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Agriculture Technologies and Environment in India: A Case on Sustainable Approach

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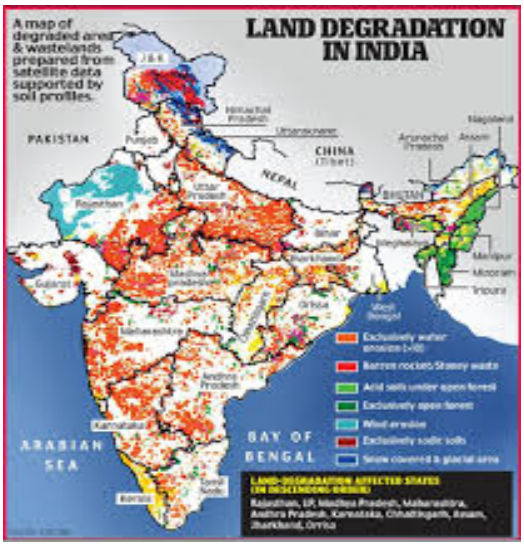
Abstract— *Since the onset of economic reforms in the nineties, the face of Indian Agriculture has significantly changed from the traditional systems, low investment of capital and technology and poor post-harvest management to more capital-intensive and value-added farming system with technology driven practices. In spite of this transformation, the major point to be noticed is that India has the most varied environment conditions with almost all crops being grown on its soil, yet it has a very meagre share of a little over 1% of the world's Agri exports. The country can boast of the largest research and extension system in the world but it ranks below world average productivity in most crops. The Agro technologies have been developed at a greater extent but extension till farm level still faces a gap. Technology enabled farming tools can be a boon for small farm. Technology based crop advisory around crop planning, pest control, disease mitigation can be very useful. Online marketplaces offering wide variety of authentic Agri inputs that are backed by scientific Agri-advisory can also help. Also, the fact that India's share in world's production is far higher than its share in world exports in most Agri-items clearly reflects the vast untapped potential of Agri-exports. Today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems allow businesses to be more profitable, efficient, safer, and more environmentally friendly*

Keywords: *Agriculture, Technology. Inputs, Environment, pollution*

At the bottom of many of our fresh water, at the sediment water interface, there lives a little worm; biologists call it tubifex. This worm has an interesting anatomy; its mouth is at the front end, but it breaths oxygen at the rear end. This represents a worm with a conflicting situation. In order to eat it tends to operate deeper into the food bearing sludge where oxygen is depleted; in order to breathe, however, it tends to ascend higher water layers that contain dissolved oxygen but where there is little food. The example of this anatomy – and organism being suspended between layers of nutrition and respiration illustrate the basic constitutive property, of all organisms including humans. Conditions of life preservation are unavoidably interrelated with conditions of endangerment. This constitutive element is particularly evident with humans in their conflict between exploitation of natural resources and protection of environment. Humans have always built up their own order at the expense of some order in the environment. They have been forced to multiply destruction of environmental order to build up the increasingly intricate structure of culture and civilization. Thus, humans have developed from relatively unimportant physiological consumers to inventive intellectual being and geological manipulators who use external flow of energy of materials to build up their civilization. Most of their energy utilized by a society, however, ultimately reflects a perturbed ecosystem. The countries of the third world in post sixties witnessed growing aspiration of people to improve quality of life and, as the population boom was taking place, the thrust was further attainment of self-sufficiency in food by putting larger input of energy in crop production. A technological energy input for crop production on land water system may include deforestation, conversion of natural grassland into cropland, use of chemical fertilizers, pesticides and irrigation, and growing high yielding varieties.

Land degradation A survey report of 2018 by the international institute of world resources indicate the agricultural input in the land during the last forty years has resulted in converting fertile agricultural land equivalent to crop land of China and India combined together, into fertile wasteland. Land degradation is one of the most serious challenges the mankind is facing in attempts to feed the growing population.



Source:https://iasscore.in/upsc-prelims/land-degradation

It is any way from twenty to thousand years for a centimeter of soil to form. Erosion of soil preferentially moves low-density materials i.e. with high organic matter content and small clay particles. Both have great contribution to soil fertility. An extreme example of degradation is the phenomenon of desertification. According to Worldwatch Institute, almost 20 million km2, or 15% of all land surface may already be experiencing desertification.

Source: https://timesofindia.indiatimes.com/india/india-to-announce-massive-land-restoration-drive-stretching-from-porbandar-to-delhi-during-upcoming-un-meet/articleshow/70931671.cms

Agriculture can directly contribute to desertification through poor agricultural practices such as deforestation, leaving soil barren for a long period of time, and lack of conservation practices followed during cultivation. The rate of loss of carbon following deforestation depends on many factors, e. g. antecedent level of C in soil, method of deforestation, land use, including use of cover crops and crop residue management, cropping system, tillage methods etc. Total carbon loss from the time of deforestation may be as much as 60% in the top 0-5 cm layer and 30% in the 5-10 cm layer. The rate of decline is, however, somewhat less with conservation tillage and agroforestry.

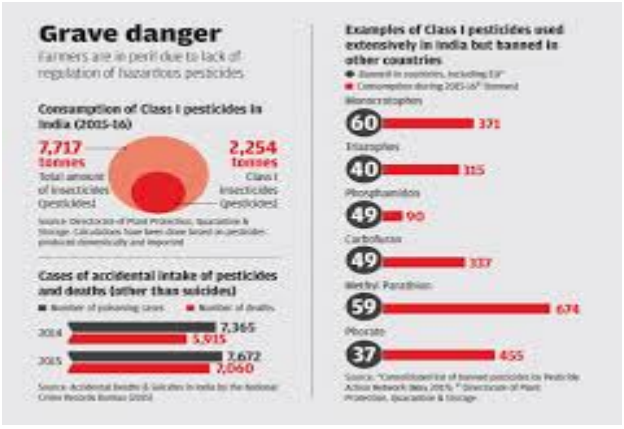
With some exceptions subsistence or some commercial farmers with none or no level of off-farm input use most arable land. Fertility depletion is a norm due to intensive cropping and resultant soil degradation. Initially there is a steep decline in carbon reserve of these lands, which ultimately become degraded as the soil organic matter level attains equilibrium. The cropping practices relevant to soil conservation include crop rotations and combinations; fertility maintenance including use of inorganic fertilizers and organic manures, conservation tillage methods, cover crops and crop residue management should be followed to protect the land.

Soil and ground water pollution.

Agriculture affects water resources in two ways: irrigating fields using surface water of aquifer which diverts water from other potential uses; and when farming practices pollute surface water and aquifers they reduce the amount of water that is suitable for other use. Similarly the practices of using sewage sludges for irrigation purpose are widely prevalent. The toxic heavy metals often come into food and feed chain.

As a result human beings and animals become prone to several diseases. The application of chemical fertilizers more than the crop requirements and injudicious use of irrigation water often result in nitrate pollution in ground water or eutrophication.

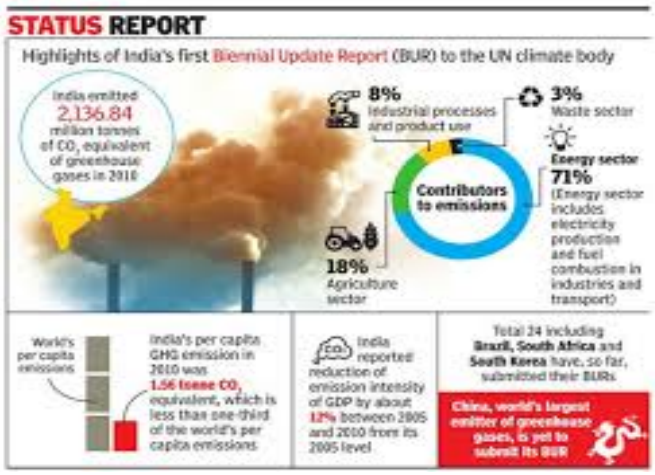
The environmental impact of excessive use of pesticides in agriculture includes widespread decline in bird and beneficial insect populations. This can disrupt the balance between predator and prey because pests often recover faster from pesticide application than does the predators that normally keep pest populations under control.



Source:https://www.downtoearth.org.in/news/agriculture/vidarbha-s-toxic-trail-59173

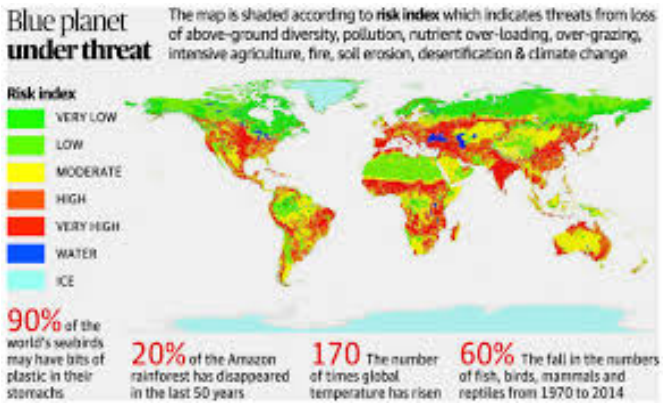
There are chances of ground water pollution by the pesticide residues. Pesticides produce both short and long term effects of human health. The United Nations has estimated that about 2 million poisonings and 10,000 deaths occur each year from pesticides, with about three-fourths of these occurring in developing countries. The long-term effects include elevated cancer risks and disruption of body's reproductive, immune, endocrine and nervous systems.

Emission of Greenhouse gases Important gases generated within soil include carbon monoxide, nitrous oxide, methane, ethane and ethylene under anaerobic conditions and mostly carbon dioxide under anaerobic condition. About 80 per cent of the radiative forcing created by agriculture arises in tropical agro ecosystems. Carbon dioxide emissions associated with agricultural development are a major component of radiative forcingattributable to tropical agro ecosystems. Methane emissions from ruminant animals and rice fields are also important, but nitrous oxide emission are of minor importance. About one third of the anthropogenic radiative forcing attributable to agriculture is associated with soil sources, while the bulk is derived from ruminant animals and animal wastes. The soil sources of carbon dioxide and methane are essentially all in the tropics and half of the nitrogen oxides emission is estimated to come from the tropical soils.



Source: https://economictimes.indiatimes.com/news/politics-and-nation/india-cut-carbon-emission-intensity-by-12-in-5-years/articleshow/50693635.cms

Soil as a sink and source of carbon Soil carbon in the form of soil organic matter is a major source of energy for agriculture. It is a major component of terrestrial carbon cycle. The soils of the world contain more carbon than the combined total amount occurring in the vegetation and the atmosphere. Consequently soils are a major reservoir of carbon and an important sink. Because of the relatively long period of time that carbon spends within the soil and is thereby withheld from the atmosphere, it is often referred as being sequestered. But with the advent of modern agricultural technologies and to meet the growing population, it is being harnessed injudiciously. This results in a steep decline in its concentration in the soil and alarming increase in the green house gases in atmosphere.



Source: Article India among nations that face grave danger to soil biodiversity: WWF, October 31,2018

Increasing the capacity of soil to sequester carbon provides a partial, medium term countermeasure to help ameliorate the increasing carbon dioxide levels in the atmosphere arising from fossil fuel burning and land clearing. Such action will also help alleviate the environment impacts arising from increasing carbon dioxide.

International negotiations have been carried out over a number of years with the objective of putting in place a global response to the threat of climate change for the ever-growing emission of greenhouse gases, particularly carbon dioxide. The negotiation carried out in Kyoto protocol in 1997 and subsequently the Conference of Parties in Bonn in July 2001 has recognized soil as a significant terrestrial reservoir of carbon. At the Bonn meeting, it was decided to expand the land management systems to make soils eligible for inclusion as C sinks. This decision increases greatly the scope and opportunities for the sequestration of carbon by soils under a wide range of management and production systems to be incorporated legitimately under articles of Kyoto protocol. The tendency to harvest more from the soil by any means has led to unsustainable methods of agriculture because it is simultaneously eroding natural resources faster than the environment can regenerate them. Reducing the dependence on chemical fertilizers and including more of organic manures and biofertilizer in the crop production is a vital tool to sustain crop production for a longer period with minimum risk to the environment. It is essential to identify the cause of declining trend to yield so that it can be arrested with proper nutrient management. Similarly in the crop protection part, integrated pest management system prefers biological methods and uses least toxic chemical pesticides only as a last resort. The main objective of such practice is use of methods, which disrupt pest cycles. Hence, if the constraints in agriculture are identified at an appropriate time and are ameliorated with and appropriate technology, sustainability in agriculture can be achieved. The quest for greater yields has landed farmers on a technological treadmill of increasing inputs and decreasing

profit margins. Hunger and food security are currently problems, not of resource scarcity, but of moral imperative to change the way of nonconventional practice. If unsustainable agriculture remains the norm, scarcity could soon become a major factor in food insecurity.

Recent Digital Innovations in Indian Agriculture:

Artificial Intelligence:

The identification of factors such as productivity, productions and harvesting place along with crop cycle is the biggest contribution of technology in Agriculture. With Artificial Intelligence tools entering into the technology , the possible solutions are easily available to technologists apart from the Extension workers and ultimately to the farmers. The best AI bases solutions indicate place bases season, time of cultivation, harvest, type of soil required, insect-pest control and also the type of harvest the crop would need.

Providing the platform for AI in agriculture, we have varied forms of Analytics available to the crops,

- Variety Analytics
- Cultivation Technique Analytics
- Agricultural operations Analytics
- Soil Analytics
- Harvest Analytics
- Meteorological analytics

Government schemes like Pradhan Mantri Fasal Bima Yojana (PMFBY) will be welcoming AI technology to reduce the time consumption in settling claims of the farmers. The government also signed an MoU with IBM to monitor the agriculture sector with AI.

The Agricultre Instituions who are using AI extensive claim that the are able to do amzing work informing farmers like when to sow crops, best time to planation etc. The result is increased yield upto 30305 percent. Here the farmers need not to install any sensors or any kind of device that incur capital expenditure from their side. They just need a mobile phone which should be caoable of receiving information based on text messages.

According to Microsoft, ICRISAT has scaled sowing insights in 2018 to 4,000 farmers across Andhra Pradesh and Karnataka for the Kharif crop cycle (rainy season). The agency has also developed multi-variate agricultural commodity price forecasting model to predict future commodity arrival and the corresponding prices. The model uses remote sensing data from geostationary satellite images to predict crop yields through every stage of farming

Mobile Application in Agriculture

Smartphones are no longer the luxury in Indian perspective, they are rather the regular commodity now. The deep penetration of digitalization has boosted up the capabilities of application of agriculture. As more and more activities moved to the smartphone, the new technology boosted the potential of applications for agricultural as well.

The government has majorly focused on backing the use of technology in agriculture with E- Nam (National Agriculture Market) an electronic trading portal for agricultural commodities. There have been individual initiatives taken by some states that benefit farmers. For example, Punjab introduced 'Punjab Remote Sensing Centre (PRSC) that sensitizes farmers on crop residue burning and measuring air quality. It has 3 applications under it- **i-Khet Machine, e-PeHal, and e-Prevent.**

Drones

The drones are used in Agriculture to collect the data precision or smart farming These drones bring efficiency with correct information reducing any kind of uncertainty while decision making. By using the correct sensors, drones can provide farmers with real-time information regarding their crops, soil deterioration, dry regions, fungal infections, etc.

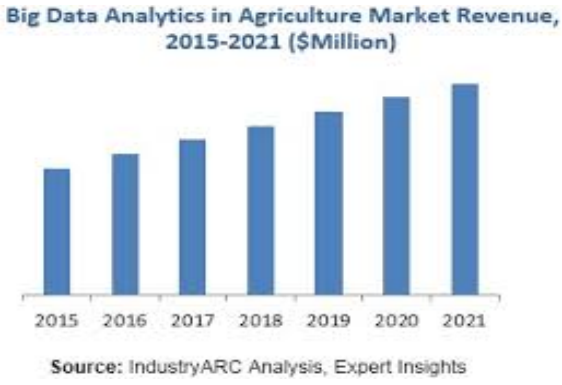
This information can be relayed to farmers in a readable format so they are able to gauge which area needs irrigation and better techniques. Adding to this, drones can be used for spraying purposes.

Drones: Agriculture Usage

This also help farmers optimize the use of inputs such as seeds, fertilizers, water, and pesticides more efficiently. This allows timely protection of crops from pests, saves time for crop scouting, reduces overall cost in farm production, and secures high yield and quality crop. With the world's population projected to reach 9 billion people by 2050, experts expect agricultural consumption to increase by nearly 70 per cent , apart extreme weather events are on rise creating additional obstacles to productivity. In this scenario the drones are of extreme help that can tackle agricultural problems , monitoring tasks collectively as well as hybrid aerial ground drones can collect data and perform a variety of other tasks.

Big Data Analytics in Agriculture

The tedious and cumbersome task of maintaining land records, data productivity, production statistics, export -import statistics can be succeeded by using Big Data Analytics. This the new innovation to conquer the redundant and menial tasks in the field. The progressive farmers and institutional bodies care benefitted by using it for trend analysis of various export-import commodities and real time research on markets.



Source:https://www.industryarc.com/Report/15476/big-data-analytics-in-agriculture-market.html

One of the things that bid data analytics solves for the agriculture industry is giving real-time insights. It will help farmers immediately identify if their techniques are working, are their inputs correct and what do they need to prepare for in case of weather changes.

Conclusion

The Indian agriculture sector is a major concern for the government and introducing new technology is be the best way forward. The scenario has significantly changed from the traditional systems, low investment of capital and technology and poor post-harvest management to more capital-intensive and value-added farming system with technology driven practices. A lot of private companies that build robots, data analytics tools and drones have taken a keen interest in the agriculture sector. With effort from companies and the right implementation of policies, the Aggrotech business should hopefully begin to flourish. There have been immense efforts from Government side, extension works by SME's , Department of Agriculture, State-National level and village level to resolve and conserve the degradation of Land, Soil and water pollution. The projects by Government of India such as "Namami Gange" has been set by excellent examples by our Government. Apart, the role of NGO's, private bodies and institutions are commendable in the field. We are no where far that with joint effort of our farmer, SME's, Government and various public and private bodies we can work towards the vision of clean Earth Green Earth.

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