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Land and Water Resource Management and Sustainable Development of Agriculture in India

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ABSTRACT

The agriculture growth and development depends on judicious use of land and water. Since mid-60s India has experienced a steady growth in food grain and the cash crops by adopting the high yielding variety of seeds and assured irrigation in under 'Green-revolution' programme in the north western part of India, On the other hand, the dominancy of rice in the north-western part of India and some of parts of western part of Godavari district of Odisha has given rise to lope-sided regional approach to the agricultural policy makers in India. In addition, this trend has given rise to development of millions of hectare of waste land, water logged lands and saline and alkaline lands within these 'Green Revolution' regions of India. Keeping in view the gravity of the problems, it become a paramount need to make the judicious use of land, water and other inputs so that the agriculture development may take place in a judicious way. It requires consistent efforts by the agricultural scientists, extension officials and the community's active participation, who may contribute significantly to lead the sustainable agriculture and ensure the food security for the growing population of India.

Key words: Judicious use of water, green revolution, regional disparity, sustainable development, food security.

INTRODUCTION:

Agriculture has played a significant role in the Indian economy; and allied activities contribute 35 % in the GDP, the gross national product and 60 percent of the total work force, directly engaged in the agriculture and allied activities in India. The *green revolution*, begin in mid 60s has given rise to steady growth of agricultural production and the productivity in some of selected pockets of the states like Punjab, Haryana and Western Uttar Pradesh. The green revolution which was mainly based on the assured water, HYV, High Yielding Variety of Seeds and applying the dose of chemical fertilizer which has given rise to grow the food-grain in a multiple way. Indian agriculture witnessed the break through after the introduction and adoption of package technology based on irrigation with the application of chemical fertilizers during the 1960s and 1970s periods in various regions of north western part of India.

During the period of mid-eighties, the increasing trend of growth in the productivity flattened and *ecological* consequences of over-irrigation appeared. The policy of lying emphasis on increasing the irrigation infrastructure for in other areas ensured the increase in food grain production and generating buffer stock in the country, but given rise to deteriorated the lands, particularly in the '*Green revolution'* regions of the country. In this context, various reports on ground water depletion have reported that the excessive water extraction means that about 1600 blocks are now classified as critical or over exploited, out of 5723 blocks. It has been observed that there are 15 % of aquifers are in a critical condition; in 50 years this could be 60 %. The peak theory suggests, extraction will now here to be balanced with economically viable yields eg. Below 200 meters extraction require massive investment, **Chaddha**, **G.K**. (1995)

According to B.B.Vohra, about 87 million hectares of good agricultural lands currently under production are in fact seriously affected by soil erosion, water logging and

salinity. If we add to this (i) 48 million hectares of forest pasture land having practically no tree cover, and (ii) 40 million hectares of *culturable waste* and fallows which are currently unproductive but capable of production, the total area of land expected to yield either crop production, forest products or grass but already recognized as degraded land, along with our sick agricultural land is about 176 million hectares. If 40 million hectare of land annually affected by floods is also included, this total of sick lands exceeds 200 million hectares, i.e., as much as two thirds of our total land resources are depicted of good soil cover (B.B.Vohra, 2008).

Aiming at the gravity of the problem, it requires an integrated and efficient management of land and water resources. The strategies which include, " (i) effective control of soil erosion and implementation of soil conservation measures particularly in catchment and command areas of irrigation projects and (ii) intensive efforts for correcting the degraded land in the '*Green revolution'* areas, (iii) recharging the ground water in severely ground water depleted areas (S.D.Sawant, 2011). The Geo-spatial technology has enabled the geographers to have a better grasp of land use and land cover changes. GIS as a tool can handle vast set of spatial data. It can also map the pattern of temporal fluctuations in accordance with the environmental parameters of agriculture to enable the planners to adjust their models. Remote sensing and GIS tools can also be used for study the soil quality, status of soil erosion, land use and land cover as well as fluctuations in crop outputs.

THE OBJECTIVES OF THE STUDY

- To examine the spatio-temporal changes in under water-logging and soil salinity in India with special reference to Haryana;
- To examine the spatio-temporal change in agricultural production in relation to irrigation and other agricultural inputs in India;
- To suggest some of recommendations for sustainable development of agriculture in India.

MATERIAL & METHODS

The main source of data collection for *Water logging* and Salinity has been collected from the *Central Salinity Soil Research Institute*, Karnal. The source of data for land use planning has been the *National Bureau of Soil Survey* & *Land Use Planning*, Regional Centre, *Indian Institute of Agriculture Research Service*, New Delhi. Apart from all these institutes, some of information has been collected from KVC, the '*Krishi Vigyan Kendra'*, located in various districts of Haryana. In order to review the changing pattern of food grain production, Net area sown, cropping Intensity, gross cropped area, gross irrigated area, and water for irrigation and fertilizer application, the statistical abstract of India has been used for desired results. Keeping in view the multiple objectives of the study, the required data have been complied accordingly. In order to analysis the data, the data have been tabulated and subsequently, the data have been analysed in accordance with the objectives of the study. The other information has been

collected from the important *websites*, belong to Ministry of Agriculture and Farmers Welfare, Keeping in view the growth trends of food production of the country, it has been observed that the production of food grain was 50 million tons in 1950-51, which has increased 213 million Tonnes in 2001-2002. With more intensive agriculture, there has been a rising stress on natural resources in the parts of the country. The major environmental problems of intensive agriculture include degradation of soils from over dose of chemical fertilizers, has given rise to residual effects on the soil in a gigantic ways. An extensive use of chemical based pesticides causing health hazards, declining in crop diversity, over exploitation has given rise to depletion of water, particularly in rise growing areas of north-eastern region of India. The other concerns which includes decreasing man-land ratio and conversion of agricultural lands for non-agricultural use. Keeping in view various agricultural and water parameters we can draw some of inferences from the tabulated data as follows:

Table: 1

PARAMETER WISE PERIODIC TREND OF INDIAN AGRICULTURE

(2001-2050)

Parameter	2001-2002	2025	2050
Food grain production (Million tons)	213	375	581
Net Area Sown (Million Hectares)	142	142	142
Cropping Intensity (In percentage)	136	146	157
Grossed cropped Area (Million hectares)	193	209	223
Grossed Irrigated area (Million Hectares)	79	104	134
Water for irrigation (billion cubic meters)	606	780	994
Fertilizer Consumption (Million tons)	17	37	53

Sources: National Bureau of Soil Survey & Land-use Planning, Regional Centre, Indian Institute of Agricultural Research, New Delhi

2. Ministry of Agriculture, Government of India, New Delhi.

3. Statistical Abstract of India, 2015.

The projections are that there will be very essential for India to produce at least 367 million tons of food grains by 2025 and 581 million tons by the year 2050 to become self reliance in food security. However, the table-1 shows that there is no scope of expand the net area sown; as a result, the self sufficiency will solo depend upon the increasing the cropping intensity and putting more area under irrigation. The yields under assured irrigation are double or triple the yields taken under *rain-fed* conditions. The gross area under irrigation would nearly double from the existing 79 million hectares will require 994 billion cubic meters of water by 2050, which may be unsustainable development of agriculture.

Keeping in view the gravity of the problem, it has been estimated that the *cropping intensity* will tend to increase to 223 million hectares by 2050 from the present 193 hectares, which may not be easy considering increasing land requirements by other sectors including *rapid urbanization*. On the other hand, the irrigation potential is estimated that there is 140 million hectares of land will be under irrigation by 2025, which will be increased by 60 percent, i.e. nearly 134 million hectare, by the year 2050. It means that the grossed area under irrigation will be nearly double from the present 79 million hectares. Meaning thereby, the 780 billion cubic meters of water will be required for irrigation by the year 2025 and 994 billion cubic meters irrigation water by 2050. Irrigation will be continued to be predominant end-use. Its share is, however, projected marginally from 95.1 % in 2001-02 to 94.5 % in the year 2025 and 93.8% in 2050.

LAND MANAGEMENT

Keeping in view the problematic areas, which include soil degradation due to physical, chemical and biological stresses, decreasing organic matter have cumulatively given rise to aggravate the problem which has been depicted as follows:

Table: 2

PROJECTED AREA UNDER WATER LOGGING & SOIL SALINITY IN IRRIGATION COMMANDS

(1955-2025)

Year	Area Irrigated by canals (Million hectares)	Area affected by water-logging/ soil salinity (Million hectare)			Increase in % per annum
		Actual	(**Haryana**)	Projected	
1955	2.4	0.01			
1977	3.2	0.46			
2025	3.2		2.00		1.10
			INDIA		
1992	17.29	3.47			
2020	45.00			9.0*	
				2.7**	
				11.7	
2025	50.00			10*	
				3.0*	
				13	

Source: Central Soil Salinity Research Institute, Karnal

***Assuming 20.0% of the area would be affected at any time.**

**Assuming the area affected would increase at the rate 0.06% per annum in the existing command (lowest of the two figures is taken in to account for calculating the area to take in to account the area reclaimed and improvement in the situation as a result of new preventive measures that may be executed in accordance with prevailing local conditions)

Recent figures on nutrient mining in India indicate that the nutrition additions are unable to cope-up the nutrient removal by crops. Increased ratio of N: P: K (at present about 7:3:1) from its balanced composition of 4:2:1 has resulted in nutritient imbalance in general and appearance of deficiency of micro-nuritiants in particular. All these issues need to be addressed through focusing on R&D efforts on:

SUGESTIONS FOR FURTHER IMPROVEMENT IN AGRICULTURE IN RELATION TO ITS SUSTAINABILITY

- Keeping in view the problematic areas, It become imperative to characterization and monitoring of soil resources by using of effective techniques, like GIS/ *Remote sensing* in the problematic areas of the country;
- It is also necessary to make use of sustainable land-use planning for each agro-*ecological* zone in the country by considering bio-physical and socio-economic conditions of the target groups at *Panchayat* /*watershed* level;
- It become very essential to build up an Integrated Plant *Nutritient* Systems models for dominant cropping pattern under different irrigation systems and *rainfed* region for improving fertilizer use efficiency and soil health;
- To improve the sustainability in accordance with changing environment scenario, it becomes very essential to develop the quality of organic carbon pools, capacity for soil/ *agro-ecological* regions;
- It is also necessary to zonning of recurring flooding areas and development of technology for conservation of tillage and residue management for achieving synergy between nutrition, water and energy particularly under *rain-fed* conditions;
- Promotion of organic matter based farming through demonstration and training on system of *organic farming*, bio-fertilizers, vermin-composing and compost;
- Promotion of people participation so that the strategy executed by the experts may be fully responsive in accordance with prevailing local conditions.

By adopting the above mentioned suggestions, we can lead to *sustainable development* of agriculture in relation to present and future environment, provided the strategies implemented in the problematic areas, may be fully responsive to prevailing local conditions. For this, it is very essential to take the farmer's community in the land reform process in the problematic areas. It is very essential to bring a crop-diversification in the areas where the rise has been a dominance kharif crop, particularly in north-western part of India. Only then, the agriculture may attain the sustainable position in agriculture and ensure the food security in India.

CONCLUSION

Agriculture is a back bone of Indian economy, because a considerable share in GDP, the Gross National Product, is contributed by the agricultural sector. Since mid 60s due to development of HYV, the yielding verities, assured irrigation and the application of chemical fertilizers a tremendous growth in agricultural production and the productivity has been experienced during different successive periods. Keeping in view the direction of growth and development of agricultural under '*Green revolution*' programmes, it has been observed that the green revolution has been confined to wheat and rice, as a food crops. No doubt, a multiple growth has been experienced in Punjab, Haryana and western part of Uttar Pradesh, but due to haphazard growth of application of chemical fertilizers, pesticides, herbicides and other chemical inputs have given rise to development of *waste lands* within these '*Green revolution*' areas. Apart from these problematic areas, the flood irrigation system within these regions has given rise to make the cultivable land *alkaline* and *sodic soil* and ultimately turned into unsuitable for cultivation. However, the main source of irrigation within the '*green revolution*' regions, have been tube-wells, as a result, a tremendous growth in *depletion* of ground water has been experienced within these states.

Keeping in view the gravity of the problem, it become very essential to think and take the preventive and curative measures to combat the waste land, so that a sustainable position may be attained in the agriculture within these regions. A judicious use of irrigation water and diversification of crops, particularly in the '*Green Revolution*' areas, where a chronically has been suffered with *water-logging* problem. Only executive and legislative measures are not enough to cope with these pressing problems; but an active *community participation* is also required to combat this '*Menace*' in the coming years. Only then, we will be in a position to sustain the agriculture sector in relation to existing and future environment. As a result, it is expected to pave the way for food security for millions of people living in different regions of India. It is therefore, it become imperative to have a periodic review of the agriculture in relation to existing and prospective environment for different *agro-ecological zones* of India. Only then, it can be ensure to attain the position of '*growth with justice*' by utilizing the land and water resources in a judicious way to get the desired results of sustainable development of agriculture in relation to steady growing rural and urban population of India.

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