Land Use Management in Irrigated Agriculture

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Abstract:
Agriculture has been the bedrock of civilasations from the times of yore. Almost all major civilasations grew up and thrived on the banks of rivers and water bodies. Most of the population of India are still cultivators. Since our country is privileged to have extensive fertile and cultivable tracts, land is the single most precious resource in India. Green Revolution was ushered in to rapidly increase foodgrain production to feed our growing population and to become self-reliant and reduce dependence on foodgrain imports. A necessary accompaniment to it was provision of irrigation facilities. It indeed had a positive impact on crop production. But subsequently many problems were noticed including decline in land and water quality and use. Fertile land, a precious resource, was being lost increasingly to waterlogging, salinisation and erosion. It was therefore necessary to focus attention to land use management in irrigated commands. This paper highlights the extent of the problem of land use and degradation of land, its main forms cause for the same and offers some possible remedial measures. It stresses on the need for adopting an integrated management approach to achieve the desired objectives.

Keywords: *population, Land use, waterlogging, salinity, policy*

1. Introduction

Earth, our mother planet is known as the 'Blue Planet' because it appears as such from outer space. This is so because 71 per cent of Earth' s surface is covered by water. Land constitutes only 29 per cent of the Earth s surface. Of this area (Lithosphere) approximately 10 per cent is covered by glaciers and another 19 per cent is barren land. Therefore, only 71 per cent of land surface is habitable. Half of this only is used for agriculture. But not all of it is used to grow crops. Since agriculture consists of cultivation and allied activities, around 72 per cent of this land is used for livestock, meat and dairy farming, leaving only about 28 per cent of agricultural land for cultivation. While land available for cultivation is limited, if not scarce, increasing population derives its sustenance directly from it. The world's population gets 8 per cent of its calorie supply from plant-based food and 63 per cent of its protein supply again from plant- based food. (Data Source: UN Food and Agricultural Organisation FAO, Our world data org.)

Give these facts, it becomes clear that for mankind to survive and develop, this scarce resource is to be used with utmost care. It has to be sustained for future generations too.

Since global population has grown rapidly.it has forced the expansion of agriculture and has driven the need for increasing cropping intensity. But this has over the years given rise to the major threat of land degradation. It has therefore become imperative to adopt land use management and develop policies for it that are sustainable.

2. Why Land Management

Modern inputs of agriculture which are used to increase production and cropping intensity, along with the need for agricultural expansion, has led to deforestation, put a lot of pressure on the use of

freshwater, led to the deterioration in soil nutrients and soli quality. Modern agriculture necessitates the use of chemical fertilizers, pesticides, herbicides and is becoming more and more mechanized. All of this has adversely affected the quality of soil, increased soil erosion and has negatively impacted surface and ground water quality. This can have a disastrous affect on the environment, on agriculture and ultimately on human survival. According to the United Nation Food and Agriculture Organisation, Land degradation has been exacerbated where there has been an absence of any land use planning or of its orderly execution--- as a consequence, the result has often been misery for large segments of local population and destruction of valuable habitats and ecosystems. Thus, there cannot be any doubt of the enormous significance of the policy of land management.

3. What is Land Use Management

In agriculture, land use management refers to how land is used for raising crops in a sustainable manner and with a long-term vision. Good land management practices should integrate the use of traditional inherited knowledge and wisdom of our forefathers along with modern knowledge and new techniques. As far as use of land for cultivation is concerned, land use management must have the following broad goals:

- Economic goals in terms of maximising output in order to meet the requirements of an increasing population.
- Conservation goals, in terms of preserving the quantity. quality, potential and output. Sustainability is the keyword in any agricultural activity and policy.
- Reclamation of what has been lost in the form of degraded land, depleted nutrients, and erosion, so that's it restores it's use potential.
- Similarly, sound land management policy needs to encourage the adoption of good practices over time.
- Finally, a viable land management policy should be adaptable to changing conditions and circumstances, while ensuring sustainability.

'Sustainable Land Management (SLM) is defined as a knowledge-based procedure that helps integrate land, water, biodiversity and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihood.' -World Bank, 2006

4. Need of Land Management in India

Agricultural land may be irrigated and non-irrigated, non-irrigated land is dependent primarily on rainwater for raising crops, while irrigated land is provide with manmade arrangements for watering of crops. According to FAO the percentage of irrigated land to non-irrigated land varies a lot amongst countries, "leading countries like India and China with about 30 percent and 52 percent of all cropland irrigated respectively" (Source FAO)

Agricultural irrigated land as a percentage of agricultural land in India was 37.9 in 2014 and had increased to 40.0 by 2020. (World bank – databank)

About two thirds of the population of India is dependent directly or indirectly on agriculture. Of this, some are either cultivators or agricultural labourers. Agricultural wage labourers make up about half of the population living below the poverty line. Thus, anything that happens to land, directly impacts the lives of this population. When agricultural land turns unproductive due to wrong agricultural and irrigation practices, it gives rise to problems like waterlogging, soil salinity, change in land use pattern, etc,. This affects the lives and livelihoods of this vast extremely vulnerable part of the population. Therefore, managing land becomes very important for economic as well as social reasons. Land use in irrigated commands are often found to suffer from the following problems and require urgent redressal.

5. Wastelands

India is facing a massive expansion of wastelands, posing a big threat to its productive resource base. Against a total land mass of about 329 m hec of the country,90 m hec is degraded wasteland. Around 40 percent of our population depends on this land for livelihood. According to the National Wastelands Development Board, "Wasteland is a degraded land which can be brought under vegetative cover, with reasonable effort; and which is currently underutilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes."

The Indian Space Research Organisation (ISRO) has provided a Wasteland Atlas of the country. It has classified such land in various categories: Waterlogged Areas; Mountains under Permanent Snow; Savanna Grasslands; Pasturelands; Deserts; Sand Dunes; Rocky Outcrops and Plateaus.

It has been observed that although irrigation facilities were provide in the country to enable farmers reduce their dependence on monsoons and grow multiple crops in a year, but sometimes unplanned or poorly planned projects had become tools of converting fertile land into wastelands, particularly due to waterlogging and salinization.

6. Waterlogging

Waterlogging has been the biggest drawback of irrigated agriculture, particularly under canal irrigation. More than 33 percent of the worlds' irrigated land is affected by waterlogging and salinization. Land is considered waterlogged when the water table rises to reach or submerge the rootzone of the crops, such that the soil becomes over saturated preventing the diffusion of oxygen to the roots, thereby effectively suffocating the plants. This problem aggravates in the monsoon season. Waterlogging in any particular area over a long period of time cause widespread damage to the soil. This directly negatively impacts production and productivity- sometimes by 20 percent or more.

According to the National Commission on Agriculture (1976), soils where water table remains within 1.5 m from the surface are most likely to be waterlogged during monsoons. Soils where water table was less than 2 m classified as waterlogged or critical; those with water table below 2-3 m were potentially waterlogged; more than 3m were safe areas (Data Source; Ministry of Water Resources Government of India ,1991).

In India, by 2015-2016, 17231.29 sq. km. of land was waterlogged (Data source: India Water Resource Information System, Government Of India, Ministry of Jal Shakti, Department of Water Resources, RD & GR). Considerable areas in states like Uttar Pradesh, Gujrat, Rajasthan & Haryana face alarming levels of waterlogging and salinity. In post-independence plan period, the problem of waterlogging was particularly noticed when major irrigation projects were executed. According to data given by India-WRIS, area of waterlogged land in Uttar Pradesh was 49.397 tha hec in the total command area of 3412.493 tha hec of 62 major irrigation projects.

Poor drainage aggravates the problem of waterlogging in the command areas. Unlined canals and channels allow continuous seepage of water. Often, water in the canals witnesses heavy flows during the time of rains leading to surplus water accumulating in the fields, standing water in the fields for long periods of time totally spoils the crops and also delay the next crop. Weeds and grass grow quickly in marshy conditions adversely affecting the growth of crops. Cultivators also find it difficult to grow vegetables and other cash crops due to this problem. Excessive moisture content reduces soil temperature, retarding growth of bacteria needed for a good crop. Water has a very high opportunity cost, and wastage of water, which can be used in regions of scarce water, raises external costs. A number of crop diseases afflict standing crops due to excessive water, further reducing yield. Cattle get afflicted with various kinds of diseases due to waterlogging. This increases expenditure on their treatment. Some may even die. All this takes a heavy toll on the incomes of the cultivators.

7. Dealing with Salinity

Another major problem in irrigated agriculture is salinity. In India approximately salt affected area occupies 1034.541 The ha which is 1.16% of major and medium command areas studied. The corresponding figure for Uttar Pradesh were 283.146 tha hec and 1,21 percent of command area. Secondary salinization is related to provision of high levels of irrigation water without adequate drainage. Due to absence of proper leaching, salts reach roots of plants preventing them from absorbing micronutrients from the soil, thus destroying them. Soil sodicity denotes excessive presence of sodium ions in the soil which damages the soil profile and loosens the soil. Irrigation over a period of time can cause salinity increase in the absence of proper management practices. Water seepage from canals causes soil salinity which may be aggravated by the use of chemical fertilisers and soil curers.
Excess salinization of soil over a long time may turn it barren, having huge ecological, economic and social consequences. Studies report tremendous crop losses in states like Gujrat and Uttar Pradesh due to salinization.

8. Soil Erosion

It has been estimated that India is losing close to 5334 m tons of soil every year due to soil erosion. Most of it is due to the excessive use of chemical fertilizers, insecticides and pesticides which are the invariable accompaniments of irrigated agriculture. Waterlogging in irrigated areas causes erosion of top soil. Improper management of irrigation often causes cracking of soil, which may lead to bypass flows of water, nitrate leaching and ultimately soil shrinkage. Extensive Soil erosion raises the risk of unplanned use of inputs and of desertification. Bad irrigation practices, mechanized cultivation, overuse of land and improper land use policies hasten the process.

In Uttar Pradesh, approximately 13075 tha hec of agricultural land was affected by soil erosion, while for India the corresponding figure was 92400 tha hec. (Data Source: Report of Survey on Soil Erosion, Ministry of Agriculture and Farmers Welfare, New Delhi)

The annual loss in output of major crops in the country is estimated to be 7.2m tons, about 74 m tons of nutrients are lost to soil erosion annually in our country. This calls for immediate intervention to make cultivation sustainable.

9. Non -Agricultural Land Use

Over the years India has witnessed a considerable shift of area of land use from agricultural to non - agricultural use. Rising residential construction and infrastructure development activities (like rapid construction of highways) is taking away large tracts of fertile land. This is bound to affect agricultural production and have a number of ripple effects. This increases land use conflicts. Assessment values of land, hitherto used for agriculture, rises and so do property rates and taxes. Expansion of land for non-agricultural activities has led to an increase in culturable waste, an area which is supposed to be used for agriculture. This shift may in the long run impact our ability to adapt to changing economic and market conditions.

10. Possible Solutions

- **Drainage :** In order to remove excess surface and ground water, more surface and vertical drains are needed. Surface drainage is usually done by making shallow open drains that take away water to larger collector drains. Borings have to be made for vertical drainage, either by deep open drains or buried pipe drains to remove excess water from the rootzone. A network of main drains, intermediate drains and field drains need to be constructed. Tiled drains can be used to keep water tables at safe levels. To prevent percolation canals should be lined. Full supply levels of the irrigation channels should be reduced and planned according to rains to prevent over supply of water.

- **Maintenance:** Regular and proper monitoring and maintenance of the structures and areas of the command is a must for the proper functioning of the canal system. Weeding out the growth of water plants and grass in the channels and regular desilting of the canals is extremely important to maintain the proper flow of water and prevent waterlogging.
- **Salinity control:** Leaching is the first recourse to treating saline soil. Water of low saline content is flooded on the land to be leached, allowing excess water to pass through the rootzone hereby removing the salts from this region. The thumb rule is applying 1cm of water per cm of soil to be leached**.** But the quantity can vary according to the texture of the soil and the fraction of salt to be leached. Application of curers like gypsum and pyrites is also used for treating such soil.

Timely and accurate detection of waterlogged and saline / alkaline (sodic) soils and their spatial distribution along with severity and seasonal dynamics are vital in determining the sustainability of any irrigated production system. Soil salinity/alkalinity significantly limits crop production and consequently has negative effects on it. Prevention and reclamation of salt affected soils require an integrated management approach, including consideration of socioeconomic aspects, monitoring and maintenance of irrigation scheme and reuse and /or safe disposal of drainage water. Implementation of efficient irrigation and drainage systems and good farming practices including proper crop selection and rotation can prevent and, in some cases, reverse salinisation/alkalinisation. If appropriate management practices are not applied in time, it may result in the land out of production altogether.' (Assessment of Waterlogging and Salt and / or Alkaline affected Soils in the Commands of all Major and Medium Irrigation Projects in the Country using Satellite Remote Sensing; Government of India Regional Remote Sensing Service Centre Indian Space Research Organisation Jodhpur; Central Water Commission New Delhi)

- **Soil Survey and Mapping:** For land management and better land use, the fundamental step is to undertake proper soil survey and classifying soils according to their irrigabilty and productivity . On the basis of soil survey and soil mapping, land potential, irrigation categories, fertility status, and others, recommendations are made for cropping patterns, fertiliser use, frequency and quantity of irrigation. Diagnosis and mapping of land for waterlogging and salinization in command areas, is a pre requisite for the management of land use. These reports give detailed information and recommendations for the reclamation of saline and alkaline soil according to their pH value and also the best practices for water management for cultivation.
- **Planting specific plants:** Plants like beans, oats, sunflower, corn, soyabean, asparagus, and barley can be grown in mildly saline soil, Asparagus and barley are good absorbers of salts too and can therefore be used to remove excess salinity.
- **Aquaculture:** Some places in the country have successfully practiced saline aquaculture. They have profitably used degraded soil areas and excess water for shrimp farming.
- **Sound land use Planning:** Land use pattern needs to be carefully planned by farmers in collaboration with authorities in order to bridge the gap between potential and realized use of land resource. Infrastructural and residential area construction activities should be directed away from designated agricultural areas. Certain business activities that support agriculture may be allowed within these agricultural areas.
- **Raising Awareness:** Public awareness should be raised about best practices of irrigated agriculture. Cultivators the need to be educated about efficient use of irrigation water, the harmful effects of unplanned use of inputs and agricultural practices so that most of the problems at the ground level may be solved.
- **User Charges:** Nominal user charges should be levied on the beneficiaries of irrigation to make them more responsible for use of the facilities and also to make the running of such systems economically viable.
- **Peoples' Participation:** Involvement of local communities in Land use planning and implementation is a must in ensuring any degree of success in achieving targets. Only when the

problems are viewed from the perspectives of the land users can any management policy become meaningful. Users must not only be educated about efficient and best practices of managing land and water resources, but must also be encouraged to participate in the construction of drains, lining of canals, digging ponds and other related activities which would improve the management of their land.

11. Conclusion

Efficient land use for agriculture in irrigation command areas is a complex of several factors. While the main objective of such irrigation is indeed to assist farmers and rural community in particular and the country in general in raising crop yields, becoming self-reliant, raising incomes and improving lives, but implementation of the projects presented several problems. Identification of such issues, though difficult earlier, have now been done. The extent of damages, be it in the form of waterlogging, salinization of soils, erosion and degradation, health issues of livestock and people, loss of valuable fertile agricultural land, and socio-economic harm has been vast. Thus, addressing these issues is still relevant. Efforts are being made to reclaim land and restore the quality of land and water resources. But consistent and persistent efforts have to be made by all agencies involved to restore and regain what's been lost. Winning over the trust of those affected directly and involving them in decision making and implementation will be half the battle won. Since the government is fully aware of these issues it has involved a number of agencies to work in unison to help ameliorate the situation creating an atmosphere of hope.

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