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Land Use and Sustainable Management

Dr. Rajendra Kumar

Associate Professor in Botany, Dr. Bhim Rao Ambedkar Govt. College, Sri Ganganagar, Rajasthan, India

ABSTRACT: "Land use" is the term used to describe the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given place. Public and private lands frequently represent very different uses. For example, urban development seldom occurs on publicly owned lands (e.g., parks, wilderness areas), while privately owned lands are infrequently protected for wilderness uses.Land use differs from land cover in that some uses are not always physically obvious (e.g., land used for producing timber but not harvested for many years and forested land designated as wilderness will both appear as forest-covered, but they have different uses). Land use changes occur constantly and at many scales, and can have specific and cumulative effects on air and water quality, watershed function, generation of waste, extent and quality of wildlife habitat, climate, and human health.EPA is concerned about different land use activities because of their potential effects on the environment and human health. Land development and agricultural uses are two primary areas of concern, with a wide variety of potential effects.

KEYWORDS: land use, environmental, practices, EPA, water, agricultural, health, climate

I.INTRODUCTION

- Land development creates impervious surfaces through construction of roads, parking lots, and other structures. Impervious surfaces:
    - Contribute to nonpoint source water pollution by limiting the capacity of soils to filter runoff.
    - Affect peak flow and water volume, which heighten erosion potential and affect habitat and water quality.
    - Increase storm water runoff, which can deliver more pollutants to water bodies that residents may rely on for drinking and recreation.[1] Storm runoff from urban and suburban areas contains dirt, oils from road surfaces, nutrients from fertilizers, and various toxic compounds.
    - Affect ground water aquifer recharge.[1,2]

- Point source discharges from industrial and municipal wastewater treatment facilities can contribute toxic compounds and heated water.
- Some land development patterns, in particular dispersed growth such as "suburbanization," can contribute to a variety of environmental concerns. For example:
    - Increased air pollution due to vehicle use results in higher concentrations of certain air pollutants in developed areas that may exacerbate human health problems such as asthma.
    - Land development can lead to the formation of "heat islands," domes of warmer air over urban and suburban areas that are caused by the loss of trees and shrubs and the absorption of more heat by pavement, buildings, and other sources. Heat islands can affect local, regional, and global climate, as well as air quality.[3]

Agricultural Uses

- Agricultural land uses can affect the quality of water and watersheds, including:
    - The types of crops planted, tillage practices, and various irrigation practices can limit the amount of water available for other uses.

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  - Livestock grazing in riparian zones can change landscape conditions by reducing stream bank vegetation and increasing water temperatures, sedimentation, and nutrient levels.
  - Runoff from pesticides, fertilizers, and nutrients from animal manure can also degrade water quality.[3,4]
- Agricultural land use may also result in loss of native habitats or increased wind erosion and dust, exposing humans to particulate matter and various chemicals.
- Some land uses can accelerate or exacerbate the spread of invasive species. For example:
  - Certain agricultural land use practices, such as overgrazing, land conversion, fertilization, and the use of agricultural chemicals, can enhance the growth of invasive plants.[5] These plants can alter fish and wildlife habitat, contribute to decreases in biodiversity, and create health risks to livestock and humans.
  - Introduction of invasive species on agricultural lands can reduce water quality and water availability for native fish and wildlife species.

Research is beginning to elucidate the connections between land use changes and infectious disease. For example, some studies indicate that spread of vector-borne disease may be influenced by land use and/or other environmental change.

Other studies indicate that fragmentation of forest habitat into smaller patches separated by agricultural activities or developed land increases the “edge effect” and promotes the interaction among pathogens, vectors, and hosts.

In some cases, changes in land use may have positive effects, such as increasing habitat (as a result of deliberate habitat restoration measures) and reclamation of previously contaminated lands for urban/suburban development.[5,6]

The ROE presents two indicators providing information about land use trends: Land Use and Urbanization and Population Change. Available indicators in this area are limited because numerous circumstances (including lack of data; varying approaches to data classification and management, and difficulty in delineating land use) create significant challenges and limitations in tracking trends in and effects of land use.

- Lack of data:
  - There is a general lack of comprehensive data on the types and rates of land use and land cover change, and even less systematic evidence on the causes and consequences of these changes. On a global scale, the National Research Council identified land use dynamics as one of the grand challenges for environmental research.
  - No indicators are available to assess the effects that trends in land use have on human health, as effects have not been shown or quantified on a national basis. Researchers have conducted site-specific studies on individual land uses, but little is known about overall national trends in land use and potential impacts on human health.
  - An additional challenge is that a variety of state and local laws, regulations, and practices govern the use of land. There are few state-level efforts to organize land use data; most activities occur over specific local, usually urbanizing, geographic areas.

    This means that land use records are not maintained statewide or nationally, as they are in other nations. This contributes to challenges in tracking and monitoring land use changes. It also means that efforts to coordinate land use across jurisdictions are difficult to develop.[7,8]
- Varying approaches to data classification and measurement: Estimates of the extent of various land uses differ across data sources, and each source uses different classifications, measurement approaches, methodologies for analysis and interpretation, and sampling time frames. The data are collected by many different agencies that manage land for many different purposes.

  Some data collection efforts arise out of specific interests, such as tracking changes in the extent of agricultural land or farmland, or understanding how much land is used for timber production. These data collection efforts tend

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to develop their own classifications and categorization, making it difficult to integrate the data over time, across inventories, or as a national picture.

- Difficulty in delineating land use: Finally, the difficulty of actually delineating land use presents a challenge in developing data to determine trends. Land use is generally a function of laws, policies, or management decisions that may not always be possible to infer by examining the ground via surveys. Analysis of zoning maps or property records at the local level may be necessary to understand land use.[9,10]

II.DISCUSSION

The United Nations defines sustainable land management (SLM) as "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions".

TerrAfrica (2005) defines SLM as "the adoption of land-use systems that through appropriate management practices enable land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources".

The productivity and sustainability of a land-use system is determined by the interaction between land resources, climate and human activities. Especially in the face of climate change and variability, selecting the right land uses for given biophysical and socio-economic conditions, and implementing SLM, are essential for minimizing land degradation, rehabilitating degraded land, ensuring the sustainable use of land resources (i.e. soils, water and biodiversity) and maximizing resilience.

SLM encompasses established approaches such as soil and water conservation, natural resource management and integrated landscape management (ILM). It involves a holistic approach to achieving productive and healthy ecosystems by integrating social, economic, physical and biological needs and values, and it contributes to sustainable and rural development. [10,11]

SLM is based on four principles:

1. targeted policy and institutional support, including the development of incentive mechanisms for SLM adoption and income generation at the local level;
2. land-user-driven and participatory approaches;
3. the integrated use of natural resources on farms and at the ecosystem scale; and
4. multilevel, multistakeholder involvement and partnerships at all levels – land users, technical experts and policy-makers.

FAO has a mandate to: support its member countries and partners in developing or reforming norms, standards and policies; provide technical advice; and implement national and local programmes through capacity development and technical knowledge management activities.

FAO implements a range of SLM-related programmes and approaches, such as farmer field schools; conservation agriculture; catchment- and farm-scale approaches to integrated land and water management and land husbandry; gestion des terroirs and local land-use planning; integrated plant and pest management; and sustainable forest management.

FAO is the custodian UN agency for 21 indicators of the Sustainable Development Goals (SDGs), cutting across SDGs 2, 5, 6, 12, 14 and 15, and it is a contributing agency to four other SDG indicators. FAO has a strong comparative advantage in its capacity to assist countries in meeting the monitoring challenge posed by the SDGs. Activities are under way for country-level collaboration in the development of indicators for land; land degradation; soils; drought; sustainable forests

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and mountains; sustainable land management; water efficiency and scarcity; women's access to land ownership; food losses and waste; and others. [12,13]

FAO is executing a number of projects, funded by the Global Environment Facility (GEF), addressing transboundary land degradation issues, including: "Integrated Management of the Fouta Djallon Highlands"; "Globally Important Agricultural Heritage Systems"; "Transboundary Agro-ecosystem Management Programme for the Kagera Basin"; "Using Farmer Field School Approaches to Overcome Land Degradation in Agropastoral Areas of Eastern Kenya"; and "Integrated Natural Resources Management in Drought-prone and Salt-affected Agricultural Production Landscapes in Central Asia and Turkey" (CACILM2) (in development).

FAO also implements integrated land resource planning strategies through a wide range of complementary SLM approaches, tools and measures adapted to different biophysical and socio-economic contexts.

Land degradation and desertification threaten the food security and livelihoods of millions of people, especially in drylands. Promisingly, after many decades of on-the-ground work on SLM approaches and practices, many SLM options are available for reversing these negative trends. FAO is prioritizing the identification of affected communities and target areas for implementing locally suitable SLM options for managing land resources with the overall goal of scaling up SLM over large areas.

FAO-developed similarity analyses are used to match areas of interest with areas where farmers have tested, fine-tuned and implemented SLM technologies and where water and land management packages might be applied. Professionals, planners and decision-makers can use the information and products generated from these analyses to identify the most suitable SLM practices and technologies for targeted areas and communities. ILM and land resource planning are other tools for supporting decision-makers and land users in choosing suitable land uses and SLM practices for local biophysical and socio-economic circumstances.[14]

FAO launched the GEF-supported project, "Decision Support for Scaling up and Mainstreaming Sustainable Land Management (DS-SLM)" in September 2015. The project has 15 participating countries in Africa (Lesotho, Morocco, Nigeria and Tunisia), East and South Asia (Bangladesh, China, the Philippines and Thailand), Europe and Central Asia (Bosnia and Herzegovina, Turkey and Uzbekistan), and South and Central America (Argentina, Colombia, Ecuador and Panama). FAO provides technical support, alongside the project's main scientific partner, the World Overview of Conservation Approaches and Technologies (WOCAT) Consortium, the secretariat of which is located in the Centre for Development and Environment at Bern University.

The DS-SLM project builds on existing SLM practices and experiences in target landscapes in each partner country by scaling up and mainstreaming strategies and actions, supported by a global knowledge management platform on SLM and ILM. The project will make relevant tools and methods available for planning, management, monitoring and impact assessment and by sharing experiences within and between regions, and it will develop and test strategic guidance and approaches for scaling up and mainstreaming. In particular, the project will build capacity in the 15 partner countries in three interlinked components: 1) national and local decision support for combating desertification, land degradation and drought (DLDD) and promoting the mainstreaming and scaling up of SLM best practices; 2) the development of a global DLDD and SLM knowledge management and decision-support platform; and 3) monitoring and evaluation, impact assessment, and the dissemination of project results.

There is a separate page for projects, it is necessary to arrange the cross-referencing between the different pages (themes) and the projects as almost all projects are linked to more than one page (theme).[15]

III.RESULTS

FAO is supporting the governments of Burundi and Uganda (the latter jointly with the United Nations Development Programme) in tackling the major drivers of environmental degradation through a holistic, integrated approach to enhancing agricultural productivity in smallholder systems where food insecurity is linked directly to agriculture. The pro-

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poor and inclusive approach aims to mainstream gender and nutrition as crucial issues for achieving food security. The project is part of a GEF regional programme involving several agencies, 11 country projects, and a regional hub project with three components: 1) strengthened institutional framework and support mechanisms; 2) improved livelihoods and food security though integrated natural resource management; and 3) the monitoring and assessment of global environmental benefits and socio-economic impacts. Two projects have been submitted to the FAO project review committee and GEF for approval, with the aim to start implementation in mid-2017. Land degradation in Burundi's highlands is leading to declines in agricultural production and the loss of agrobiodiversity and contributing to food shortages, food insecurity, chronic malnutrition, land and social conflicts, poverty, rural–urban migration, and increased vulnerability to climate change. This project has the specific objective of increasing the adoption of resilient, improved production systems for sustainable food security and nutrition through ILM and sustainable food value chains. It will achieve this objective through a range of outcomes, as set out below.

1. Multistakeholder and multiscalar platforms in support of policy and institutional reform, and a knowledge-sharing mechanism for scaling up SLM and ILM, are in place.
2. Increased land area and agro-ecosystems under SLM and ILM best practices and improved market access and value chains, leading to enhanced and sustained production and livelihoods
3. A monitoring and evaluation framework is in place, and relevant institutions are capacitated in carrying out monitoring activities and communicating experiences and results.

The project will be implemented on the ground in eight selected microcatchments in Burundi's Gitega, Mwaro and Muramvya provinces in the highland agro-ecosystem east of the Congo–Nile watershed divide. The project will also catalyse transformational change across a wider area by providing training and knowledge management products for partner (co-financing) projects, with a gender-sensitive focus. At the national level, the project will support an incremental increase in capacity to realize and monitor the win–win–win benefits of ILM and SLM. [16,17]

Fostering sustainability and resilience for food security in the Karamoja subregion

This project seeks to respond to chronic food insecurity in the Karamoja region caused by environmental degradation and climate change, among other things. Most people in the region experience year-round or seasonal food shortages in the face of increasing droughts. The project seeks to achieve its objective through three outcomes: 1) development and strengthening of multistakeholder platforms that will enable better planning, including landscape-based planning; 2) channelling investments into resilient and adapted food production systems and value chains using a farmer field school approach adapted to the realities of the agropastoral communities in Karamoja and their need for enhanced food and nutritional security; and 3) supporting the development of monitoring and assessment methodologies and the participatory monitoring of project indicators, global environmental benefits, and socio-economic benefits. The project will develop capacity in sound and resilient production techniques and support efforts to diversify production to increase income and reduce vulnerability to climate shocks. Emphasis will be placed on rehabilitating ecosystem services, particularly land-based services, through agroforestry, natural regeneration and sound pasture management. The project will also target specific activities aimed at women and youth, who are especially vulnerable, to ensure equality of participation and the removal of underlying vulnerabilities. The Sixth Small Grants Programme for Uganda will be channelled as a subproject of this initiative. [18]

IV.CONCLUSIONS

Sustainable Land Use ensures a fair and balanced distribution of land, water, biodiversity and other environmental resources between the various competing claims, in order to secure human needs now and in the future. Wageningen Environmental Research integrates knowledge on soil, water, biodiversity and environmental management in order to address conflicting claims to natural resources, while maintaining social and economic security and preserving the environment. We develop this knowledge for partners in education, policy, private businesses and investment companies. The soil of an agricultural landscape has five societal functions," explains Prof. Creamer. "Nearly all soils can supply all five of these functions, but some excel at one while others excel at another." The soil has the following functions:

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- Primary production: producing 'stuff', as Prof. Schulte describes it. This may involve food, animal feed, fuel or fibre
- Regulating and purifying water: ensuring sufficient clean water;
- Sequestering carbon in relation to the climate goals;
- Biodiversity, both in the soil itself and in the crops that grow on it;
- Reuse of nutrients, such as the crucial element phosphorus (P).[19]

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