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UNIT – II
Thematic databases

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In September 2015 the Sustainable Development Goals (were formally adopted by member states of the United Nations, building on the Millennium Development Goals. The Sustainable Development Goals (SDGs) are an ambitious set of 17 goals and 169 targets.

Their stated aims are to eradicate global poverty, end unsustainable consumption patterns and facilitate sustained and inclusive economic growth, social development and environmental protection over a 15-year timeframe (2015–2030).

Achieving the SDGs by 2030 will require many communities and sectors to engage, including the geological sciences. Many of the themes within the SDGs are pertinent to geological research and practice.

The geology community, therefore, should be ready and equipped to take a leading role in promoting and facilitating responsible Earth stewardship, for the public good and global development.

The 17 sustainable development goals (SDGs) to transform our world:

GOAL 1: No Poverty

GOAL 2: Zero Hunger

GOAL 3: Good Health and Well-being

GOAL 4: Quality Education

GOAL 5: Gender Equality

GOAL 6: Clean Water and Sanitation

GOAL 7: Affordable and Clean Energy

GOAL 8: Decent Work and Economic Growth

GOAL 9: Industry, Innovation and Infrastructure

GOAL 10: Reduced Inequality

GOAL 11: Sustainable Cities and Communities

GOAL 12: Responsible Consumption and Production

GOAL 13: Climate Action

GOAL 14: Life Below Water

GOAL 15: Life on Land

GOAL 16: Peace and Justice Strong Institutions

GOAL 17: Partnerships to achieve the Goal

Sustainable development is a global issue expected to make life better for both present and future generation. Its broad principal focus is on the environment, social, and economic aspect. There is no clear approach in answering sustainable development research questions that will invariably, enhance our abilities to identify, harness, and utilize natural resources to our benefit and that for future generations.

Geology students, educators, researchers, industry professionals, all have a role to play in helping to achieve the SDGs, ensuring sustainable and equitable foundations for future global development.

Their knowledge of the Earth's structure, the materials it is made of, and the processes by which it is constantly being shaped can be used to inform many important areas of sustainable development. Here 12 ways by which geology contributes to sustainable development are visualised. Each of these broad groups includes a number of practical applications to responsible Earth stewardship. Examples include:

Access to clean water and safe sanitation (e.g., identifying groundwater resources; preventing contamination).

Food security and agrogeology (e.g., using local rock and mineral materials to improve soil fertility).

Disaster risk reduction (e.g., understanding the physical science underlying the generation of landslides, earthquakes and volcanic eruptions; assessing exposure through producing hazard maps; reducing vulnerability through geoeducation initiatives).

Energy supply and management (e.g., identifying the potential of a geothermal energy supply; understanding hydrocarbon potential and safe extraction of resources).

Improved infrastructure and access to basic services (e.g., geomorphological mapping for road construction; characterizing rock masses prior to dam construction).

Environmental and biodiversity management and conservation (e.g., geochemical monitoring of pollution migration through an ecosystem)

Geological research, monitoring, innovation, and engineering can drive widespread improvements to wellbeing and quality of life. The societal relevance of geology has long been recognized, with many members of the geology community committed to the practical application of the discipline to address challenges of global hardship, inequality, and vulnerability.

Organisations such as the **Association of Geoscientists for International Development (AGID)** have helped promote the vital role of geology in socioeconomic development for over 40 years.

The Geological Survey also has a long history of engagement with the Department for International Development, formerly the Overseas Development Agency.

More recent initiatives include the **International Union of Geological Sciences (IUGS)** initiative 'Resourcing Future Generations' and the launch of Geology for Global Development (GfGD) in the UK in 2011.

Since the Millennium Development Goals were agreed in 2000, there has been welcome progress in tackling poverty. Globally, the number of extreme poor has fallen by over 50%, there are almost half as many out-of-school children of primary school age, and the maternal mortality ratio has reduced by 36% when contrasting figures from 2000 and 2015.

Access to an improved drinking water source is noted to have increased from 76% of the global population in 1990 to 91% of the global population in 2015, with 73% of this increase being through piped water to premises.

These, and other aspects of progress, should be celebrated and the reasons contributing to success studied in detail to better understand how further improvements can be made.

Geology and SDGs matrix

The SDGs have been simplified into 17 short phrases by Global Goals (2016) to simplify their communication. In the vertical axis of a matrix presents these identifying phrases, together with the official wording of each SDG. On the horizontal axis 11 key aspects of geology are noted.

Though not exhaustive, this list represents a wide array of geology sub-disciplines, areas of application, skills and outreach. The 11 key aspects of geology are grouped under two headings. **A. Earth Materials, Processes and Management, B. Skills and Practice.**

Eight of the 11 key aspects of geology fall into the broad grouping of 'Earth Materials, Processes and Management'. These eight aspects are: **agrogeology, climate change, energy, engineering geology, geohazards, geoheritage and geotourism, hydrogeology and contaminant geology, and mineral and rock resources**.

Three further aspects are grouped as 'Skills and Practice', which relates to the sharing of and/or adaptations to geological methods to serve sustainable development. These three aspects are: education, capacity building and a broad miscellaneous category.

Geological Sciences (Earth Materials, Processes and Management)[1]	Description[2]	Example Job Titles[3]
Agrogeology	The use of rock and mineral resources to improve agriculture through improving soil fertility and water retention, and reducing soil erosion.	Environmental Consultant; Geochemist.
Climate Change	Using the geological record to understand past changes to the climate and applying this knowledge to understand how the climate may change in the future.	Climate Scientist; Field Geologist; Geochemist.
Energy	Identifying and advising on potential energy sources (e.g., geothermal, hydrocarbons) and raw materials required for energy supply and infrastructure (e.g., uranium ore for nuclear energy, iron ore for wind turbines, cadmium for photovoltaic cells). Contributing to the safe extraction and storage of resources and the development of energy infrastructure.	Engineering Geologist, Geochemist; Geophysicist; Hydrogeologist; Mining Geologist, Petroleum Geologist; Seismic Interpreter.
Engineering Geology	The application of geological sciences to engineering, supporting the design and construction of infrastructure at all scales (e.g., dams, roads, tunnels, airstrips, ports, pipelines, shelters).	Engineering Geologist; Geomorphologist.
Geohazards	Understanding the physical science underlying the generation of natural hazards, including landslides, earthquakes, tsunamis and volcanic eruptions. Assessing exposure through producing hazard maps. Supporting efforts to reduce vulnerability through geoeducation and capacity building initiatives.	Engineering Geologist; Sedimentologist; Seismologist; Volcanologist.
Geoheritage and Geotourism	Using geology and landscapes within tourism, aiding the conservation of geodiversity and building a greater understanding and appreciation of the geological sciences by tourists and those communities living and working around geological features.	Geoscience Communicator; Geoscience Educator.
Hydrogeology and Contaminant Geology	Understanding and sustainably managing groundwater resources. Using geological sciences to assess and monitor and remediate contamination, including understanding the origin, transportation and fate of contaminants.	Contaminant Hydrogeologist; Environmental Consultant; Geochemist; Geophysicist; Hydrogeologist.
Minerals and Rock Materials	The use of geological sciences to identify and develop mineral and rock resources, for a variety of uses (e.g., ores for metal production, limestone for building stone or glass).	Economic Geologist; Exploration Geologist; Geochemist; Hydrogeologist; Mineral Commodity Geologist.

[1]Key aspects (areas of geological science application) taken from Figure 2.
[2]A description of the eight key aspects, used within the grouping '*Earth Materials, Processes and Management*' in Figure 2.
[3]Selected examples of the professional positions that may be involved in these areas of application, recognising that there is crucial role for other professional positions (e.g., survey geologists and professional researchers) in all these roles.

Group Definitions		
Earth Materials, Processes & Management	Understanding of '**Earth Materials, Processes & Management**' is important to one or more targets/means of implementation relating to the given SDG.	Colour
Skills & Practice	Sharing of and/or changes to geological '**Skills and Practice**' is important to one or more targets/means of implementation relating to the given SDG.	Grey

				Geological Sciences										
				Earth Materials, Processes & Management								Skills & Practice		
				Agrogeology	Climate Change	Energy	Engineering Geology	Geohazards	Geoheritage & Geotourism	Hydrogeology & Contaminant Geology	Minerals & Rock Materials	Education†	Capacity Building†	Miscellaneous
Sustainable Development Goals (SDGs)	1	No Poverty	End poverty in all its forms everywhere.	■	■	■	■	■	■	■	■	■	■	
	2	No Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.	■	■		■	■		■	■			
	3	Good Health	Ensure healthy lives and promote well-being for all at all ages.	■						■				
	4	Quality Education	Ensure inclusive and equitable quality education and promote life-long learning opportunities for all.									■		
	5	Gender Equality	Achieve gender equality and empower all women and girls.											[a]
	6	Clean Water & Sanitation	Ensure availability and sustainable management of water and sanitation for all.							■				
	7	Clean Energy	Ensure access to affordable, reliable, sustainable, and modern energy for all.			■	■				■			
	8	Good Jobs & Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.			■			■		■			
	9	Innovation & Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.				■						■	[b]
	10	Reduced Inequalities	Reduce inequality within and among countries.											[c]
	11	Sustainable Cities & Communities	Make cities and human settlements inclusive, safe, resilient and sustainable.		■		■	■	■	■	■			
	12	Responsible Consumption	Ensure sustainable consumption and production patterns.			■			■	■	■	■	■	[d]
	13	Protect the Planet	Take urgent action to combat climate change and its impacts.		■		■	■				■		
	14	Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.		■					■				[e]
	15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems...*	■						■				
	16	Peace & Justice	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.											[f]
	17	Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.										■	

Notes

SDGs from United Nations (2015a).

* (Abbreviated) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

†Education and Capacity Building are important to some degree within every goal.

Miscellaneous

[a] Promoting equality of opportunities to all (including access to geoscience education). Eliminating all forms of violence and discrimination against women and girls in public and private spheres.

[b] Supporting research and development.

[c] Promoting equality of opportunity, and ending discrimination.

[d] Shared responsibility to improve sustainable practice, particularly in the private sector.

[e] Increased international cooperation on marine protection and research.

[f] Transparency of payments and contracts, helping to fight corruption.

Making decisions based on the terrain conditions is basic to human thinking.

What are the resource potentials of the area, how to manage and what shall we do when we get there are applied to the simple event of going to the store or to the major event of launching a bathysphere into the ocean's depths.

By understanding the terrain and people's relationship to location, we can make informed decisions about the way we can effectively manage the resources and sustainably live on our planet. Hence, thematic databases are the tools which provide baseline information for making intelligent decisions.

A thematic map has a table of contents that allows the reader to add layers of information to a base map of real-world locations. For example, a social analyst might use the base map of Trichirappalli district, and select datasets from the Census survey to add data layers to a map that shows residents' education levels, ages, and employment status.

With an ability to combine a variety of datasets in an infinite number of ways, GIS is a useful tool for nearly every field of knowledge from archaeology to zoology.

Geomorphology deals with the activities of different natural surface and subsurface agents engaged in removal of old and formation of new landforms on the earth's surface. In modern days geomorphic evaluation of each and every area is utmost important for sustainable development. It helps in many fields such as groundwater exploration and storage, flood control, waste disposal, smart city development, oil and natural gas exploration, infrastructure development etc.

What if you are told to stop growing vegetables in your garden because the soil is too toxic? What if farmers refuse to produce nutritionally valuable crops because of risk of massive floods? What would you do if you are forced to leave your home / agricultural field due to fear of floods?

And if you are a geoscientist, you have a major role to play. In fact, many of the sustainable development issues are at the heart of geoscience disciplines (e.g., sustainable agriculture, water and sanitation, and climate change).

These goals and the role of geoscientists in addressing them were discussed for the first time during this year's General Assembly.

Soil erosion and conservation as well as mitigation of and adaptation to climate change and hazards as topics that challenge today's geomorphologists. Of all the 17 sustainable development goals, climate action (goal 13) and Life on Land (goal 15) as areas where geomorphologists can make a significant contribution. "Geomorphologists also make indirect contributions to Zero Hunger (goal 2) and Clean Water and Sanitation (goal 6), Study of environment involves understanding of two major set of conditions:

- physical conditions and
- social and cultural conditions.

Physical conditions constitute mostly the abiotic attributes of the environment such as the terrain conditions, minerals, soils, water, landforms that together affect growth and development of the society.

The social and cultural conditions include environmental parameters such as the ethics, economics, aesthetics, etc. which affect the behaviour of individuals or a community.

Geological appraisals of a terrain recognize the potential hazards and resource utilization pattern. These investigations are either site specific or problem specific respectively.

Geoscientific studies involve preparation of various thematic maps, syntheses of collateral and primary data and finally integrated comprehensive output is generated in the form of geoenvironmental maps showing hazards and the potential resource utilization pattern.

Based on the land-capability assessment, a suggested land use map is prepared for overall regional development and optimum resource utilization for sustainable development in the area.

Geomorphological maps contain information concerning the

- morphology (appearance of landform),
- genesis - effects of passive (in terms of lithology) and active (in terms of tectonic) structures,
- the dynamic relief forming processes (endogenic and exogenic) by various agents viz. fluvial, glacial, structural, volcanic, aeolian, marine, denudational etc.),
- age/relative age of the relief (morphochronological view point) and
- spatial arrangement of various relief elements and their interrelationships (morpho association/ morphofacies or morph regions) for facilitating geomorphological regionalization. Besides, the geomorphological maps must consider the practical significance of the relief to the society.

Geomorphological Survey and Mapping may be directed to different aims. Thus there can be following types of geomorphological surveys and maps:

- General Geomorphological Survey and Mapping concerned with the genesis, dynamics and age of the relief forms.

- Special Geomorphological Map concerned only with particular aspect of information about relief forms i.e. morphology, genesis, relief forming processes, age and value added information.

- Applied Geomorphological Survey and Mapping provide basic information about the relief (information mostly detailed in General Geomorphological Maps) plus value-added information to achieve different goals.

- Regional Geological Survey and Mapping concerned with regional differentiation of relief (with respect to lithology, structure, forms and age) for both General and Applied Geomorphological Mapping.

The scale of mapping is very important for both General Geomorphological Mapping and Applied Geomorphological Mapping. In larger or medium scale geomorphological mapping, relief forms (morphostructures) must be connected with the tectono-lithologic conditions; while in case of smaller scale geomorphological mapping it is not connected.

Landscape modifications have been going on owing to the geomorphic processes operating over the earth materials. However, their magnitude and frequency are subject to change due to natural and man-induced changes which have been very rapid in recent times. Hazardous earth processes must be recognized and avoided where possible so as to minimize threat to human life and property.

Since most natural systems are self-regulating, priority wise response to environmental hazards should be: avoidance, stabilization (e.g. engineering measures to train a flood-prone segment of a river or arrest mobility of active dunes by suitable plantations, etc.) and provision for safety in civil structures, e.g. incorporation of recommended aseismic designing, etc.

Geomorphology, along with information on soil, water and vegetation has become one of the essential inputs in planning for various developmental activities. The scope of geomorphology has further expanded with the landform maps finding increasingly wider applications in various fields of resource surveys, environmental analysis, hydrological studies, Civil engineering applications and geo-tectonic studies, urban planning etc.

Thus, it is desirable to map the entire country on 1:50,000 scale due to demands from various user communities mentioned above. Geomorphology and landscape mapping also forms an important input for National Geochemical Mapping Programme of GSI.

Minerals and rocks are essential for the growth of human civilization. The society depends on it next to agriculture.

We require metals for making machines, sands and gravels for making roads and buildings, limestone and gypsum for making concrete, clays for making ceramics, gold, silver, copper and aluminum for making electric circuits, and diamonds and corundum (sapphire, ruby, emerald) for abrasives and jewelry.

Lithology means "the composition or type of rock" such as sandstone, granite or limestone.

The naming of a lithology is based on the rock type. The three major rock types are sedimentary, igneous and metamorphic.

Igneous rocks are formed directly from magma, which is a mixture of molten rock, dissolved gases, and solid crystals. Sedimentary rock is formed from mineral or organic particles that collect at the Earth's surface and become lithified. Metamorphic rock forms by recrystallization of existing sedimentary and igneous rocks under conditions of great heat or pressure.

Economic Significance of Rocks

Soils are derived from rocks. Rocks are the source of types of building material directly or indirectly.

Granite, gneiss, sandstone, marble, and slates are extensively used in the construction of buildings.

Slates are used for roof purposes in different parts of India.

Minerals are the foundation of modern civilization. Provide all metals ranging from very precious gold, platinum, silver, copper to aluminum and iron. These metals are obtained from different rocks.

Certain rocks and minerals are used as raw materials for many industries.

Similarly, other precious stones like gems, rubies, and sapphires are obtained from different types of rocks.

Fuel in the form of coal, petroleum, natural gas, and nuclear minerals are derived from different rocks.

Fertilizers are also derived from some rocks.

Realizing the potential for minerals / rocks to contribute to development in all countries where it takes place is arguably one of the greatest priorities facing the minerals sector.

Minerals / rocks bring extensive economic benefits. This is particularly important for poor countries that lack alternative sources of development and are otherwise unattractive to foreign investors. Occurrence of important minerals ensures that the Foreign investors are likely to be drawn to rich mineral deposits.

In the last decade, a great deal has been done to establish enabling frameworks for mineral investment, particularly in developing countries. Much of this is due to the World Bank. This has resulted in a substantial flow of investment, creating new opportunities as well as challenges.

The opportunities include hard-currency earnings in economies where they are scarce, increased government revenues, jobs, improved education and skills development, and the development of infrastructure such as roads, electricity, and telecommunications.

Although many countries have benefited greatly from minerals extraction, for a number of reasons others have failed to capitalize on the opportunities brought by mineral extraction. The ability to manage mineral wealth effectively has lagged behind the ability to attract mineral investment.

A key challenge now for many countries is to develop policy frameworks to ensure that mineral wealth is captured and creates lasting benefits for local communities and the broader population. This framework must recognize that production from a specific mineral deposit has a finite life span; when the mine closes, it is vital that there is something to show for it in the form of improved stocks of other forms of capital.

A further challenge is for producer countries to be able to maximize the value-added from minerals. In particular, developing countries must be provided with more opportunities to do so.

Minerals development creates power for those who share in it - and potentially competition for access to it. In countries where transparent governance is weak, this may have a negative effect on social and political life (sometimes associated with corruption and human rights abuses) and can exacerbate unresolved social tensions, including issues of national versus local authority.

The policy framework must provide the means to ensure that various rights and interests are respected and to resolve conflicts when they arise.

Hence, it is important that mineral extraction and development particularly in developing countries must ensure that minerals development contribute to equitable and sustainable human development.

Lineament is a linear feature in a landscape that is an expression of an underlying geological structure such as a fault, fracture, or joint. The significance of lineaments, which 'reveal the hidden architecture of rock basement' has been recognized only recently with the advancement in geological remote sensing.

Lineament studies have found applications in various fields of earth science such as tectonic studies, delineation of lithocontacts and tectonic units, analysis of deformation pattern, groundwater and oil exploration, geotechnical and geo-engineering applications and seismotectonic studies.

Also, with the advancement in digital image processing techniques, the satellite data in conjunction with Digital Elevation Model (DEM) have great potential in lineament detection and mapping. Therefore, there is a need for detailed lineament maps of the entire country, which along with landform maps could form the basis for applications in various fields of earth science.

Numerous definitions of the term 'lineament' are given in the literature and various attributes are sometimes linked to the term - such as '**geologic lineament**', '**tectonic lineament**', '**photo lineament**' or '**geophysical lineament**' - either describing the assumed origin of the linear feature or sometimes the data source from which it has been derived.

Some researchers also use the term 'fracture trace' or 'photo linear' as an alternative term. The work by Lattman and Parizek (1964) is commonly regarded as pioneering work in groundwater exploration; they mapped linear features (on stereo-pairs of aerial photographs in carbonate terrain in the eastern United States and subsequently showed the correlation between well productivity and distance to the identified features.

The first usage of the term lineament in geology is probably from a paper by Hobbs (1904, 1912), who defined lineaments as significant lines of landscape caused by joints and faults, revealing the architecture of the rock basement.

Lineaments have been defined as extended mappable linear or curvilinear features of a surface whose parts align in straight or nearly straight relationships that may be the expression of folds, fractures or faults in the subsurface. These features are mappable at various scales, from local to continental, and can be utilized in mineral, oil and gas, and groundwater exploration studies.

Lineaments for groundwater exploration

Studies revealed a close relationship between lineaments and groundwater flow and yield. Generally lineaments are underlain by zones of localized weathering and increased permeability and porosity.

Meanwhile, some researchers studied relationships between groundwater productivity and the number of lineaments within specifically designated areas or lineament density rather than the lineament itself. Therefore, mapping of lineaments closely related to groundwater occurrence and yield is essential to groundwater surveys, development and management.

(i) produce a regional structural lineament map of the study area from remotely sensed data,

(ii) determine the hydrogeological implication of the lineaments by integrating them with the available ancillary data (Digital Elevation Model [DEM] and geological map),

(iii) analyse the lineament trend distribution of the study area using rose diagrams, lineament density maps and lineament intersection maps

Lineaments for oil exploration,

landslide and seismic hazard

Soil matters. Civilizations have flourished and collapsed because of fertile soil (or lack thereof). It is no surprise that the 2030 agenda for sustainable development highlights soil-related issues within its 17 goals.

Soil is a non-renewable resource; its preservation is essential for food security and our sustainable future. Soils provide a foundation for all life on land, sustaining 95% of food production, filtering our water and helping us to combat and adapt to climate change. Healthy and productive soils are central to achieving a number of the 17 sustainable development goals adopted by the United Nations.

Soils sustain our food systems, filter and regulate the flow of freshwater, store vast quantities of carbon and support myriad organisms. But the world's soils are increasingly under pressure from climate change, population growth and poor land management. However, intensive farming, fertilizers, pesticides, pollution and sealing by buildings, pavements and roads, are hampering it from functioning as healthy soil.

What threats soils and what one can do to prevent and remediate soil degradation are the focus, a multidisciplinary team of different organizations brought together to tackle such vital issues.

- Soil management mitigates poverty, hunger, global warming, and land degradation.

- Soil health is critical to plant, animal, human, environmental and planetary health.

- Soil education is needed to increase understanding of soil's importance.

- Soil education enhances humanity's connection to the land.

Researchers examined degraded soils of grasslands in Kenya and China to understand the role of soil biodiversity in creating and supporting healthy ecosystems. These soil systems have been damaged by decades of intensive farming, and the research has worked to scale up novel approaches to repair them.

They found that by harnessing ecological connections between native soil microorganisms (bacteria, fungi, algae) and native plants, they can accelerate the recovery from degraded to healthy soil.

There are major gaps in the scientific understanding of soil functions and management techniques which also contribute to unhealthy soil.

It's never too late to start using sustainable soil management practices. If you want to have healthy soil, you need to treat it like one of your most valuable investments.

Almost one thousand hectares of cultivated land continue to be lost every year. It means that our society receives fewer and fewer services delivered by the soil, such as filtering water and storing carbon.

After multiple seasonal uses, soil loses its nutrients and organic matter. If you leave it unattended, your yields might decrease significantly. Whether you're a gardener, home grower, or farmer, protecting your soil from depletion should be one of your top priorities.

Healthy soil is high in organic matter content, consists of many nutrients, and has a balanced structure. It is excellent for ensuring proper plant growth.

Some examples of the sustainable use of soil are

- Alternate Crops

Since different crops require different types and amounts of nutrients in the soil, crop rotation is essential for balancing them effectively. Some crops might also increase the availability of certain nutrients, which can be very beneficial for the following crops you decide to grow. Crop rotation can also help you prevent soil erosion.

- Enhance Soil Organic Matter

Healthy soil is full of life, aka worms and insects that play a crucial role in nutrient cycling. It means that they help boost the process of breaking down crop residue and turning it into organic matter in the soil. Once the process is complete, plants can take full advantage of those nutrients while you can focus on using more specific fertilizers instead of "just in case" spraying them all the time.

- **Cover the Soil Surface**

Covering crops is another way to enhance your soil makeup. Using cover crops also increases the number of nutrients in the soil and prevents soil erosion. If you leave your fields uncovered during the winter months or after the harvest, they might become more prone to erosion from rain and wind. That's why covering your crops will help you create a healthy foundation for springtime crops.

Land use

A vast majority of households, especially in developing countries, depend on land and other natural resources for satisfying their immediate needs and achieving their long-term livelihood ambitions.

Agriculture remains a major activity in most countries except in the industrialized world. Hence, crop production, use and commercialization of forest products, wild food gathering and fishing as well as extensive grazing are substantially contributing to the Gross National Product (GNP) of these countries.

At present more than 44% of the economically active people in the world is still employed in agriculture. For Africa this is even more than 57% (against more than 74% in 1965).

Land use matters

Land-use change has caused species richness to decline by approximately 8.1% on average globally, mainly as a result of large increases in croplands and grazing lands.

The main effects humans have on our planet manifest in factors of two: we have doubled the rate at which nitrogen enters the biosphere by using fertilizer; we have diverted half of the freshwater and half of all plant productivity for our own purposes; and we have modified about half of the planet's land.

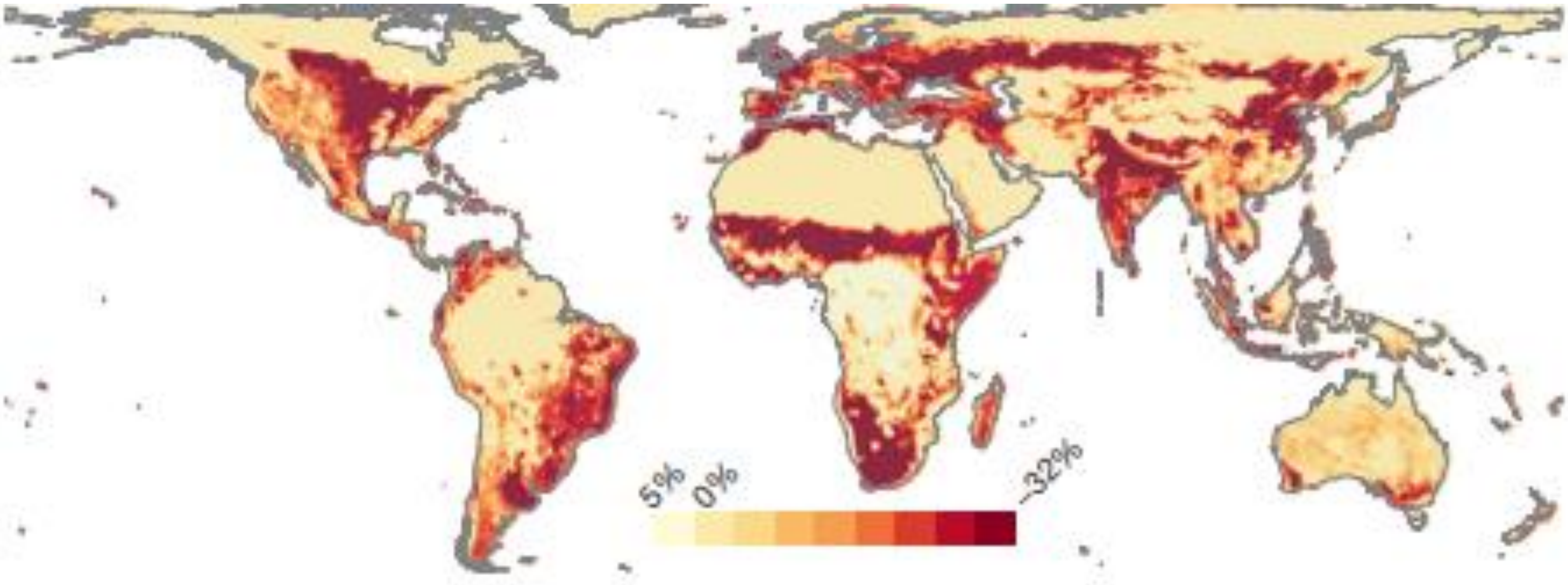
It is widely speculated that the last of these — modifying roughly 50% of all land — is the biggest human-caused threat to biodiversity.

The greatest reductions in biodiversity resulting from land-use change occur when pristine vegetation is converted to cropland or pasture, such as has occurred next to the Iguazu National Park in Brazil.

Land-use change has caused the number of species (species richness) to decline by 8.1% over 500 years when averaged across the globe and a 10.7% decline in the number of individual organisms, with an additional decline in richness resulting from this loss of individuals.

The human modifications like conversions to pasture, cropland, tree plantations, urbanization and secondary vegetation (land that was disturbed but allowed to regrow).

It was observed that land converted to pasture, cropland and urban areas show heavy loss. Most of the impact on biodiversity has resulted from conversion of pristine vegetation to cropland and pasture. As a result, most of the loss has occurred in the prairie steppes of North America and Eurasia, in heavily grazed subtropical dry areas, and in countries that have experienced rapid agricultural growth to support heavy population growth, such as Indonesia, India, Brazil and China.



Net change in local richness caused by land use and related pressures by 2000

European and North American countries, typically with a high Human Development Index, low native biodiversity and widespread historical land conversion, are mostly projected to gain in local richness by 2095.

More naturally biodiverse but less economically developed Southeast Asian and especially sub-Saharan African countries, with more natural and semi-natural habitat, will suffer the greatest losses.

Though, the habitat conversion and associated changes that reduced local biodiversity had largely positive consequences for people; agricultural intensification underpinned many countries' development.

However, benefits have not been shared equally among or within countries. Losses of local species richness exceeding 20% are likely to substantially impair the contribution of biodiversity to ecosystem function and services, and thus to human well-being.

Importantly, projections suggest that such widespread large losses are not inevitable. With concerted action and the right societal choices, global sustainability of local biodiversity may be an achievable goal.