

THE SCIENCE OF FOOD-GRAIN SUSTAINABILITY IN NORTH-WESTERN INDIA

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ABSTRACT

There is a very complex, intricate but the most interesting relationship between the environment in terms of its physical endowment and its sustainable development. The dynamic interaction between limited resource supply and unlimited human consumption is termed as 'sustainability'. Referred to as "ecological overshoot" by Meadows et al. (1992), this concept embodies the extent to which humans have exceeded ecosystem services.

Operating as an agriculturally dominated and heavily irrigated region, the water footprint and pressure on land resources of north-western India is predicted to be higher than most other Indian states. It supports a significantly high population with high consumption capacity owing to its immense physical suitability in terms of bountiful water resource, the fertile agricultural tract etc and hence is juxtaposed with the growing issues of sustainability.

The present research paper aims at a concerted effort to outline and investigate how the region can make strides toward sustainable consumption of available resources i.e. land and water being the two most significant. Crop diversification, farm mechanization, intensive use of land and judicious use of irrigation facilities can go a long way in enhancing the carrying capacity of land, sustained food production and realization of resource sustainability.

Hence the paper attempts to assess the balance between the availability of natural resources and the demands of current food grain production that helps to review the current policies and the emerging changes in the design of new and fresh proposals so that they have better chances of sustained use.

Keywords: Sustainability, Crop Diversification, Farm Mechanization, Carrying Capacity, Water Footprint.

II THE BACKGROUND

Mahatma Gandhi's wise dictum can be best applied as the introductory statement of the present research paper.

"The earth has enough resources to meet people's needs, but will never have enough to satisfy people's greed. Thus we must not only promote sustainable production processes, but equally, sustainable lifestyles across the globe."



There is a very complex, intricate but the most interesting relationship between the environment in terms of its physical endowment and its sustainable development. The dynamic interaction between limited resource supply and unlimited human consumption is termed as 'sustainability'. Referred to as "*ecological overshoot*" by **Meadows** et al., 1992) [1], this concept embodies the extent to which humans have exceeded ecosystem services. In this connection, India's development path is based on its unique resource endowments, the overriding priority of economic and social development and the maintenance of ecological balance with the north-western states being no exception to this [2].

India is an agrarian economy and one of the highly populated countries in the world next only to china with a population of 1.247 billion according to Census 2011 which increased to 1.325 billion by November 2017. Hence, achievement of food security is one of the prime agenda of the government with thrust on improved and mechanized agricultural practices to encourage sustainability of food grain production.

With the above background, the aim of this paper is to discover and explore the inherent potentiality of the north-western part of the nation as a homogenous region in terms of its resource endowments i.e. land and water being the two most significant, the ready availability of well and sturdy laborers and farmers with skill in technological know-how. Effort is also made to develop the region that is self-sustaining in terms of its ability to unleash the creative energies of the people which are sustainable to both the present and future generations.

The north -western India is a region which is not yet officially defined. However in broader sense, the Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh, Uttarakhand and the union territories of Dadra and Nagar Haveli, Daman and Diu and Chandigarh, National Capital Territory of Delhi, Gujarat and Rajasthan are the biggest states in north-western India according to their population and area (refer fig. 1). Physically, entire region witnesses semi-arid to arid climatic conditions with temperature reaching as high as 46°C in summer and to a low of 1° C and even negative in winter. The annual total rainfall mostly takes place in July and August and varies from about 250 mm in the extreme west to about 1011 mm in north i.e. Jammu & Kashmir and 600-650 mm in the north-west i.e. Haryana and Punjab.

It supports a significantly high population with high consumption capacity owing to its immense physical suitability in terms of bountiful water resource, the fertile agricultural tract etc and hence is juxtaposed with the growing issues of sustainability.

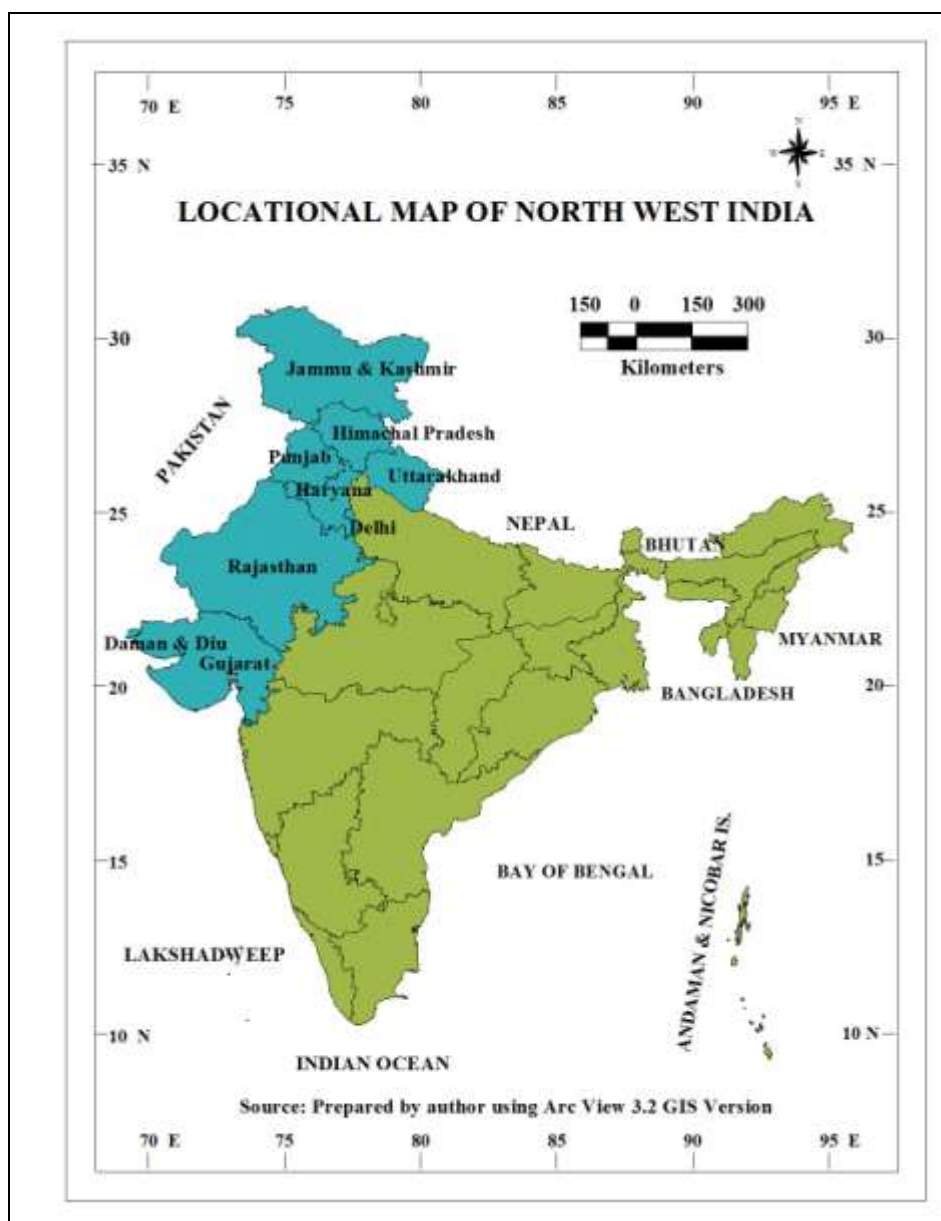
The present study attempts to visualize sustainability from the point of view of resource use and emphasize concerted effort of crop production. It includes land resource, its productivity and more importantly the judicious and rational use of agricultural inputs and farm implements as irrigation, chemical fertilizers, insecticides, pesticides etc.

The new package strategy launched by the government of India during mid 1960s received an added impetus in the north-western part of India. It resulted in reviving of agriculture and leading to bumper agricultural production

with features as; use of high yielding variety of seeds, better irrigation facilities, adequate doses of chemical fertilizers, pesticides and insecticides, mechanized farming, better credit and marketing facilities etc.

It also intends to observe and highlight the ill effects of increased use of irrigation water that on one hand is a basic requirement for the better response of HYV seeds and on the other endangers soil fertility and food security. Efforts are made to explore sound management practices to overcome the scenario and make the region agriculturally sustainable.

Figure 1



II DATABASE AND METHODOLOGY

The study mostly uses data from Census of India and National Accounts Statistics Division of Central Statistical Organization. Different set of years have been chosen to show the trend and pattern of attributes in terms of sustainability as identified within the north-western states of India. Also a number of cartographic techniques such as simple and multiple bar diagram, line graph, Choropleth etc. have been used to suit the desired objective of the study.

III CURRENT TRENDS OF AGRICULTURE: A REFLECTION OF SUSTAINABILITY

The north-western part of India is a region identified and recognized with bumper agricultural production and designated as the 'granary of India.' Hence, the present growth in crop production must be sustained in consideration to the ecological and economic factors.

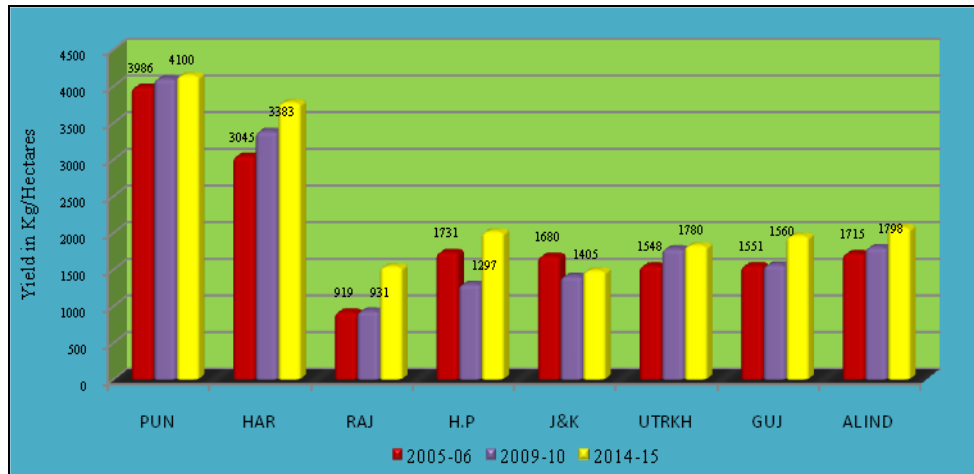
As part of the concerted effort to outline and investigate how the region can make strides toward sustainable consumption of available resources, efforts have been made to analyze the current status of agricultural inputs and attributes. Crop diversification, farm mechanization, intensive use of land and judicious use of irrigation facilities can go a long way in enhancing the carrying capacity of land, sustained food production and realization of resource sustainability.

Food grain production is inextricably linked with a number of parameters like availability of cultivable land, use of high yielding variety seeds, adequate and timely doses of chemical and bio-degradable fertilizers, dense network of canals and other possible means of irrigation etc. all contributing directly or indirectly to enhance the per acre yield and an overall increased food grain production to sustain the teeming millions in India.

3.1 FOOD GRAIN PRODUCTION

The north-western states responded very well to the ecologically sustainable Green Revolution and present a classic example in terms of record food grain production and the average yield. The record increase in food grain production as a result of the new package programme put the entire region at the cross road of agricultural revolution and hailed as an area of prosperity and economic growth. But soon the region began to feel the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change [3].

Figure 2: Total Food Grains Yield in North-Western India (2005-06 – 2014-15)



Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare (2015).

A through glance over the above fig. 2 reveals the increasing trend in the yields of food grain production in selected states of north-western India and at the same time a comparison has been made with all India average. Among all, the state of Punjab records a maximum yield of 4144 kgs per hectare for the year 2014-15 followed by Haryana and Himachal Pradesh.

States like Jammu & Kashmir and Himachal Pradesh however shows a decline in food grain yield from 2005-06 to 2009-10 from a figure of 1680 and 1731 kgs/hectare to 1405 and 1297 kgs/hectare respectively but again regained the pace of food grains yield in 2014-15. Also union territories like Dadra & Nagar Haveli and Daman & Diu recorded a negative growth in food grain yield.

3.2 AVAILABILITY OF CULTIVABLE LAND

Out of all, the two agriculturally developed states of Punjab and Haryana have reached the absolute limit of expansion of area under cultivation with a very little or meager availability of wasteland [4]. In this connection it is to be noted that the total area of wasteland in Punjab and Haryana is just 0.1 and 0.23 million hectares respectively in 2010 as compared to the national average being 47.23 million hectares.¹ Fig. 3 attempts to reveal the status of north-western states in terms of availability of wasteland and makes a close comparison with the national average.

¹Lok Sabha Unstarred Question No. 3130, dated on 29.11.2010.

Figure 3: Wastelands in North-Western India, (2010)



Source: Lok Sabha Unstarred Question No. 3130, dated on 29.11.2010.

However, other states forming a part of North-western India do not reflect a similar pattern showing a relatively high value with the individual figure being as high as 9.37 in Rajasthan and 7.38 in Jammu & Kashmir.

Also, attempt is made to assess the areal coverage of arable land, degraded land and land affected by natural calamities (refer fig. 4).

Figure 4: Existing Land Use in Selected states in North-Western India (2010-11)



Source: Lok Sabha Starred Question No. 270, dated on 15.03.2011.

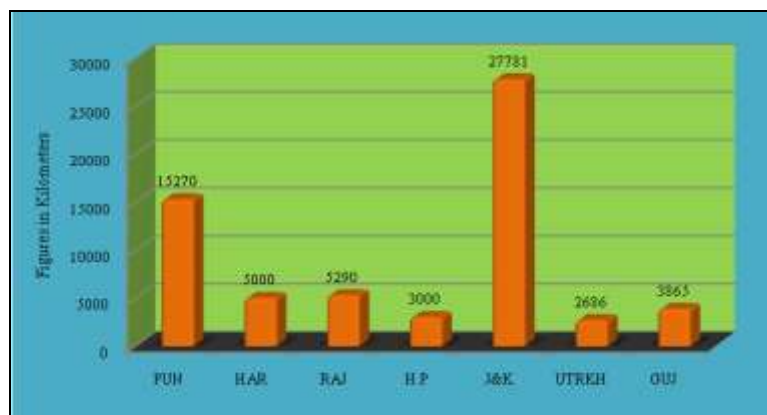
Out of the three, the land use pattern of the region is chiefly dominated by the arable land (refer figure 4) there by imparting an agricultural character to the region.

3.3 IRRIGATION: THE LIFELINE OF SUSTAINABLE AGRICULTURE

Operating as an agriculturally dominated and heavily irrigated region, the water footprint of north-western India is predicted to be higher than most other Indian states which are likely to pose challenges for future use. Irrigation in

general is deemed to be one of the indispensable forces in realized agricultural development and goes a long way in achieving the very basic objective of ‘sustainable agricultural production.’ The introduction of high yielding variety seeds i.e. ‘wonder seeds of rice and wheat in north-western India’ as a part of Green Revolution and its high water requirement led to an increased use of irrigation water in general.

Figure 5: Network of Rivers and Canals in North-Western India, (2010-11)



Source: Ministry of Agriculture, Govt. of India, 2010-11

The above figure (fig. 5) illustrates the length of canals and rivers numerically as per data available for the year 2010-11. It indicates a dense network of rivers and canals for state of Jammu & Kashmir followed by Punjab i.e. the land of five rivers. However, non availability of proper drainage system and other restoring practices resulted in degrading the agricultural tract in the region. These are identified in the form of water logging and soil salinity that poses a threat to the fertility of the soil and the overall food security – a goal with which the ‘New Package Programme’ was launched in mid 1960s. Major irrigation command areas of rice-wheat growing tract especially are worthwhile mentioning.

3.4 REQUIREMENT AND AVAILABILITY OF FERTILIZERS

As far as consumption of fertilizer is concerned, India ranks second in the world in terms of fertilizer nutrient consumption, next only to china. However, the per hectare consumption is quite less than as compared to many other countries, even the neighboring countries of India. In fact, the pattern of fertilizer consumption and availability in India is quite skewed with state wise variation being significant.

Recognizing the importance of fertilizer, it is established that adequate and timely doses of chemical fertilizer are a basic requirement for better and quick response of the new and high yielding seeds. In adherence to this, fig. 6 tries to unravel the requirement and availability of fertilizers in selected states of the region. However it is to be noted

that the term fertilizer is inclusive of Urea, Diammonium Phosphate (DAP), Mature of Potash (MOP) and Nitrogen, Phosphate and Potassium (NPK).

Figure 6: Requirement and Availability of Fertilizers, (2011-12, Up to July 2011)



Source: Lok Sabha Unstarred Question No. 3880, dated on 25.08.2011.

Non-judicious and unrealistic use of irrigation water in rice-wheat growing areas and intense use of chemical fertilizers in the agricultural tract results in irrigation induced soil salinity and water logging – a threat to environment and hindrance to the sustainable development of the region. States like Haryana, Punjab, Uttarakhand, Gujarat and Rajasthan are the chief fertilizer consuming states in the north-western parts of the nation.

3.5 DIVERSIFICATION OF CROPS: A MAJOR BREAKTHROUGH

There has been an immense diversification in the cropping pattern of the region and the two staple food grains under consideration are wheat (*Triticum* spp.) and rice (*Oryza sativa*) (Clay, 2004). Out of the two food crops, wheat is deemed to be the staple and most favored food item of the majority of inhabitants owing to which the region retains its character as ‘wheat bowl’ of India. At the same time, Crop rotation, which is a fertilizing process, should be encouraged and promoted in a holistic manner. [5]

The total area under Rabi crops has increased considerably from 3417 thousand hectares in 2001-02 to 3605 thousand hectares in 2014-15 for Punjab. However the most promising growth has been achieved by Rajasthan with a value reaching as high as 4439 thousand hectares in 2010-11 and further to 6151 in 2014-15. The below line graph (fig. 7) explains this trend from 2001-02 to 2014-15.

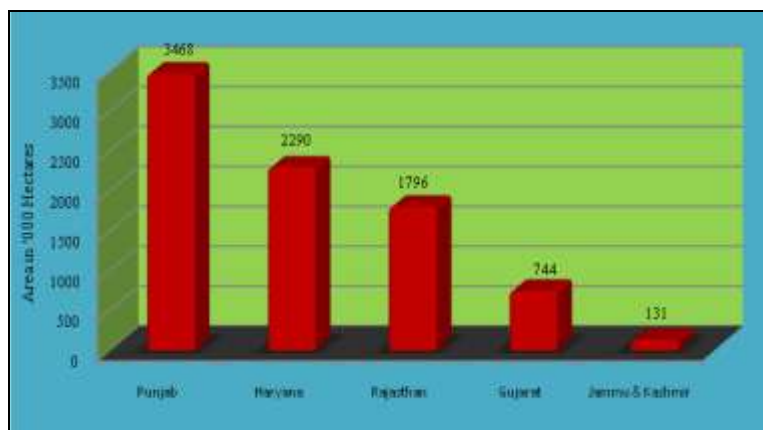
Figure 7: Trends in Area under Rabi Crops in Three Selected States of North-Western India ('000 Hectares)



Source: Ministry of Agriculture, Govt. of India & Lok Sabha Unstarred Question No. 111, dated on 22.02.2015.

Diversification of crops has been a classic trend since the ushering of green revolution and area under crops has shifted to irrigated and more stable crops like wheat, rice from the earlier trend of millets and pulses. In fact the state of Punjab and Haryana has one of the largest shares of area under the HYV of wheat in India (refer fig. 8).

Figure 8: Area under High Yielding Variety of Wheat in North-Western India (2006-07)



Source: Ministry of Agriculture, Govt. of India. (11349), (ON116)

IV CONCERN FOR SUSTAINABILITY

The region which was once at the centre stage of ecologically suitable 'Green Revolution' in the era of seventies and eighties now faces serious issue of sustainability which draws the attention of not only the state government

but is also a concern for the central governing body. The problems of water logging and soil salinity are serious constraints for sustained agricultural production (Umali, 1993).

Serious problems of water logging and soil salinity should be rationally taken care of and sound and effective management strategies should be framed and formulated so that development of a sustainable environment and agricultural prosperity in general could be realized. Therefore, it is essential to plan and implement rational policies to reap the fruits of agricultural production and growth thereby restoring its sustainability for future generations.

V GOVERNMENTAL INITIATIVES AND PROGRAMME IMPLEMENTATION

The government of India in consultation with the respective state governments has formulated efficient management strategies on a priority basis. It intends to optimize the efficiency of existing irrigation systems, including rehabilitation of systems that have been run down and also expand irrigation, where feasible, with a special effort to increase storage capacity. Incentive structures will be designed to:

- Promote water-neutral or water-positive technologies,
- E-charging of underground water sources and
- Adoption of large scale irrigation programmes which rely on sprinklers, drip irrigation and ridge and furrow irrigation.

Finally, our approach must also be compatible with our role as a responsible and enlightened citizen of the nation.

VI CONCLUDING REMARKS

Thus it is successfully concluded sustainability in agricultural production could be realized with a balanced and effective doses of farm inputs as use of irrigation water, application of chemical fertilizers, insecticides and pesticides and other necessary mechanization process.

In a nutshell, the research paper attempted to restore and maintain the balance between the availability of natural resources and the demands of current food grain production within the parlance of north-western India that helps to review the current policies and the emerging changes in the design of new and fresh proposals so that they have better chances of sustained use.

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