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Environmental and Hydrological Consequences of Agriculture Activities: General Review & Case Study

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Abstract: Cultivated agriculture provides food, fibres, construction material and storable energy. The ecosystem and reservoirs have been harmed, particularly because of human activity. The scale of changed initiated by human is no longer local but global. The substantial growth implying compatibility with limitations of natural resources and environmental absorption capacities is the goal. Agriculture is extremely reliant on natural resources, particularly water supplies. Instinctive thing of a country is in a state of emergency that is putting extreme pressure on country economy. It is questionable that sector level policies, mainly policy making of natural things are old and are lagging demographic transformations this one is changing a sample of resources. Resource degradation has occurred in Pakistan and all throughout the globe, because of misguided policies that have resulted in a cost mismatch between costs of private and social life. Several technological inputs were sponsored for a long time 1966-1996. Because power to tube well activities is charged at a lower yearly growth, poor-quality tube well water was wasted, increasing to soil salinity. Furthermore, the data Transitioning to more sustainable techniques like integrated fertilizer and pesticide application, as well as more diverse cropping seasons, is insufficient to internalize fast changes in soil and water quality parameters. With no need for a doubt, public service research has favored the technological advancements focused on bundles of modern inputs while ignoring research on public goods such as holistic farming methods and plants which support agricultural and irrigation system variety and sustainability. More funding through management systems, education and research, investigation to grow wide - ranging but more durable agricultural trends or angular motion, the elimination of inflationary pressures on major factors, especially moisture and policy objective to engage in components such as plaster that could mitigate an issue of low rail well water is all needed from a policy standpoint. The reduction discrepancies in policies and legislative restrictions mostly in physical power and water sectors are critical variables for promoting long-term sustainability in both agriculture and agriculture-based industries. Agriculture's environmental and hydrological impacts were highlighted in this study and conclusions were given on the problem.

Key words: Hydrology · Water · Environment · Agriculture · Natural resources

INTRODUCTION

A system in which organisms interact with each other in physical environment is ecosystem. Environment is the subset of ecosystem; the other members are organisms and process. In land and water management need on water security, revegetation, wildlife, energy production and long-term watershed managements are important. Life is maintained by organisms. Overtime organism have evolved in synergism with their envious and developed due to process that is different cycles like bio-chemical cycle, different flows and different cold effects. Environmental concerns and ecological concerns are two different things. The ability to reproduce one's own life is a worry for the environment. The sustainability of life is a concern for the environment. As a result, it is self-evident that every environmental occurrence has an ecological impact. Pakistan, as an Islamic Republic, must

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establish goals and solutions for issues such as global warming has had an impact on the land and water in the area, by evaluating impact on quinary factors at present or future weather change and by determining the influence of environmental issues on farmers, its social behaviour [1]. There are three basic roles of life production, consumption and decomposition. The production is synthesis, the consumption is conversion and decomposition are breaking. The agriculture sector is operating in a hazardous environment, as evidenced by present natural and climatic threats [2]. Furthermore, productive loss not only equivalent in that extent that is financially stable commodities producer outcomes, but it also regularly exceeds them [3]. The energy is not recycled. It moves unidirectionally through the ecosystem being consumed at each step of the food and fibre. The process of appraising resources using old methods and techniques is made difficult in some areas by a unique and permanently declining number of stages, quick alterations in hydrometeorological terms geometry about portions of the state, as well as the absence of microclimatic conditions methods. In efficient resource utilisation, ageing framework, lack of application in practise of necessary standards and norms, in addition to the bad state of the environment along with excessive pollution levels, irritate exposed region even more [4]. Quality of agriculture in different countries wealth varies greatly, but as GDP per capita rises and the economy's infrastructure changes, agriculture's share of the economy shrinks, as is to be expected. Agriculture generates more than 30% of total wealth activity. In a few of the globe's poorest nations and it is responsible for 27% of GDP in Least Developed Countries Group. Pakistan has a modest agriculture sector compared to India and in comparison, low energy output to neighbouring [5]. Pakistan's "common richness" is its advantageous geostrategic location, which has made it [6] the unifying connection spanning the Middle East, Central Asia, Europe Asia and South Asia. Although, the construction of a developed infrastructure is essential to turn this into a vital prerequisite for transforming Pakistan into a significant power regional centre of collaboration and growth. A large-scale problem like this necessitates a lot of time and effort to solve. Agriculture is one of Pakistan's most important industries. Wheat is the country's principal crop [7].

The network of ecosystems through which energy flows is known as a food web. Most of the food web has a lot of inherent stability. Unless the damage is very severe, they can easily repair themselves. Pakistan's agricultural delivery facilities are in significant jeopardy (Ecological-Succession n.d.). Around 70% of the irrigated land is scattered. Irrigation from wells, dams, canals and rivers is used to irrigate a large area of agriculture. Numerous irrigation projects are still being built that will benefit Pakistan's future agricultural sector [8]. Agriculture sector expansion is critical in every region of a country, particularly in Pakistan, where it plays a critical role in the country's economy. Though climate change is critical, dangerous and diplomatic for the agricultural sector [9]. Changes in climate, on the other hand, has a severe impact on cotton plant growth, development and yield, as well as farmer livelihoods. Agriculture is Pakistan's economic backbone and the primary source of renewables. They allocate roughly 21 percent of National GDP of Pakistan (agricultural GDP) and accounts for roughly 60% of foreign exchange [10]. Approximately 68 percent of the population in rural areas relies on agriculture for food and a living. Agriculture is divided into numerous sub-sectors like forestry, fisheries etc. The crop sub-sector accounts for 8.27% of agricultural GDP. The livestock sector accounts for 11.77 percent of agricultural GDP. The sub-sector of fishing accounts for 0.43 percent of agricultural GDP. 0.41 percent of agricultural GDP is contributed by the forestry sub-sector [11].

Agriculture could play a significant role in future economic development, food security, improved livelihoods and poverty alleviation via increasing production. Despite this, Pakistani agriculture faces the most serious water, land, environmental, agronomic, institutional and socio-economic difficulties, all of which have a negative impact on agricultural productivity. For increased agricultural productivity in Pakistan, comprehensive strategies and policies for the management of water and non-water elements of agricultural productivity must be created and implemented. The development of economic research and appraisal of the usage of climatic information is required to ransom the production system and the increase of possible damage from natural disasters. Indemnity in crop production was categorised as mandatory because to the importance of the agricultural sector in the country's economy and its reliance on natural and climatic conditions. Furthermore, agricultural production is vulnerable to natural disasters and climaxes. Drought, hail, heat waves and floods are all common problems that can result in significant production losses [12]. The issue of persistent unfavourable climate incidents is impacted by their systemic nature, as droughts affect vast areas of the country's agricultural land, due to massive losses for agricultural producers. As a result, Pakistan is a high-risk agricultural area, with an average annual drought rate of 40%, attaining 60% in some regions of the country. Agricultural producers' financial stability and solvency are also impacted by unfavourable weather conditions. According to [13] in her publications on stabilising the financial situation of agricultural enterprises, climatic conditions influenced the indicators of declining productivity. There is a weather risk that is layered on economic risk at the same time, making it harder to identify and analyse. In their articles, [14] stated that effective ways to reduce agricultural risks must be identified, which must be done based on the expansion of empirically based suggestions and knowledge of the structure and sources of financial assistance provided by equipment, crop protection products and financial guarantees of insurance covergae. As a result of the effect of insurance on risk, other approaches cannot adequately compensate for the potential harm and losses caused by diverse risks. Misuse of resources, scientific issues, limited investment, infrastructure, agricultural trade issues and delicate electricity and energy shortages are all problems that Pakistan faces in the agricultural industry [15]. Climate change, droughts and floods have added to the severity of these issues. Important weather forecasting of various extreme weather events can cause fatalities and can become more common and catastrophic in Pakistan as the climate changes. Extreme weather events produced by climate change, in contrast to typical climate regimes, can produce sudden, unexpected events, such as rainfall regimes. Water scarcity occurs when the rainfall regime changes and a significant number of impermeable surfaces disrupts the normal water flow system. Underground and above-ground water sources are not being fed due to changes in the water cycle. Because of the ongoing rise in temperature and change in precipitation patterns, the amount of water required by farmers would decrease and a scarcity situation will emerge, threatening food security and farmers' lives in the Indus Basin, as well as in Pakistan [16].

The environmental and hydrological impacts of agricultural activities were discussed in this study:

Organisms and Environment: The cultivated agriculture started nearly 10, 000 years when human being began settling near the banks of natural streams and domesticating the wild species of plants and animals to produce food for their consumption. The agricultural impact activities on biodiversity like plants and animals has a vast tale, that started when human being first began the control process over 7000 years ago [17]. These ancient agriculturists initiated the selection process that continues today as farmers, researchers and companies strive for more prolific plants and animals by picking a few supposedly more useful or edible species. At both the species and genetic levels, this process necessitates a reduction and simplicity of nature's vast biological diversity. However, because the early farmers chose their favoured plants and cultivated their land with the few rudimentary equipment and primarily organic inputs available on a local (small) scale, their actions had a minor impact or were confined geographically. There are still cultures that practise small-scale, low-impact agriculture today [18].

As energy flows through the food chain, it’s temporarily stored at various stages called Trophic levels, the producers represent such as green plants at first trophic level, at second trophic level herbivores and the third are carnivores and at the fourth number are eaters of carnivores. As a general estimate, only 10% of the energy available at one trophic level passes onto the next. In cultivated agriculture, it takes 10, 000 kilocalories of maize to produce 1000 kilocalories of beef and 100 kilocalories by human effort. The rise in population and urbanisation necessitated the production of larger quantities of food that could be carried over longer distances. To commit bigger tracts of land to agricultural activities, animal traction, irrigation canals and other intensification techniques were deployed. Ground utilization adjustments, like emptying forested for cultivation and agricultural practises like crop rotation and mixes, grazing practises, residue management, irrigation and drainage, all have an impact on the soil environment and alter the range of habitats and foods available to soil organisms. Water and water resources are also harmed by improper and unconscious agricultural practises. Tillage techniques, pesticide application and other land treatments all have an impact on the physical and chemical environment, specifically the qualities of water and soil. As the population became more urbanised, a lower percentage of the population was involved in food production. As a result, agricultural methods have evolved, including the creation of modern farming techniques that include technology. Cultivated agriculture depends on the flux of solar energy. The first trophic level autotrophs are designed to capture and convert solar energy into high energy chemical by carbohydrates, proteins and fats. The agriculture has had a huge impact on humanity, especially in terms of population. This is because the supply of human digestible calories per square kilometre has expanded dramatically because of plant and animal breeding. One way to look at it is that we replaced non-human consumable items with human consumable items. In the last 2000 years, the world's population has increased by a factor of 28 to reach seven billion people. Agriculture has advanced in around 10, 000 to 15, 000 years, allowing the human population to become nearly to 1000 times larger.

Temperature Response: Of autotrophs is more distinct and well-studied. All plants and cold-blooded organisms exhibit increased growth with increasing temperature above low temperature tolerance and decreases sharply at higher temperature. The warm-blooded animals have regulated body temperature within narrow limits excepting some species which go into hibernation by switch from warm blooded to cold blooded state. To convert CO_2 into organic carbon molecules, autotrophs use either light or chemical energy. Photoautotrophs are photosynthesizing creatures that use light to do so, such as algae and higher plants. Heterotrophs, on the other hand, rely on pre-existing organic molecules for their chemical energy. Every plant has perfect temperature requirements and they develop more efficiently at certain temperatures. Bacteria, which absorb organic material from their surroundings and a variety of animals, which ingest and digest other species, are examples of heterotrophs. The stoichiometric flexibility of these two fundamental dietary methods, autotrophy and heterotrophy, is also different. Many heterotrophs get all their carbon, energy and nutrients from the same food packages, whereas autotrophs get them from multiple, somewhat independent sources. Growth rate (μ, g g^{-1} d^{-1}) is related to autotroph nutrition content.

Light Response: Photosynthesis is the mechanism by which autotrophs transform carbon dioxide and water into carbohydra. Most plants respond to increasing light intensity with increasing photo synthetic rate. However, some plants require shade to grow well and must avoid direct exposure to sun. The aquatic plants respond to light like land plants excepting light inhibition of photo synthesis in marine phytoplankton at light intensities approaching full sunlight. The U.V light in general limits the development of plants. The animals respond to light in different way Most have biological clock determining time of exposure. The timing regulates endocrine glands. gonads and colour, the intensity and duration of light carry significant influence over the biological clock. The organisms' reliance on carbon dioxide and light, or inorganic respiratory substrates, may be due to a need for other energy sources if they are unable to receive adequate energy for growth through organic compound respiration. The effect of organic chemicals on autotrophs and the enzymes contained in them is investigated, as well as alternative possibilities of specific aspects of autotrophic metabolic regulation or enzyme shortages as possible causes of obligate autotrophy. Autotrophic nutrition in plants can be divided into two types depending on the type of energy source employed. Photo-autotrophic nutrition (where sunlight is the sole source of energy) and chemo-autotrophic nutrition are the two types (where chemicals are the only source for energy).

Carbon Dioxide Response: Plants assimilate carbon dioxide in the process of photosynthesis. Plants generally respond well to increased concentration of CO, up-to double the normal atmosphere (0.03%). Based on the process of assimilation of CO, the plants are classified as C.C and CAM. The Cs plants fix carbon as three carbon acid as first stage and C. plants as four carbon acid. Thus C, plants are more efficient and are well adapted to warmer and drier climate compared to C: CAM plants open their stomata at night and take on CO_2 or store for processing during day and thus are well adapted to desert like conditions, Cs plants exhibit the greatest photo synthetic action by at higher concentrations of CO compared to C and CAM. The direct response of animals to increasing CO_2, levels are undetectable until the concentration exceed 1000 ppm. The increased level of CO; adds to the ambient temperature which in turn make the animals shift from areas of CO_2 rich. When carbon dioxide levels in the atmosphere rise, most plants thicken their leaves in an unexpected way, according to researchers. Thick-leaved plants appear to be in our future as carbon dioxide levels in the atmosphere grow owing to human activities. Scientists have acquired a lot of data on how leaves thicken in reaction to high carbon dioxide levels, as well as the levels of carbon dioxide in the atmosphere that will be seen by the turn of the era., " Kovenock said. “We settled to consolidate the known corporal effects of leaf thickening into climate models to see what, if any, effect this would have on a global scale." [19]. Even though the effect of carbon dioxide on carbohydrates perception is unknown at this time, several studies have employed exogenous carbohydrates to treat plant roots, resulting in increased root sugar content, which could reflect higher root sugar content coming from greater photosynthesis under carbon dioxide. Most study on the role of carbohydrates in plant roots has focused entirely on sucrose. Other studies revealed the impacts of other carbs such as glucose and fructose, non-sucrose carbohydrates may have many additional functions to play. Although much of this research has focused on A. thaliana, sugars are expected to perform a wide range of roles in root function in other plant species. The probable results for roots of plants cultivated under carbon dioxide, where surplus sugar is transferred to the roots of leaves, with in upcoming sections, we'll talk about them:

Properties of Water: Water is necessary for life and accounts for roughly 70% of the body's weight. Water is the only substance found as gas, liquid and solid on planet earth. It is colourless, odourless transparent to visible light and opaque to infra-red radiation. Water is absorbed by plants through mots and released from leaves because of solar heating. The water stream flowing front root lo leaves carry the nutrients needed by plants. The nutrient load is the function of water quality. Pure water increases the improved supply of nutrients to the plants. The animals also consume water to assimilate and transport nutrients in their body. The excess water is discharged taking away the body wastes. There are weak interactions between the hydrogen ends of other water molecules and the oxygen ends of both a unit due to the structure of the water molecule. Even though these "polar" interactions are rather weak and frequently break and rebuild, their presence gives water several unique features in comparison to other substances on Earth. Water's characteristics are significantly responsible for the existence of life on Earth. Dissolved salts, micronutrients, certain metals and gases are constantly present in natural waterways. Water named as "Universal Solvent" since it dissolves so many different things. Whereas many of these substances are required for thriving aquatic environments, their quantities can have detrimental repercussions as they rise, which is why we refer to them as pollutants. Photosynthetic species adapted to living in water are known as aquatic plants. Many land plants are "vascular" plants, which means that their roots absorb and transport water and nutrients to the leaves. Because they live in water, these "macrophytes" don't need to transfer it and they can usually require nutrients from it. The type and form of aquatic plants are determined by the level of water or that it is moving or still. We are primarily concerned about the function bacteria play in virus transmission from the perspective of waterbodies. Bacteria and other single-celled creatures are increasingly being recognized for their role in decomposing organic matter, digesting minerals and nutrients and, in certain situations, turning carbon dioxide into new plants. Water transports the flow of soil water, into the bases, through the plant and on to the atmosphere is viewed as a series of interconnected actions, which makes a significant contribution to plant water relations. When investigating plant water balance, this idea, known as the Soil–Plant–Atmosphere Continuum [20], is beneficial in underlining the need of examining all elements of water relations. As a result of this approach, the water movement in the SPAC system is considered as if it were the current flowing in a conducting system. In coming days, relationship of water with plants will be promising and it will generate new ideas for the development and growth of plants, listed below:

- SEM electron microscopy with EDAX, e.g., is a nanoscale observational technique.
- Optical microscopy
- Atomic force microscopy has the potential to be useful in analyzing the luminal surface chemistry of conducting elements.
- Magnetic resonance imaging (MRI) could be used to map hydrological linkages in wood in three dimensions.
- New multispectral techniques that allow for more accurate surface warming mapping can reveal information about water distribution, evaporation, ice formation and even sap flow.
- Ample computing power involves investigation of more reliable estimates of sap mobility.

Bio-Geo-Chemical Cycle: Environment in fact focuses the bio-geochemical cycles. The identification and rectification of imbalances in the bio-geochemical processes describe the environment protection and or conversation activities. The nutrient elements such as nitrogen, oxygen, carbon, phosphorus and sulphur occur in different forms within organism and environment. Because nutrients cycle within and through the biotic and a biotic compound of environments, the process is called Bio geo chemical cycles. When human interrupt these cycles or modify through addition of certain compounds to the environment, there is impact on the ecosystem. Human facilities, poor design and land usage have all had a negative impact on the ecosystem. Changes in the water, carbon and nitrogen cycles have also been caused by climate change, resulting in land degradation and desertification. The bio-geo-chemical perturbations be local or global depending upon the scale of interruption and or addition the example is the me fossil fuel energy which is changing the carbon, nitrogen and sulphur cycles, the use of fertiliser is changing. Nitrogen and phosphorus cycle and use of biomass for food, fibre and fuel is modifying the hydrologic, nitrogen and phosphorus cycles.

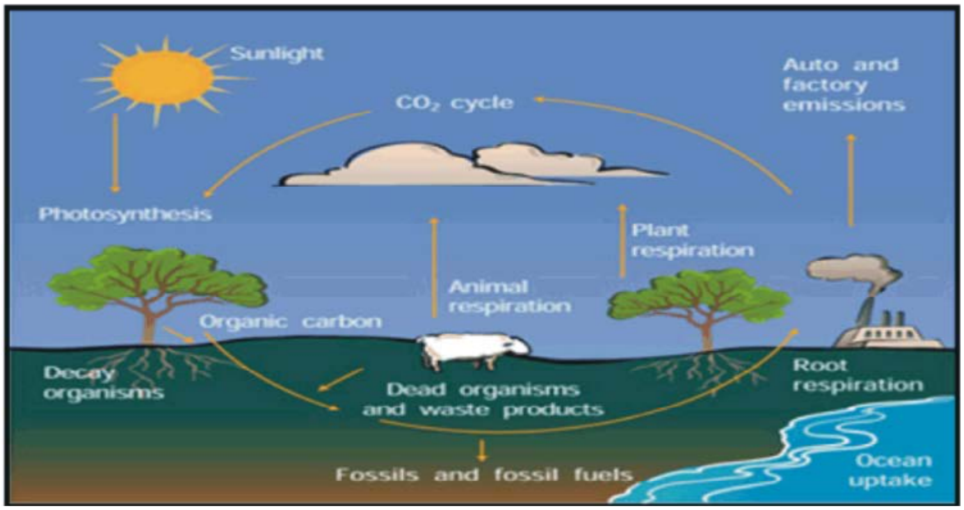

Fig. 1: Biogeochemical cycles in earth (https://scied.ucar.edu/learning-zone)

Many interrelated processes in an estuarine system's biogeochemical cycles are subject to a variety of external factors. Understanding the variables that influence the organic nitrogen and carbon cycles in this system, as well as their overall fate, is crucial and difficult due to the extreme dynamism of estuaries, both mechanically and biogeochemically. The interactions between the nonlinearity of state variables and parameters are extreme. According to this research, the principal source of nitrogen and carbon in this system is litterfall from neighbouring mangrove areas, which helps to maintain a healthy detritus food chain. Seasons and tidal flush play a significant influence in the transportation of insoluble and resistant organic materials from land to sea via this river. The flow of energy and matter in biochemical processes is intimately associated to daily existence and the Earth's environment. Foreign matter, such as chemicals and contaminants, has an impact on marine biology's development. Marine biodiversity is influenced by circulation patterns and regional distribution. The presence of nutrients also has an impact on the life cycle and life span of marine science. Pollutant transmission inside the marine body is caused by higher nutrient and lower organic carbon concentrations, variable microbial community components among habitats and assemblages of organisms that demonstrate migration behavior on aquatic species. The increased retention of organic stuff within the body is due to physical and biological processes, aquatic species, which has a negative impact on marine ecosystem. As previously stated, biogeochemical cycles seem to be converting energy and materials into useable forms to enable the operation of ecosystems, it is crucial to the existence of life. The transfer of materials between the Earth's principal reservoirs, which include the atmosphere, terrestrial biosphere, seas and geosphere, is determined by these cycles. The six most frequent elements present in organic molecules, which serve as the foundation of lifeforms, are carbon, nitrogen, hydrogen, oxygen, phosphorus and sulfur dioxide. These elements exist in various reservoirs to varying degrees and take on a few chemical forms, both organic and inorganic.

Hydrological Cycle: In the form of reservoirs, the earth retains tremendous volumes of water. The atmosphere, lithosphere, hydrosphere and biosphere all contain water. These parts are all constantly flooded with water masses. The hydrologic cycle is what it's known as in general. Water is evaporated by solar energy from lakes rivers, ocean, soil and vegetation. It rises into the atmosphere where it cools and condenses. Under appropriate conditions falls back to earth as rain, snow and dew. The hydrologic cycle is the simplest of the bio-geo-chemical cycles and is well understood Only 5% of the water is in circulation through the hydrosphere (the portion of the earth occupied by water) and 95% is bound-up in lithosphere (the outer part of earth composed of rock) On the average a water molecule travels through the atmosphere for 10 days before falling back. Cultivated agriculture has increased requirements of good water which speeds up the hydrological cycle of evaporation, transpiration and precipitation. The concentration of animals near the cultivated agriculture adds on to the speed of hydrologic cycles along with loading it with

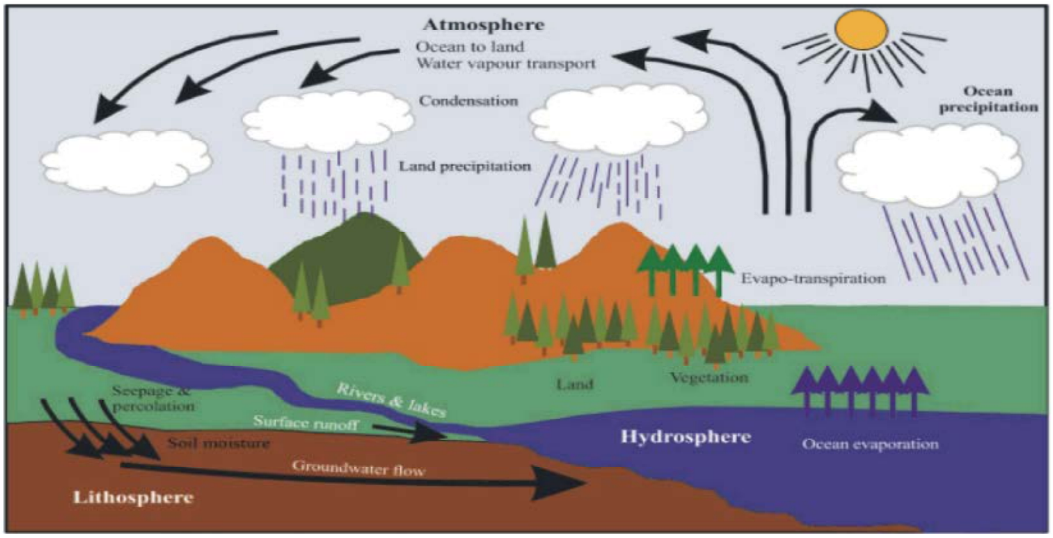

Fig. 2: Hydrological-cycle-process in ecosystem (https://theconstructor.org.)

nutrients and other chemicals which may or may not be easily degradable. The hydrological cycle of the earth is the sum of all mechanisms that move water from land and ocean surfaces to the best possible extent in the form as rainfall. Oceans and land surfaces, among other things, have an impact on the hydrological cycle. The preservation of the hydrologic budget on the land surface is dependent on vegetation [21]. The ability of the ground surface to hold water is improved by vegetation development. Plants intercept precipitation, which is then evaporated instantly when it is gathered by the glass roof. Through evaporation processes, the plants themselves materialise and contribute significantly to the production of water vapour. Surface runoff is substantially higher on bare ground than it is on vegetated regions. Plants are essential to the hydrological cycle's operation because they dominate the processes of energy, water vapour and carbon exchange. The hydrological cycle is the driving force behind all of the globe's freshwater resources.. Cyclic circulation paths of water in the earth must be identified.

Evaporation, condensation, precipitation, infiltration and surface runoff are examples of physical processes that carry water from one reservoir to another. Water covers 70% of the Earth's surface equating to 1.41018 m^3. The oceans contain 97 percent saline water, whereas rivers, lakes, glaciers, permanent snow and groundwater aquifers contain the remaining 3% fresh water [22]. Evaporation is caused by solar intensity, which removes roughly 5771012 m^3 of water from the Earth's atmosphere, with oceans accounting for 86% and land accounting for 14% [23, 24]. Water evaporates from the Earth's mantle enters the environment, where that compresses to form raindrops and finally falls to the land as precipitation. To complete the water cycle, excess water collected on land is returned to the oceans via rivers and groundwater [25]. As a result, solar energy moves a considerable amount of water from the oceans to the land each year through the atmosphere, making the hydrologic cycle essential not only for human existence and natural ecosystems, but also for industrial and agricultural productivity. Precipitation, surface runoff, evaporation, transpiration, infiltration, condensation, evapotranspiration, sublimation, groundwater base flow and interception are the key components of the hydrological cycle. Solar input, earth rotation, distance from the ocean, geography and general air circulation are all elements that can influence the hydrological cycle. Water courses in the forest uplands vary widely in terrain and distance from the ocean. The west and north, in general, receive the most yearly precipitation, with amounts reaching 4000 mm. In the east and inland portions of vast coastlines, the average annual precipitation is 1000 mm. The maximum and minimum mean annual precipitation over the period 1961–1990 was 6944 and 128 mm, respectively. Runoff is not spread equally throughout the year and can be divided into distinct runoff zones [26]. The lowest runoff occurs in coastal locations with an Atlantic regime from May to August and the rest of the year is similar. Low winter runoff (January–March), a considerable increase due to melting snow in April and May and low summer morals that grow

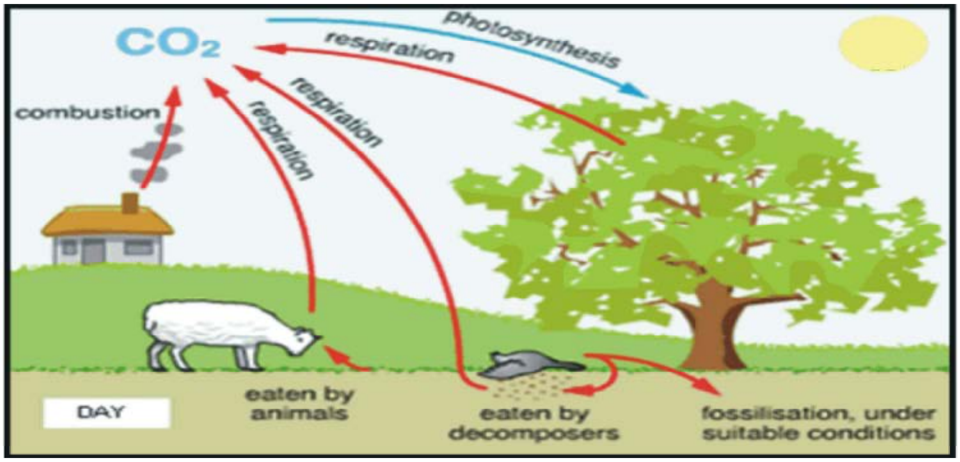

Fig. 3: Carbon cycles in Earth (https://www.sciencefacts.net)

from August till winter begins distinguishing the inland regime, which is located between the Atlantic and mountain regimes. The river flow regime reflects the variance in precipitation across the country. Some rivers have recording period spans several years before and after the production of many projects in hydropower. Hydropower development has resulted in a dramatic reduction in the flood-to-minimum discharge ratio.

Carbon Cycle: Approximately 49% of the dry weight of the organism is carbon the only source of carbon to producer organisms is atmospheric carbon dioxide. The respiration of carbon dioxide by all organisms return carbon to the atmosphere. Carbon is deposited in the soil and sequestered in sediments of lakes and streams. The atmospheric reservoir of carbon in 718 GT (339 parts per million or 0.339% by volume) compared to deep sea sediments of 32000 GT, fossil fuel 12000 GT and organise 1760 GT. One GT is 10kg. The cultivated agriculture consuming fossil fuel and releasing carbon through respiration and purification is releasing more carbon into atmosphere which is increasing the CO, concentration by about one ppm per year The concentration of carbon in the atmosphere before industrial revolution was 268 ppm.

The carbon cycle is one of several important biogeochemical cycles that connect the biosphere, atmosphere, geosphere and hydrosphere. It is no longer in equilibration because of the use of fossil fuels and the conversion of forested land to low-carbon alternative solutions. As a result of these interferences, greenhouse gases accumulate in the atmosphere, causing warming. We examine the current rates of change in carbon flow rates and discuss the cycle's critical processes. Finally, we look at how the carbon cycle can be managed by reducing deforestation, developing alternative energy sources and using geo engineering. Organic C mineralization results in major changes at degradation loci, particularly with respect to oxidant consumption. Due to its prevalence in the atmosphere and the high energy yield associated with aerobic respiration, oxygen is the primary (and ultimate) oxidant for organic C. At sites where access to oxygen is limited, usually by diffusion through water, it disappears first and usually rapidly. When they are available, other electron acceptors are then consumed in the order NO_3^-, Mn^{4+}, Fe^{3+} and SO_4^{2-}. When all these oxidants have been consumed or are otherwise unavailable, detrital carbon is converted to a mixture of CO_2 and CH_4. Once particulate detritus has been hydrolysed, the soluble hydrolytic products are almost inevitably and rapidly catabolized to CO_2 only or to $CO_2^{+,}$ CH_4 in the absence of electron acceptors. Approximately 38 000–40 000 Pg of carbon is stored in the ocean depths, 5000 Pg on land and in soil, 750–850 Pg in the atmosphere and 900 Pg in the ocean surface layer (1 Pg C = 1015 g C). The atmosphere, biodiversity, soil and ocean surface layer are all inextricably linked, with continuous, relatively rapid carbon exchanges taking place between them. Carbon exchange between this fast-response system and the ocean depths takes a lot longer (of the order of thousands of years). In other words, exchange with the deepest part of the ocean limits CO_2 absorption, resulting in CO_2 accumulation in the atmosphere. As a result, the ocean depths cannot help to reduce CO_2 build-up. Human activities contribute to CO_2 accumulation in two ways: fossil fuel combustion (coal, oil and natural gas) and deforestation, particularly of tropical rain forests. To meet humanity's growing energy needs, biomass and fossil fuels are damaged, releasing CO_2 into the atmosphere.

Furthermore, livestock breeding, as well as solid waste and wastewater management, emit significant quantities of CH_4 and N_2O into the atmosphere, further altering climate change. All these inputs cause significant abnormality in the biosphere's delicate equilibrium conditions, particularly fossil fuels, which are burned in an infinitesimal time compared to the centuries required by slow depositional processes to form this resource [27].

Nitrogen Cycle: Nitrogen is the building block of protein. It is present in the air in abundance. Unlike CO_2, it cannot be used by the organisms directly from the air. Nitrogen is absorbed by the plants through its roots as Nitrate, Nitrite and ammonia (NH) or ammonium. Animals obtain their nitrogenous compounds by eating plants. The nitrogen cycle is complex. It follows several pathways. Most of the nitrogen is incorporated into the times of the organisms after fixation is through the reduction process. Denitrification is the process by which molecular nitrogen is released lo the atmosphere This process also release energy to be used by the sod organisms for metabolism. NO_3 is reduced to NO_2. The oxygen released in the presence of glucose or phosphate provide both energy compounds for life. Denitrification occurs generally under anaerobic conditions created by poor aeration of soil or heightened organic decay. Nitrogen compounds are highly soluble in water and do not readily bind to soil particles. Therefore, are easily carried by water into the aquifer, lakes and streams. Nitrogen from fertiliser used in cultivated agriculture dissolves in irrigation water and the runoff enriches the streams resulting in vigorous growth of aquatic plants. When these plants die, much of the available oxygen is consumed and the lake become anaerobic depriving the aquatic animal from the needed oxygen. The result is stinking situation. The largest reservoir of nitrogen are rocks, sediments and the atmosphere with 1.9x 10"Kg. 4 x 10^12 and 3.9 x 10^18 kgs N respectively. Dissolved Nitrogen in the ocean is estimated to be 2.2x10^16 kg. The plant biomass has about 1.4x10^14 kgs N. Denitrification is another important step in the nitrogen cycle that has a significant environmental impact by producing nitrous oxide (N_2O), a powerful greenhouse gas and reactive nitric oxide (NO), both of which have the potential to drive climate change. Through a quantitative proteomic analysis, this activity was considered in Paracoccus denitrificans PD1222 by Olaya-Abril *et al*. [28] and identified significant aspects stimulation of denitrification various metabolic enzymes, along with TCA and glyoxylate cycle enzymes and enzymes that generate acetyl-CoA. Nevertheless, Liu B. *et al*. evaluated the change of denitrification gene expression as well as the formation of NO, N2O and N2 in microxia-affected soils They terminated those governing mechanisms observed outlying are also observed in complicated sections, emphasising the key to selection in course like recognizing engaged key creatures [29].

Nitrogen is the fourth much abundant component in cellular biomass, accounting for a large portion of the Earth's atmosphere. Microbial activities regulate the trade of static dinitrogen gas (N_2) with 'reactive nitrogen' in the living environment (nitrogen molecules that support and the outcome of, cellular metabolism or growth). This was not the case in the original atmosphere, where abiotic processes were most likely important in nitrogen oxide inter-transformation. Although abiotic reactions such as this are still necessary, the current nitrogen cycle is driven by reductive dinitrogen fixation and an enzyme inventory that facilitates dinitrogen-producing reactions. Prior to the Haber-Bosch process (the industrial fixation of N_2 into ammonia, NH_3) in 1909, microorganisms created and recycled nearly all the reactive nitrogen in the biosphere. Chemical fertilisers and other anthropogenic factors have more than doubled the yield of agricultural crops, notwithstanding the Haber-Bosch process. The importance nitrogen contribution to the ecosystem and cellular life cannot be overstated; nonetheless, our understanding the bacteria and enzymatic processes that transform nitrogen into its oxidised form many is still limited (Table 1). The nitrogen cycle's major microbial processes, the pathogen this one performs nitrogen alterations, the extensible and emergent antiquity of the nitrogen cycle [30].

Sulphur Cycle: All organisms require sulphur. Inorganic sulphate (SO) is the major source of sulphur for organisms. Sulphur is used in the folding of amino acids to form protein molecules in the protoplasm. Plants and microbes can reduce sulphate for proteins synthesis, but animals obtain sulphur containing in the form of amino acid in their food. Sulphate is abundant in nature. It is leached and from soil taken by plants and replenished by rain. Consequently, vegetation can usually meet it needs. Over cropping of vegetation deplete sulphate availability to such an extent that it must be replenished using fertiliser. The action of several sulphur-containing proteins is degraded by soil organisms into their constituent amino acids. Another type of soil bacteria converts amino acid sulphur to hydrogen sulphide (H_2S).

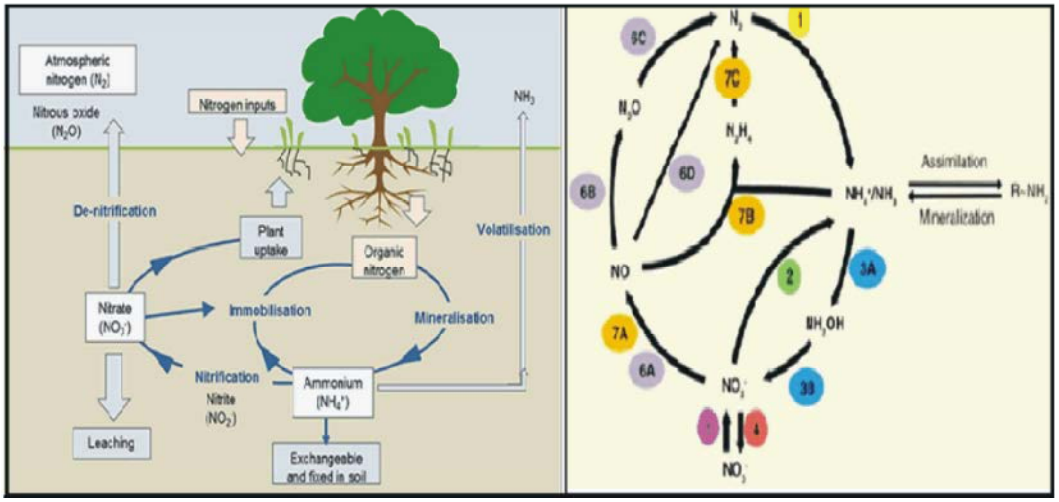

Fig. 4: Nitrogen cycle in earth (https://www.cimmyt.org)

Table 1: Oxidation states of nitrogen

Molecule	Name	Oxidation Rate
C-NH2	Organic-N	Reduced
NH_3, NH_4^+	Ammonia, Ammonium -3	
N_2H_4	Hydrazine -2	More electrons
NH_2OH	Hydroxylamine -1	
N_2	Dinitrogen 0	
N_2O	Nitrous Oxide +1	
NO	Nitric Oxide +2	Fewer electrons
HNO_2, NO_2^-	Nitrous acid, Nitrite +3	
NO_2	Nitrogen Dioxide +4	
HNO_3, NO_3^-	Nitric Acid, Nitrate +5	Oxidized

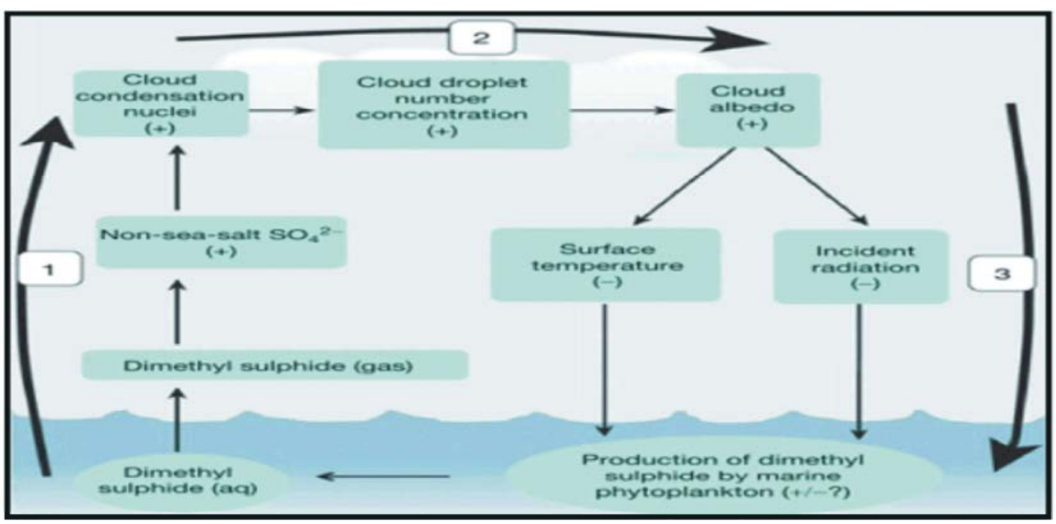

Fig. 5: (https://www.sciencedirect.com/topics)

In the presence of oxygen, sulphur bacteria convert H_2S to sulphur and then to sulphate. Eventually, the sulphate decomposes into H_2S. Every year, the sulphur cycle transports massive amounts of this physiologically significant element through the atmosphere. Human activities have had a significant impact on the sulphur cycle, probably most notably in the creation of acid rain, notwithstanding the extent of natural reservoirs.

Windblown dusts are produced on the Earth's surface; however, this is influenced by grazing and desertification. Mineral extraction and fuel consumption mobilise large amounts of sulphur. Human emissions to the atmosphere are mostly derived from the refining and combustion of fossil fuels, which much outnumber natural sources. The decline in anthropogenic emissions in North America and Europe is being offset by rising emissions in Asia, which could pose a unique problem in the twenty-first century. Sulphate is much more soluble than phosphates and move readily between land and sea were these accumulate. Sulphur is 240 times more abundant in sea water than in fresh water. Sulphur is absorbed as sulphate through the roots and to some extent through their leaves. It is passed to the animals and comeback to the ground by excretion, demise and decompose. Sulphur occurs in living cells as sulfhydryl molecule within amino acids. Microbes decompose organic matter by converting sulfhydryl molecule into H_2S. Under aerobic conditions bacteria oxidise H, S into SO_4 and use the energy liberated in the oxidation to obtain carbon from CO_2 by reduction The sulphate produced is then useable by plants. Under anaerobic conditions such as bottom of lakes, it is impossible to oxidise H, S but certain photo synthetic bacteria use H_2S to manufacture carbohydrates and in the process oxidise H_2S to elemental sulphur or to sulphate. The presence of H, S eliminates animals in the bed of deep lakes and sea [31].

Due to the amount of sulphate, cycling in Sulphur is more significant in coastal and marine ecosystems are more diverse than terrestrial and freshwater ecosystems. Because of high concentration of sulphate in sediment pore water, sulphur decline is a primary TEA activity when OM mineralization occurs in coastal sediments. Sulphate reduction becomes main mechanism when sulphate intake is increased, affecting the other elements cycling including Iron, Carbon and Nitrogen [32]. The linkage for the anaerobic methane oxidation pathway to the pore-water sulphate reduction pathway accounts for a major amount of the pore-water sulphate reduction [33]. Human activities have had a significant impact on the Sulphur cycle, probably most notably in the creation of acid rain, notwithstanding the extent of natural reservoirs. Windblown dusts are produced on the Earth's surface; however, this is influenced by grazing and desertification. Mineral extraction and fuel consumption mobilize large amounts of Sulphur. Human emissions to the atmosphere are mostly derived from the refining and combustion of fossil fuels, which much outnumber natural sources. The decline in anthropogenic emissions in North America and Europe is being offset by rising emissions in Asia, which could pose a unique problem in the twenty-first century.

Phosphorus Cycle: Phosphorus has major importance to organisms for mutating DNA, RNA and ATP called phosphorylated compounds. Phosphorous is also formed in vertebrates as phosphate salts in bones and teeth. Plants assimilate phosphorous from inorganic phosphate as orthophosphate ionic. The other organisms get their phosphorus needs from plants. Phosphorus does not occur naturally in the atmosphere except in small quantities clinging to the dust. In water, where there is abundant oxygen, phosphorus is oxidised and form insoluble compound which precipitate and are not available to aquatic plants. Eventually the precipitated phosphorus from rocks which upon erosion in returned to the soil. In the soil phosphorus comes from decaying organic matter which can be readily taken by the plants. The phosphorus from the sedimentation takes a complicated route. The plants can only absorb phosphorus an inorganic phosphate made available as DAP fertiliser under natural conditions. The loss of phosphorus from the soil is through conversion into insoluble compounds by reacting with Ca, Fe etc. [34].

Phosphorus entering streams as phosphate from fertilisers, detergents, excrements etc produce undesirable enrichment resulting in rapid growth of algae and higher plants and reduced concentration of oxygen and consequently aquatic life such as fish etc. Phosphorus is an important component related as growth of a plant and its application has been around for a long time. recognised as necessary to keep crop production at economically feasible levels. P is required in agricultural systems for cellular metabolism, seed and root formation, crop maturation (particularly cereals), crop quality and cereal straw strength. P is recycled into the soil through litter, plant residues and animal waste in natural (non-agricultural) systems [35]. However, in agricultural systems, P could be removed from crop or animal output. To boost and maintain production, agricultural systems import chemical P fertilisers, crops and feed additives [36]. Consider the relatively small pool of native soil P is incapable of supplying and maintaining enough soluble orthophosphate (H_2PO4) to soil solution for satisfactory crop growth, soils must be supplemented with water-soluble P fertilisers. Even though surrounding P levels launching into streams and lakes along groundwater flow clearly reflect the collision of land use, soil P is largely transported across surface flow. Water can dissolve and

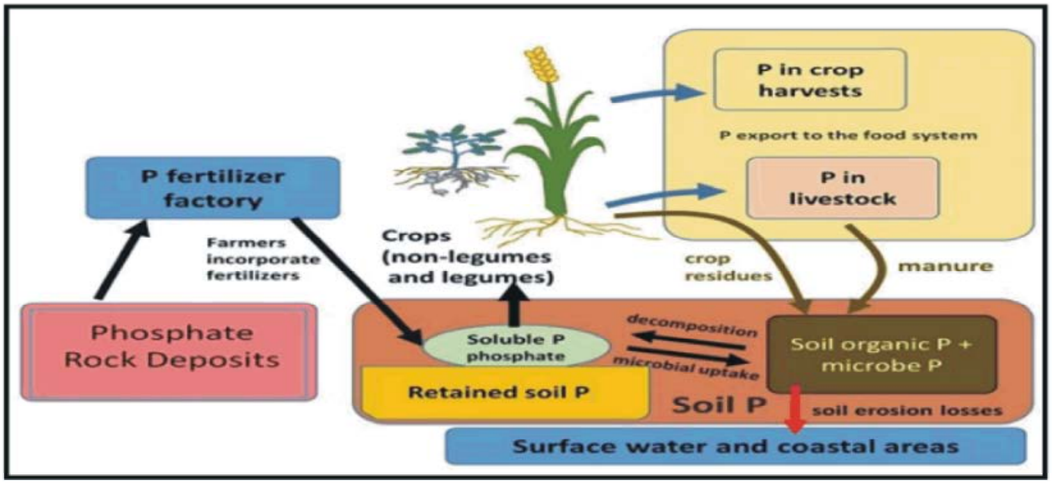

Fig. 6: Phosphorus cycles (https://serc.carleton.edu)

transport soluble P or erode and move particulate P when it flows through the soil surface. Soluble P can be inorganic or organic, whereas particulate P is made up of smaller soil particles, such as clay and lighter organic matter. Regardless of how much P is applied, the amount of soluble P is critical. Diffuse leakage of P from soils is widely accepted as a possibility that contributes to water quality degradation. Individuals have had an eminent impact on the phosphorus cycle, primarily to produce fertiliser to support an expanding human population, with much of the increased phosphorus mining and application occurring after the mid-twentieth century. Human phosphorus mining is now estimated to be 23.5 Tg per year, more than doubling the amount of phosphorus flowing through the environment in comparison to the Holocene baseline. Preindustrial weathering processes produced 15-20 Tg of mobilised phosphorus per year, but human mining of phosphorus is now estimated to produce 15–20 Tg of mobilised phosphorus per year. This extra phosphorus has a considerable impact on the Earth System's functioning, largely through and it may contribute to the eutrophication of freshwater lakes, but it may also contribute to the formation of anoxic zones in the ocean (Sustainability Challenges in the Phosphorus System n.d.). Because phosphorus is locked up in bedrock, soils and sediments, it is not directly available to organisms. Geological and biological events in the global phosphorus cycle convert inaccessible forms to bioavailable ones, which can be digested directly. Wastewater treatment plants and industrial outlets are examples of point sources and on the other side, the most significant contributors to phosphorus pollution. Detergents are the most common source of phosphorus in municipal wastewater, while the phosphorus content of detergents has been reduced in many countries by substituting alternative compounds. Fertilizer manufacturing industries may produce amounts of P comparable to the total emissions of small countries, while these emissions have fallen dramatically due to advances in technology and wastewater treatment. Phosphate minerals are the principal source of phosphorus, whether they are found in phosphate ores, rocks, or soils. Their quantity, availability and reactivity are thus critical to the Earth's entire phosphorus cycle, as well as the carbon cycle, which is influenced by biological activity regulation.

Environmental Impacts: Cultivated agriculture is all about biomass production. The increasing intensity of biomass production carries potential environmental impacts on the form of introducing of bio geochemical cycles in balance. Policymakers have been prompted by the urgent need of alleviate attempts in reply to change in weather are required to accelerate the spread of bioenergy, resulting in significant land-use changes on short timescales. Despite the potential negative effects on biodiversity and the environment, large-scale bioenergy production has hardly become a reality. received appropriate scientific consideration. Environmental rules or regulatory constraints in most nations are still lagging the exponential rise of energy crops. Most of the research finds beneficial effects on biodiversity at the field scale, but the results are highly dependent on biomass plantation management, age, size and variability. Significant uncertainties exist at the regional level and there is also a strong fear that large commercial

Table 2: A comparison of phosphorus recovery methods from sewage sludge ash

	Method name	Scale	Principles	Obtained product
Wet extraction methods	SEPHOS/ Advanced SEPHOS (Schaum *et al.*, 2013)	Lab.	SSA leaching with H_2SO_4 added up to pH value 1.5. Neutralization of the system with NaOH (pH=3.5) and $AlPO_4$ precipitation. Advanced method: dissolution of $AlPO_4$ in NaOH and heavy metals separation.	$AlPO_4$/ $Ca_3(PO_4)_2$
	PASH (Dittrich *et al.*, 2009)	Pilot	SSA leaching with 8% HCl, liquid-liquid extraction using tri-(C_8C_{10})-alkilamine (Alamine® 336) and tri-n-butyl phosphate (TBP) to obtain high phosphorus against iron recovery selectivity. Final step: phosphates precipitation.	Magnesium or calcium phosphate/MAP
	BIOCON (Donatello *et al.*, 2010)	Pilot	SSA leaching with sulphuric acid. The step of treating extract on ion exchange columns.	H_3PO_4
	AquaReci (Stark *et al.*, 2006)	Pilot	SSA from supercritical water oxidation process (374°C, 220 bar), subsequently leaching with base. Phosphate compounds precipitation with lime milk.	Calcium phosphate
	SESAL-Phos (Petzet *et al.*, 2012)	Lab.	Acidic leaching due to phosphorus transformation into Al-P form, afterwards precipitate dissolution in basic extractant, selectively among HM. Phosphorus compounds obtained *via* CaO addition.	Calcium phosphate
	Zero sludge discharge technology (SPIRIT 21, 2007)	Project	SSA basic leaching with KOH or NaOH, an intermediate for liquid fertilizers is obtained. Final step: precipitation with lime milk.	liquid K_3PO_4/ calcium phosphate
	ECOPHOS (PL) (Gorazda *et al.*, 2012)	Micro-technical	Thermic pre-treatment of the ash at 950°C (iron transferred into hematite form that is insoluble in acids), acidic leaching with HNO_3 or H_3PO_4, phosphate precipitation with CaO.	Calcium phosphate
Thermochemical	AshDEC (Nowak *et al.*, 2012)	Pilot	Thermochemical treatment of the ash mixed with $MgCl_2$ or $CaCl_2$ at 1000°C, volatile chlorides formation, transformation of the phosphorus compounds into bioavailable form.	Ash as fertilizer
	Mephrec (Nieminen, 2010)	Pilot	SSA briquettes sintering in a shaft furnace with dolomite and lime as a fluxing material and coke as a reducer and an energy carrier. Temperature of the process: 2000°C, silica phosphate from metals separation at 1450°C	Ash with high calcium and phosphorus concentration

production will have a negative impact on biodiversity in areas of high sustentation consequence. Although, incorporating biomass crops into agricultural landscapes has the potential to boost rural economies while mitigating the harmful effects of farm demission. and assisting in the rehabilitation of damaged land, resulting in higher biodiversity values. The dimensional structure and dispensation of biomass plantations will decide the intimation, given the degree of land conversion required to meet bioenergy targets. To ensure sustainable biomass crop production, biodiversity would have to become an integral component of risk assessment measures in all countries that have not yet committed to making it a requirement of strategic landscape planning. To aid in the long-term economic and ecological sustainability of biomass production, as well as to avoid costly mistakes in our efforts to alleviate change in weather, we need to do integrate environmental and economic research. A considerable amount of dust is put into the air by tillage operations. The dust costs the leaves of the plants and diminishes the photosynthetic activity. Tillage favours topsoil inhabitants over subsoil dwellers by burying crop leftovers and manure. Night crawlers are infrequent in long-term clean-tilled fields. Tillage also promotes topsoil dryness and large day/night temperature swings. As a result, the number of earthworms is lower in clean-tilled fields than in no-tilled fields. Tillage brings earthworms to the surface, where they are preyed upon by predators such as birds. Long-term no-tilled fields frequently have at least twice as many earthworms as clean-tilled fields [37].

The water, fertilisers and pesticides used in the cultivated fields invariably get into ground water affect area downstream disturbing N, S and P cycles. Non-point source pollution by agricultural inputs is the major concern arising out of the cultivated agriculture. The agricultural waste decomposition adds to the environmental degradation by releasing CH_4 and disease organisms. Agricultural operations can also have a direct impact on aquatic species' habitats by causing physical disturbances caused by cattle or equipment. Although agricultural NPS pollution remains a severe concern across the country, much has been accomplished in terms of sediment and nutrient reduction from privately owned agricultural areas during the last several decades. Much has been learnt about more effective techniques to prevent and mitigate NPS pollution from agricultural activities in recent years. Excess nitrogen creates other water quality issues in addition to eutrophication. Fish, particularly trout, may be poisoned by dissolved ammonia at quantities more than 0.2 mg/L. In addition, nitrates in drinking water might be harmful to newborn babies. In the digestive tract, nitrate is converted to nitrite, which lowers the blood's oxygen-carrying capacity (methemoglobinemia), leading in brain damage or death. The United States Environmental Protection Agency has set a maximum a nitrate-nitrogen concentration of 10 mg/L in swilling water [38]. The intensively managed ecosystem completely changes the community of organisms. The natural areas surrounded by the cultivated fields exhibit changes in the form of population of various species of organisms. Monocultures tend to attract exotic species more susceptible to disease and require large chemical applications. The noise generated from agricultural operations disturbs the natural habitats of the animals in the vicinity forcing them to migrate or die off. The increased use of land for biomass production heightens soil erosion. The erosion rates in the cultivated soil averages 20 metric ton per hectare annually. The maintenance of adequate vegetative cover and reduced run off velocities processing solutions to the soil erosion and nutrients loss in variety do not provide with intense agricultural practices. The ecosystem stability remains the prime concern. The concept is that perturbation is reduced to the level it can repair itself. The preservation of ecosystem stability is difficult. The long-term perturbation such as extended period of drought, insect infestation, fire etc introduces ecological succession.

The ecological session is a well-ordered community development process that involves changes in species organisation. At each stage of succession, the prescient microclimate is modified by the organisms. Wherever there is perturbation, there is opportunity for succession. Whether it is cutting of forest, stripping of land surface, damming of valley, drilling for oil, the succession will follow and environment will change. Because of the relatively brief era of cultivated agricultural history during which technologies have played a dominating role, people have rated them differently at different times. Some represent the removal of the wear and tear of regular living, while others represent a necessary evil to produce biomass. The goal is to optimise farming methods that are both productive and resource efficient while also contributing to a more homogenous landscape at the micro and macro levels. This implies principally a genuine balance between the aim of cultivated agriculture and values by the bio geo chemical cycles. Most people in Pakistan have relatively close contact and relationship with cultivated agriculture. A vast number of free and independent farmers and a limited number of major estate owners used to make up the agriculture sector. As a result, changes in agriculture are likely to affect a larger number of individuals. The only thing that is being modified is their own cultural inheritance.

Deforestation Impacts: Assessing an environment is challenging enough, but policymakers also need to understand how different habitats collaborate. As in China and Pakistan, degradation in highlands can exacerbate floods in grasslands and agricultural fields below. To limit the effects of various water-related natural disasters, such as floods, effective disaster management plans are required. According to a document prepared by the United Nations Environmental Program (UNEP), out of 30 million species on the earth, 11.5 million have ever been described. Of this figure, 750, 000 are insects, 41, 000 are vertebrates and 250, 000 are plants. The remainder are invertebrates, fungi and micro-organisms. The document further states that about one quarter of the earth's 30 million species risk extinction within the next 30 years because they are being destroyed in a systematic manner. The tropical forests, for instance, contain more than half of the world species and one single activity namely "Tropical Deforestation" can eliminate 5-15% of the species by the year 2020. This would multiply the sediments loads manifold as being witnessed presently. Deforestation has aggravated the soil erosion to the extent that has exceeded all the previous estimates e.g., about 550, 000 tons of sediments are pouring daily into a single Tarbela water reservoir. Pakistan government has been forced to build a new reservoir instead with cost estimates of about 800 billion rupees. However, rivers transmit the effluents and by-products of agriculture, industry and urban areas to the beaches, causing indirect damage to these ecosystems. And if that isn't bad enough, man-made climate change poses a threat to all coastal places, because melting glaciers push more water seaward and the oceans warm and expand, causing sea levels to increase. Coastal cities might be flooded and entire islands could be submerged under the seas [39].

Environmental Direct Impact: Table 3 indicates the various percentages of direct environmental consequences on the agriculture sector.

Indirect Environmental Impact: Table 4 shows the various percentages of indirect environmental consequences on the agriculture sector.

Environmental Total Impact: Table 5 Illustrate total environmental impact on agriculture sector in Pakistan.

Impact of Fertilizers: Excessive use of fertilizers has adverse effects on environment which is causing major concerns. Following tables and graphs illustrates the problems:

Upsetting the System: Anybody that has attended a basic subject understands that the World's most vital components circulate in cycles, moving from the sky to the land, sea and back. Habitat has become so powerful

Table 3: Pakistan's agriculture sector's direct environmental affects and sectoral ties to Pakistan's overall ecological consequences

Item	Downstream Environmental Linkage (%)	Internal Environmental Linkage (%)	Total Indirect Environmental Linkage (%)
Land	16.7	10.0	26.7
Water	58.3	35.0	93.3
Blue water	61.9	37.2	99.0
Grey water	48.7	29.2	77.9
Nitrogen impact	57.3	34.4	91.7
N_2O	56.5	33.9	90.4
NH_3	61.9	37.2	99.0
NOx	9.2	5.5	14.7
N	62.1	37.3	99.4
CO_2	0.9	0.5	1.4

[1]Pakistan's overall sectoral environmental effect is calculated by adding all sectoral environmental impacts from the 2015 IO table, which can be found at http://worldmrio.com/.

Table 4: The indirect environmental implications and sectoral linkages of Pakistan's agriculture sector on the country's overall environmental impact

Item	Upstream Environmental Linkage (%)	Mixed Environmental Linkage (%)	Total Indirect Environmental Linkage (%)
Land	0.24	1.24	1.48
Water	0.01	0.30	0.31
Blue water	0.00	0.32	0.32
Grey water	0.03	0.25	0.28
Nitrogen impact	0.04	0.29	0.35
N_2O	0.03	0.26	0.28
NH_3	0.00	0.32	0.32
NOx	0.48	0.03	0.51
N	0.002	0.32	0.32
CO_2 (Gg)	0.37	0.005	0.38

Table 5: Overall environmental impacts of Pakistan's agriculture sector in relation to Pakistan's total sectoral environmental impacts

Item	Total Environmental Impact (Direct + Indirect)
Land	28
Water	94
Blue water	99
Grey water	78
Nitrogen impact	92
N_2O	91
NH_3	99
NOx	15
N	100
CO_2	2

Table 6. Fertilizer Use on Arable Land

Country	Fertilizer Use (kg/ha)
Egypt	663
China	565
Bangladesh	279
United Kingdom	243
Japan	241
Indonesia	212
India	165
France	152
USA	138
Pakistan	134
Turkey	105
Canada	89
Australia	54

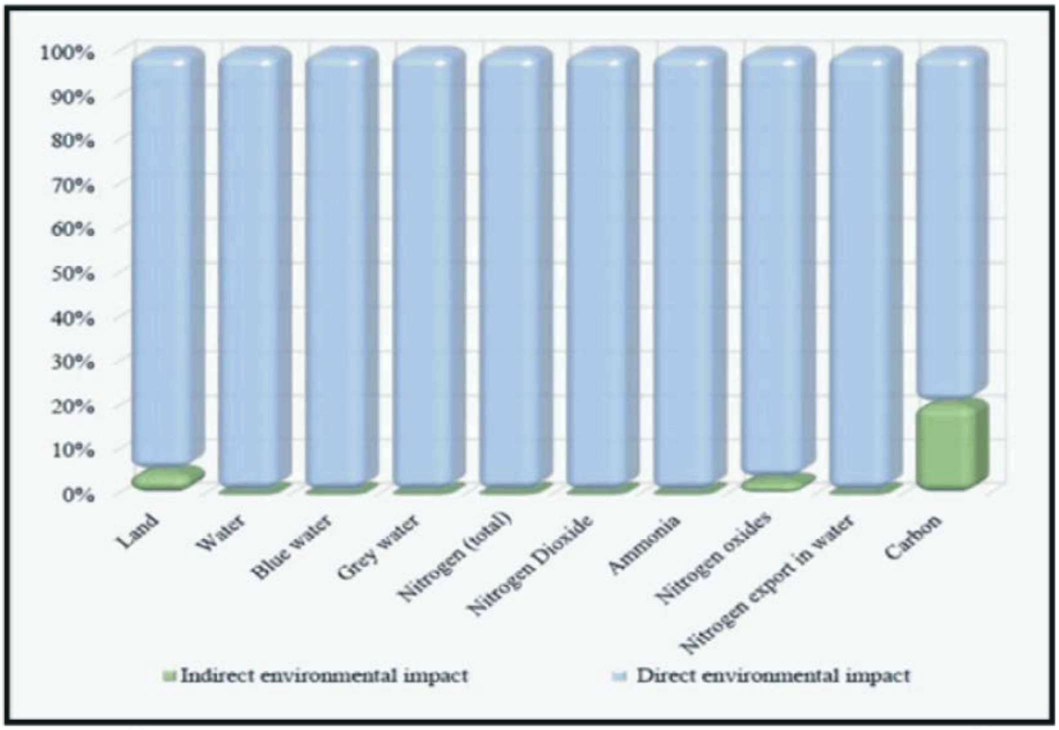

Fig. 7: A comparison of Pakistan's agriculture sector's total direct and indirect environmental impacts

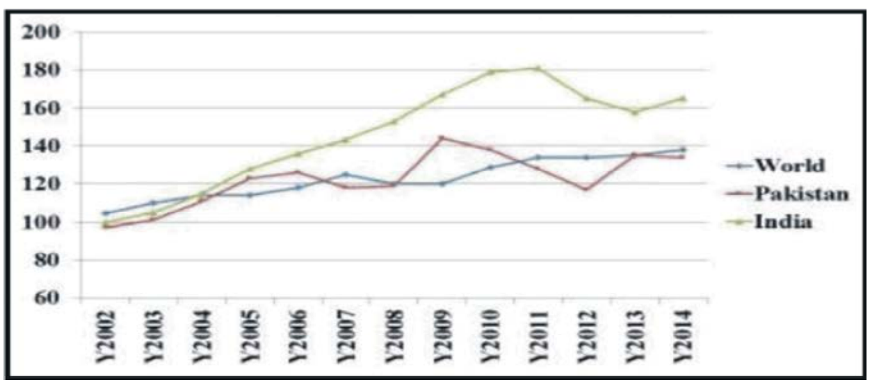

Fig. 8: Fertilizer Trends Application in Pakistan (http://data.worldbank.org)

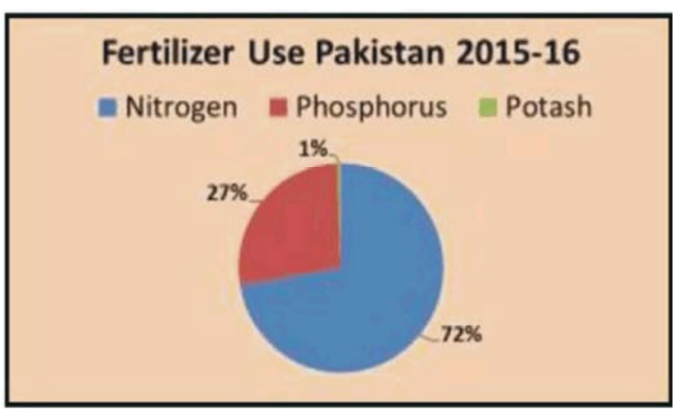

Fig. 9: Fertilizer use Pakistan (2015-16) (http://data.worldbank.org)

that it has affected even the planet's most basic systems. The most well-known example is what we've done to the carbon cycle. Because we're pouring carbon dioxide into the atmosphere much faster than land and water can absorb it, the accumulating gas traps heat and causes climate disruption. The outcome is not simply higher sea levels and more powerful storms, but also a likely repositioning of the world's ecosystems as forest and grassland boundaries moves. Several organisms are unable to adapt to abrupt habitat changes. The destruction wreaked on the nitrogen cycle is less well-known. Humans have increased the amount of nitrogen compounds that can be utilized by living things by using fertilizers, burning fossil fuels and clearing land. However, those levels are higher than what plants and animals can efficiently absorb and recycle into the atmosphere. These extra nitrogen compounds wash into fresh and saltwater systems, where they stimulate suffocating algal growth, resulting in dead zones. Because the global food system relies heavily on fertilizer, restoring the nitrogen cycle's balance is a difficult task.

What we've done to the water cycle is far more disastrous. Human demand for freshwater is so tremendous that many huge rivers, such as the Yellow in China and the Nile in Egypt, dry up before reaching the sea. When diverted water is returned to rivers, it is frequently contaminated with unpleasant chemicals and sewage. Furthermore, the construction of 40, 000 huge dams and numerous smaller barriers has transformed the majority of the world's rivers into a network of interconnected lakes. Thousands of species evolved to free-flowing water face severe repercussions because of such a water system, unlike anything seen since the end of the last ice age. The impact of humans on the water cycle can also be found underwater. Sometimes irretrievably damaging these reservoirs of groundwater [40].

Although industrialization assures economic development of a country, it does so at the expense of raised environmental temperature. Rising emissions of greenhouse gases such as carbon dioxide and methane, which trap heat in the atmosphere, are causing global warming. Improved energy efficiency and the use of newer, cleaner energy sources can help minimize these emissions. Food, particularly animal protein, is strongly reliant on the oceans. The oceanic fish capture increased from 19 million tons to more than 90 million tons between 1950 and 1997. Since mid-century, the capture of most maritime fisheries has increased fivefold, pushing them to their boundaries or even beyond. The three concurrent trends of declining water tables, declining farmland land per person, with balancing of marine fish capture all signal that keeping up with global food demand over the next half-century will be significantly more challenging if the world stays on the UN medium development path and if incomes continue to rise.

CONCLUSION

Input intensification and area expansion are the primary drivers of increased agriculture production, although total factor productivity (TFP) is dropping over time. Chemical pesticides and fertilisers have had a negative impact on natural resources such as quality and safety of soil, water, air and food. Immense manufacturing costs, low average yields and low-quality products are all allowing foreign goods to enter our local marketplaces. These worries have rendered Pakistan uncompetitive at international markets, furthermore this have made a negative effect on the welfare of domestic customers. Scarcity of water is a major concern which is a critical agricultural input, but Pakistan's crop production system's water use efficiency is extremely low. Evidence suggests that agriculture has taken over some of the world's richest and most productive regions while food consumption is continuously rising as total world’s population and per capita income rise. Due to rise in widening imbalance between supply and demand is putting severe damage to future food security and reduction in poverty. It is justified that if the government does not overcome the following problems and challenges faced by the agriculture sector, not only will future generations' food security be compromised, but also the manufacturing sector's development will be slowed and the trade deficit and balance of payments will increase. The agriculture sector's poor performance is attributed to the absence of capacity for creating and implementing revolution at each apex of the utility chain. Stakeholders at various points along the value chain are either unable to implement current manufacturing, grading and processing procedures or are uninformed of the benefits of doing so. Structure modifications at the macro and local levels may aid in the rehabilitation of the agriculture industry. The widening imbalance between social and economic returns on agriculture transformation explains low private investment in the region. Contract farming and the creation of agro-industrial clusters (AIC) could be feasible options; however, contract farming will not be sustainable if diverse players in the value region lack the ability to monitor new automations or advances. Agriculture's transition from highly productive to marginal areas could be slowed by rectifying strategy, encouraging perpendicular development in household and commercial raising. Investing in issue research, developing agricultural technology, rural infrastructure, stakeholder capacity building, forming farm-based vocational academies and innovators and bolstering public-private partnerships could assist the agriculture industry recover. The spotting of feasible groups for every crop must aid in the promotion of corporate farming to overthrow the ineffective manufacturing and marketing structure currently in place. Despite significant irrigation infrastructure, gaps in water management infrastructure, such as dams, result in surplus water being discharged into the sea, leaving the country water-stressed for much of the year. Changes in monsoon patterns and rising temperatures are projected to provide significant problems to agriculture, particularly in northern Pakistan, which is already vulnerable to climate change. Temperature rises will most certainly accelerate agricultural growth cycles and reduce the time between sowing and harvesting, lowering crop yields. Climate change threats and shocks to Pakistan's agricultural sector are becoming more frequent. Smallholder farmers who rely on rain-fed agriculture and have limited capacity to cope with climatic uncertainties are significantly affected by rising temperatures and variations in monsoon systems.

REFERENCES

1. Pointner, Wolfgang and Doris Ritzberger-Grünwald, 2009, Climate Change as a Risk to Financial Stability.
2. Chandio, Abbas Ali, Yuansheng Jiang, Abdul Rehman and Abdul Rauf, 2020. Short and Long-Run Impacts of Climate Change on Agriculture: An Empirical Evidence from China. International Journal of Climate Change Strategies and Management, 12(2): 201-21.
3. IMF Report 2016. Commodity Price Shocks and Financial Sector Fragility. IMF Working Papers 16(12): 1.
4. Manisalidis, Ioannis, Elisavet Stavropoulou, Agathangelos Stavropoulos and Eugenia Bezirtzoglou, 2020. Environmental and Health Impacts of Air Pollution: A Review. Frontiers in Public Health, pp: 8.
5. Nodari, Rubens Onofre, 2011. Agriculture: Risk Assessment for Brazil's GM Bean. Nature, 479(7373): 299.
6. Khetran, Mir Sherbaz, 2016. Economic Connectivity: Pakistan, China, West Asia and Central Asia *. Institute of Strategic Studies, pp: 61-76.
7. Finance Division, Government of Pakistan. 2019. Pakistan Economic Survey 2017-18. Pakistan Economic Survey, pp: 115-31.
8. Kahlown, Muhammad Akram and Abdul Majeed, 2002 Water-resources Situation in Pakistan: Challenges and Future Strategies.
9. Ali, Uzair *et al*., 2021. Climate Change Impacts on Agriculture Sector: A Case Study of Pakistan. Ciencia Rural, 51(8).
10. Tareen, Wajahat Ullah Khan *et al*., 2020. Present Status and Potential of Biomass Energy in Pakistan Based on Existing and Future Renewable Resources. Sustainability (Switzerland) 12(1).
11. Aslam, Muhammad, 2016. Agricultural Productivity Current Scenario, Constraints and Future Prospects in Pakistan. Sarhad Journal of Agriculture, 32(4): 289-303.
12. Easterling, David *et al*., 2012. 3 - Changes in Climate Extremes and Their Impacts on the Natural Physical Environment. Cambridge University Press. Ecological-Succession.
13. Ali, Sajjad *et al*. 2017. Climate Change and Its Impact on the Yield of Major Food Crops: Evidence from Pakistan. Foods, 6(6): 1-19.
14. Kahan, David, 2013. Managing Risks in Farming.
15. Ahmed, Riaz and Usman Mustafa, 2017. Impact of CPEC Projects on Agriculture Sector of Pakistan: Infrastructure and Agricultural Output Linkages. Pakistan Development Review, 56(4): 511-27. https://hau.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=20183128850&site=ehost-live&scope=site%0Ahttp://www.pide.org.pk%0Aemail: usman@pide.org.pk.
16. Asif, Muhammad. Examensarbete i Hållbar Utveckling 170, 2019 Climatic Change, Irrigation Water Crisis and Food Security in Pakistan Climatic Change, Irrigation Water Crisis and Food Security in Pakistan Muhammad Asif.
17. Unep-Unctad, 2008. Biodiversity and Agriculture: Safeguarding Biodiversity and Securing Food for the World.
18. Wishnie, Mark, 2016. Conservation and Subsistence in Small-Scale Societies Author (s): Eric Alden Smith and Mark Wishnie Published by?: Annual Reviews Stable URL?: Http://Www.Jstor.Org/Stable/223430 Your Use of the JSTOR Archive Indicates Your Acceptance of the Terms & Cond. 29(2000): 493-524.

19. Shindell, D. *et al*., 2012. Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers. Sustainability Challenges in the Phosphorus System. pp: 1-34.
20. Philip, J.R., 1966. Plant Water Relations: Some Physical Aspects. Annual Review of Plant Physiology, 17, 245-268. https://doi.org/10.1146/annurev.pp.17.060166.001333
21. Pielke, Roger A. and Dev Niyogi, 2010. The Role of Landscape Processes within the Climate System. Lecture Notes in Earth Sciences, 115(January): 67-85.
22. Rodda, John C., 2004. World Water Resources at the Beginning of the Twenty-First Century. Choice Reviews Online, 41(07): 41-4063-41-4063.
23. Shiklomanov, L.A., 1993. World Freshwater Resources. In: Gleick, P.H., Ed., Water in Crisis: A Guide to World's Freshwater Resources, Oxford University Press, New York, 13-24.
24. David Pimentel, Bonnie Berger, David Filiberto, Michelle Newton, Benjamin Wolfe, Elizabeth Karabinakis, Steven Clark, Elaine Poon, Elizabeth Abbett and Sudha Nandagopal, 2004. Water Resources: Agricultural and Environmental Issues, BioScience, 54(10): 909-918, https://doi.org/10.1641/0006-3568(2004)054[0909:WRAAEI]2.0.CO;2
25. Paz, V. P. da S., R.E.F. Teodoro and F.C. Mendonça, 2000. Water Resources, Irrigated Agriculture and the Environment. Revista Brasileira de Engenharia Agrícola e Ambiental e Ambiental, 4(3): 465-73.
26. Fowler, Keirnan, Murray Peel andrew Western and Lu Zhang, 2018. Improved Rainfall-Runoff Calibration for Drying Climate: Choice of Objective Function. Water Resources Research, 54(5): 3392-3408.
27. Government of Pakistan, 2014. Climate Change Division, Framework for Implementation of Climate Change Policy(2014-2030). (November 2013). http://www.pk.undp.org/content/dam/pakistan/docs/%0AEnvironment%2520&%2520Climate%2520Change/Framework%2520for%2520Implementation%2520of%2520CC%25%0A20Policy.pdf.
29. Bueno, Emilio *et al*., 2022. Regulation of the Emissions of the Greenhouse Gas Nitrous Oxide by the Soybean Endosymbiont Bradyrhizobium Diazoefficiens. pp: 1-16.
30. Buresh, R.J., K. Ramesh Reddy and Chris van Kessel, 2008. Nitrogen Transformations in Submerged Soils. Agronomy Monographs: 401-36. http://doi.wiley.com/ 10.2134/ agronmonogr49.c11.
31. Van Den Bosch, Pim L.F., 2008. Biological Sulfide Oxidation by Natron-Alkaliphilic Bacteria Application in Gas Desulfurization.
32. Holmer, M. and P Storkholm, 2001. Sulphate Reduction and Sulphur Cycling in Lake. Freshwater Biology, 46: 431-51.
33. Jørgensen, Bo Barker and R. John Parkes, 2010. Role of Sulfate Reduction and Methane Production by Organic Carbon Degradation in Eutrophic Fjord Sediments (Limfjorden, Denmark). Limnology and Oceanography, 55(3): 1338-52.
34. Von Wandruszka, Ray, 2006. Phosphorus Retention in Calcareous Soils and the Effect of Organic Matter on Its Mobility. Geochemical Transactions, 7: 1-8.
37. Bertrand, Michel *et al*., 2015. Earthworm Services for Cropping Systems. A Review. Agronomy for Sustainable Development, 35(2): 553-67.
38. Federation, Water Environment, 2012. APHA, AWWA, WEF. ‘Standard Methods for Examination of Water and Wastewater.’ Anales de Hidrología Médica, 5(2): 185-186-186.
39. Catastrophiques, Sinistres *et al*., 2010. Canadians at Risk?: Canadians at Risk?: Our Exposure to Natural Hazards Authors Edited By.
40. Sheil, Douglas, 2018. Forests, Atmospheric Water and an Uncertain Future: The New Biology of the Global Water Cycle. Forest Ecosystems 5(1).