rill erosion is deep, fast-flowing channels that are scoured into the ground from the concentration of surface (sheet) water, detaching and transporting soil particles. Gully erosion forms from the deepening and widening of rills and cannot be repaired using tillage equipment. This occurs as water erodes the face or undercuts the head wall, causing upslope migration or via undercutting the collapse or slumping of sidewalls. Once established, gully erosion is dif cult to mitigate and requires a combination of control measures e.g. re-vegetate gully floor and walls and the upstream catchment; divert surface drainage away from the gully, etc. Wind erosion is more common in arid and semi-arid climates, and during droughts.

Shifting cultivation has also been an important cause of land degradation. The chemical processes include salinisation, alkalisation, acidification, pollution and nutrient depletion. Acid soils are highly leached soils and are generally poor in fertility and water holding capacity. An area with pH value less than 5.5 is problematic with severe deficiencies of phosphorus, calcium, magnesium and molybdenum and toxicities of aluminum and iron. Increase in soil pH beyond 8.5 results in sodicity or alkalisation leading to an increase of exchangeable sodium percentage in soils (>15). Based on the type of problem, soils can be divided into saline, sodic and saline-sodic. The biological processes, on the other hand are related to the reduction in organic content in the soils; degradation of vegetation; and impairment of activities of micro flora and fauna.

Land degradation in India

In India, the earliest assessment of the area affected by the land degradation was carried out in 1976 by the National Commission on Agriculture over 148 million hectare (mha). Later in the year 1978, Ministry of Agriculture estimated degraded lands to be 175 mha. In the year 1994, National Bureau of Soil Survey and Land Use

Planning (NBSS&LUP) has estimated 187 mha as degraded lands using the GLASOD methodology; based on the soil resource mapping at the national level on 1:250,000 scale, the estimates were revised to 147 mha in the year 2004. During the year 1984, Society for Promotion of Wastelands Development (SPWD) reported that in India about 129.58 mha of land was degraded.

The estimations of wasteland differ due to the use of varying definitions of land degradation, data sources, classification systems, methodologies and scales. In the year 1985, the National Wasteland Development Board estimated an area of 123 mha under various kinds of wastelands. Based on the land degradation statistics at the state level, in the year 1985 Ministry of Agriculture reported 173.64 mha under degradation. In the year 2000, National Remote Sensing Agency (NRSA) (presently known as NRSC) followed the remote-sensing data based assessment in preparation of the soil degradation and wasteland maps with adequate field checks and reported 63.85 mha under different categories of wastelands. In one of the recent studies, Space Application Centre (SAC) reported that the total land area undergoing the process of degradation is 105.48 mha, which is 32.07 per cent of the total geographic area (TGA) of the country. Recently as a collaborative effort NBSS&LUP carried out the harmonisation of the degraded and wastelands of India by integrating the spatial datasets of degraded and wastelands using GIS methodology and reported that 120.72 mha are under different categories of degraded lands.

About 169.44 mha (51.5 per cent) of India's total geographical area (about 328.72 mha) is under dry lands (arid and semi-arid). Recent works of NBSS&LUP on harmonised degraded and wastelands data sets show that in India, out of the 51.13 mha of arid and 118.31 mha of semi-arid region, nearly 32.18 per cent of arid region and 37.54 per cent of semi-arid region is affected by various degradation processes. Because arid and semi-arid land ecosystems have little ability to buffer the effects of climate variability relative to most other terrestrial ecosystems, they are particularly vulnerable to climate change and global environmental change.

Acid soils found in the zones of high rainfall and temperature are distributed in almost all the states except in the western states, middle and upper Indo-Gangetic plain. In the eastern plains, acid soils are mostly confined to Assam valley although they occur to some extent in eastern Bihar and West Bengal in the lower Gangetic plains. Acid soils of the coastal plain occur in the west coast including Kerala and deltaic areas of Sunderban in West Bengal. These soils are generally described as acid sulphate soils. Highly acidic soils in India are restricted to the Himalayan ecosystem, red and lateritic region of India, comprising both the southern and eastern plateau region and some pockets in the greater plains of the country. As per the recent estimates of NBSS&LUP, the soils with pH value <4.5 covers only 1.9 per cent of the TGA while moderately acidic soils having pH in the range of 4.5 to 5.5 cover about 7.4 per cent of TGA of India.

Food security and environment

Land degradation acts as both a cause as well as an effect of poverty. It bears long-term environmental externalities to which people in marginal lands are especially vulnerable. Land degradation may lead to a lower response to the same inputs and/or require increasingly higher inputs so that crop yields and farm incomes can be maintained. Higher investment in land has a potential to negatively affect the production of food crops,

Gully erosion is difficult to mitigate and requires a combination of measures, for example, re-vegetation of gully floor and walls; diversion of drainage away from gully, etc.

particularly for poor farmers as they face resource constraints in investing in land and water management. Industrial effluents and mining waste are also gradually emerging as important agents of land degradation and environmental pollution. In many parts of the country, industrial effluents and their discharge into inland waters and irrigation with poor quality water are not only rendering stretches of land degraded, use of such waters for irrigation affects the chemical and biological conditions of agricultural lands.

In one of the studies conducted on human-induced soil degradation in Asia, researchers found that almost 20 per cent of all land suffers from moderate to extreme degradation in the 17 countries that were covered. Agricultural productivity is greatly reduced on moderately degraded lands. Land where degradation is classified as strong or extreme is irreversibly destroyed and can no longer be reclaimed for farming.

The Food Insecurity Atlas of India prepared by the UN World Food Programme and M S Swaminathan Research Foundation on the basis of a food insecurity index shows that Bihar and Jharkhand are two 'extremely food insecure' states in India. According to the Atlas, Madhya Pradesh, Rajasthan, Uttar Pradesh, Chhattisgarh, Orissa and Uttarakhand are also 'severely food insecure' states. States such as Andhra Pradesh, Maharashtra, Karnataka and West Bengal are 'moderately food insecure' while Kerala and Tamil Nadu are 'moderately food secure' and Punjab and Himachal Pradesh are 'food secure'. Food security constitutes production, access, and utilisation - degradation of land resources may then lead to increased cost of living and to higher food prices. In fact, the relation between degradation and food security is of enormous complexity due to the interactions between land, water, populations and wealth as well as the rapid changes therein.

End note

Unsustainable land management practices such as deforestation, forest degradation, soil nutrient mining and cultivation on steep slopes are direct contributors to land degradation. Traditional agricultural practices of inter and rotation cropping help to secure the soil, prevent erosion and ensure that nutrients are not depleted. Soil and water conservation measures like contour ploughing to minimise the flow of water down the slopes, terrace farming to restrict erosion in slope areas, strip cropping to minimise the impact of wind erosion, shelter belts for the stabilisation of sand dunes etc. need to be adopted based on local conditions. Proper site specific soil and water conservation measures on watershed basis have to be adopted not only to reduce onsite soil, water and nutrient losses, but also to diminish negative downstream effects such as flooding and the silting of reservoirs. In order to ensure food security, it is important to protect the land from deforestation, fragmentation, degradation, drought and flood hazards. GY

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