

# **Impact of Agricultural Growth and Its Long-Term Viability in Punjab And Haryana's Agro – Ecosystems**

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## **I. INTRODUCTION**

Agricultural intensification, which aimed to reduce the area under cultivation while increasing crop yield by modernising farming methods and equipment, epitomised an exemplary movement from antiquated agricultural ways to modern commercialised farming in the 20th century. It is a remarkable accomplishment that Indian agriculture now feeds the world's second-largest population. We were able to accomplish this outstanding aim by updating our agricultural methods and revitalising farming as a whole. It took more than one night or one method to feed the second-largest population in the world—soon to be the largest. The Green Revolution and the practise of increasing agriculture were the answer.

Increasing agricultural inputs to boost productivity or yield on a certain plot of land is referred to as intensification of agriculture. In order to raise the value of production per hectare, agricultural intensification is increased by raising the average inputs of labour or capital on a smallholding, either on cultivated land alone or on cultivated and grazed land (Tiffen et al., 1994). Agricultural intensification was favoured over extensification since the former was thought to save more area for nature than the latter, which, if it persisted, would result in the eradication of any surviving tropical rainforests.

Increasing the use of the same resources for agricultural output is a frequent characteristic of agricultural intensification patterns, which often occur from a move from intermittent to continuous cultivation of the same piece of land (Giller et al., 1997). Therefore, increasing the number of crops planted on the same piece of land reduces the fallow time between crops, which is another component of agricultural intensification. As a result, agricultural intensification has largely ignored the danger of negative effects on the larger endowment of ecosystem services and has instead focused almost completely on yield production.

Increased usage of agrochemicals including pesticides, fungicides, and insecticides allowed for increased agricultural intensification. Today, it is well acknowledged that the uncontrolled use of agrochemicals in contemporary agriculture not only presents serious hazards to human health but also has a number of negative side effects on the ecosystem, including the extinction of species. Additionally, intensive agriculture has a detrimental effect on the long-term viability of the affected agricultural area itself. However, because to their high nutritional requirements and insect susceptibility, High Yielding Variety (H.Y.V.) seeds developed to increase production could not have been grown without these agro-chemicals. Additionally, these seedlings needed more irrigation, which raised the strain on both surface and ground water supplies. To make up for the weak monsoon's lack of precipitation, artificial irrigation was needed. Recent research, however, raises the possibility that excessive irrigation in northwestern India is to blame for the monsoons' declining frequency. The water and energy balance between the land surface and atmosphere has changed as a consequence of agricultural intensification, and these changes are having an impact on our climate (Mathur and Achuta Rao, 2019). As a result of extensive agriculture, subsurface water supplies are being depleted and monsoons are becoming unpredictable.

From 33.26 lakh tonnes in 1966–1967 to 283.93 lakh tonnes in 2015–16, Punjab's output of food grains has increased significantly. Food grain output in Haryana grew from 25.92 lakh tonnes in 1966–1967 to 163.34 lakh tonnes in 2015–16. Between 1966–1967 and 2015–16, Punjab and Haryana's food grain production rose dramatically, reaching 250.67 lakh tonnes in Punjab and 137.42 lakh tonnes in Haryana (S.A.P. and S.A.H, 2015–16). This dramatic increase was largely made possible by the peasants' intensive use of inputs like H.Y.V. seeds, artificial irrigation, chemical fertilisers, insecticides, and pesticides.

But the problem is that we accepted agricultural intensification without considering its true aim. We eventually adopted an intensification cycle, which decreased agricultural diversity and added dangerous chemicals to our soils and water supplies. Now, this carried with it a number of issues that steadily emerged starting in the 1980s. Since there was no other option at the time, we embraced this approach. We were forced to adopt it because of our geographic limitations and the pressure from the expanding population. When division took place, it upended our country's agricultural plan and left us with swaths of land that were less fruitful than the ones we had lost. Additionally, the Hindu Succession Act stipulates that property (land) would be dispersed equally among the

siblings; as a result, our land holdings are decreasing with each passing generation. Therefore, we are not as lucky as the Western countries, who are able to practise substantial agriculture owing to their wide land and low population as a result of good inheritance laws. To prevent hunger in our nation, intensive agriculture was the only option. We had to start the Green Revolution, which gave us the information necessary to implement the intensification of agricultural approach. Therefore, the purpose of this study is to better understand how this intensification was accomplished and how its long-term detrimental effects on the environment and the economy are coming to light.

According to the adage "Prevention is better than cure," it is crucial to investigate and identify the factors contributing to ecological degradation in order to avoid severe destruction in the States of Punjab and Haryana.

## **II. STATEMENT OF THE ISSUE**

For the present study, the agro-ecosystems of Punjab and Haryana have been chosen. An environment that is managed for agriculture and is connected to other ecosystems is known as an agroecosystem (OECD, 2001). An agro-ecosystem is a physical entity that has been altered by people in order to meet their needs for food. It is exciting to investigate how this changed environment interacts with other natural ecosystems. Regarding the cultivation technique used, this interaction may be advantageous or disadvantageous, sustainable or unsustainable.

Increasing agricultural intensification (increasing the intensity of cultivation on a given area) or agricultural extensification (increasing the area under cultivation) has been shown to increase food production in response to population growth around the world. Agricultural intensification is not an option in Punjab and Haryana since there is not enough new land available for cultivation. Only an intensive strategy for food production was an option. With the start of the Green Revolution and globalisation, farming became more intensive in emerging nations. This intensification of agriculture has been made possible by scientific advancements.

Those who support agricultural intensification make numerous attempts to describe it. Some people emphasise that it refers to improving yield per hectare, while others claim it refers to increasing cropping intensity or input intensity. Some see it as a sort of agriculture that requires less land. The underlying theme running across these definitions is how to maximise production from a given area of land by using more inputs, such as labour, fertiliser, and machinery, and rotating crops selectively while striving for a shorter growing season to allow the greatest number of harvests each year. In a nutshell, it refers to stepping up efforts and using a variety of cutting-edge inputs and procedures in an attempt to maximise productivity from tiny landholdings. Although agricultural intensification is connected with higher crop yields, it may also be linked to a growing specialisation in the production of wheat and rice, which results in monocultures of wheat and rice and a general loss in crop variety.

Numerous Green Revolution-era agricultural practises that are now considered standard practise include heavy inputs of agrochemicals, tillage, and artificial irrigation systems, all of which will have a significant negative impact on the environment and may jeopardise long-term food security. When comparing agricultural yield enhancements to the problem of ensuring sustainability of environmental resources and general human well-being, negative consequences are more often seen. So, sadly, the benefits of intensive agriculture methods have not come without a corresponding environmental cost. Analyses must be conducted on the less-discussed ills of the high yielding variety age. These practises, which were originally marketed as a key factor in cultivators' profitability and a practical way to achieve food security, are quickly becoming obsolete and increasing the study area's vulnerability to climate changes.

The farmers in Punjab and Haryana have often been accused of carrying out unacceptably eco-unfriendly intensification. It is important to increase the sustainability of agricultural operations. Additionally pricey is intensive farming. It requires a lot of costly and variable inputs, which alter with the state of the economy. Since the expense of cultivation inputs makes it unprofitable for them to continue, many small landowners have turned to alternative sources of income. So, is it fair to hold farmers accountable for what their governments and commercial agro-chemical firms put upon them while farmers are struggling to carry on the burden of farming? There are currently no affordable workforce sources with consistent supply. The labour force is being drawn to the cities of these states by the numerous shopping malls and other international projects, and the migratory labour force has become unreliable because better job opportunities are being found in each state independently thanks to central government initiatives like the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). The cost of managing intensive agriculture is rising, and farmers' personal finances and land are suffering. As a result, the study region chosen for this research has answered the issue of how to fill the food bowl, but in achieving the objective, they have put themselves in a worse situation.

A historical analysis of the collapse of many past civilizations may also highlight the overuse of natural resources. The recurrence of pandemics every hundred years or so also highlights how people abuse nature and fail to learn from their previous errors. Mother Nature is being manipulated via so-called economic development, but this is really just a push towards human extinction. Due to the overuse of natural resources including groundwater and other resources, these two states, Punjab and Haryana, are faced with a wide variety of

environmental issues.

The states of Punjab and Haryana were selected for the current research because of their unusual significance in India. They are the primary funders of our central pool and have contributed to India's attainment of food security. They were also the Indian Green Revolution pioneers who were the first to explore agricultural intensification. The Punjab and Haryana agro-ecosystems, however, are now very vulnerable. Agro-ecosystem sustainability in the research region may be negatively impacted by declines in agricultural biodiversity linked to present farming practises. Sadly, the advantages of intensive agriculture were not without corresponding environmental consequences.

The states of Punjab and Haryana are now dealing with a variety of ecological problems, including excessive water level reduction, water pollution, soil salinity, soil contamination, and a lack of micronutrients. The precise effects of agricultural intensification on the environment, biodiversity, and public health in the research region must be ascertained. Additionally, the search for alternatives that can maintain high yields while minimising their effect on natural resources should now be prioritised. There is apprehension about what Punjab and Haryana's future may bring. The state's natural ecology, which is abundant in animal and plant life, is struggling due to overuse and pollution. According to reports, 2.87 percent of Punjab and 7.67 percent of Haryana were desertified in 2011–2013. In the previous 10 years, there has been an increase in the area affected by desertification of 1.02 percent in the case of Punjab and 0.55 percent in the case of Haryana. In fact, from the years 2003–2005 to the years 2011–2013, 26 out of the 29 Indian states reported an increase in the region suffering desertification (SAC and ISRO, 2016). Now that we've connected it to dwindling groundwater supplies, unpredictable monsoons, and depleted soils, we can see how the problem of desertification might eventually become a major concern for not just the study region but also the majority of Indian states that have chosen this intensive farming model. Thus, it is essential to promote sustainable resource use and preserve the study area from ecological catastrophe and public health crises.

### **III. Objectives**

The objectives of the present study are to:

1. To grasp population dynamics and their effect on the practises used in agriculture today.
2. To assess the degree of existing agricultural intensification in the research region.
3. To draw attention to how agriculture in the two states has changed, moving from traditional subsistence agriculture to intensive agriculture.
4. To solve the sustainability concerns that these two agro-ecosystems' present agricultural situation has brought up.
5. To involve the agricultural community in a discussion to elucidate potential remedies and, more significantly, to propose prevention actions.

### **IV. Hypothesis**

1. The process of agricultural intensification leads to an increase in production and results in alterations to the cultivated land.
2. The current financial benefits derived from non-viable intensive farming practises will be eclipsed by the unparalleled environmental and socioeconomic detriments.
3. The intensification of agriculture is a result of the growth in population and the reduction in landholdings.
4. The process of agricultural intensification results in a heightened focus on specialised production techniques.
5. The alteration of land use has a significant effect on the level of agricultural intensity.

### **V. REVIEW OF LITERATURE**

The practise of cultivating only wheat and rice is widely regarded as being unsustainable. According to Shergill's (2007) analysis, the evaluation of scientific data pertaining to the economic and ecological dimensions of wheat-rice production in Punjab suggests that the crop rotational system is highly sustainable. Additionally, there is a projected increase in domestic demand for the next few decades, and the system of minimum support prices is expected to continue in the near future. The returns exhibit a significant magnitude, and there is currently no pressing environmental apprehension. The reduction in the water table did not surpass the threshold of peril, and the decrease in wheat-rice yield was not the sole cause of the decline. However, the threshold of danger in Punjab has been surpassed and thus necessitates a reevaluation of the situation.

Melkani (2014) posits that the viability of wheat and rice crops is challenged by the intensive nature of their cultivation. The aforementioned patterns exhibit a higher frequency in the Indo-Gangetic plains of India, where monocultures of rice and wheat are widely practised. The state of Punjab is characterised by the implementation of highly intensive farming practises, which have been shown to be unsustainable in terms of production trends.

Crop diversification has been identified as a crucial necessity by numerous scholars. S.S. Johl has been

a persistent advocate of promoting crop diversification in the state of Punjab. Certain academics have attempted to propose local substitutes for the customary crop rotation of wheat and rice. Kang et al. (2009) have proposed feasible substitutes for the rice-wheat crop rotation in the Punjab region. The wheat-rice system in S.B.S Nagar district may be substituted with a wheat-maize system, while in Faridkot district, the cotton-wheat system appears to be more advantageous. Furthermore, the implementation of diversified agricultural practises such as agroforestry and fish farming may contribute to the attainment of agricultural sustainability in Punjab.

Academic researchers have employed diverse input and output characteristics for the purpose of gauging agricultural intensification. According to Pingali (2012), the proliferation of the Green Revolution across Asia and Latin America resulted in a rise in agricultural productivity. According to Dayal's (1984) findings, there exists a positive correlation between agricultural productivity and the utilisation of fertiliser and irrigation techniques, while a negative correlation is observed between agricultural productivity and population density.

The technology of the Green Revolution was founded on various inputs such as the utilisation of high-yielding variety seeds, the presence of irrigation facilities, and the application of fertilisers, as noted by Dalrymple in 1986. According to Evenson and Gollin's (2003) findings, the contribution of high-yielding varieties (H.Y.V.) of seeds to growth was significant in Asia and Latin America, but comparatively minor in other regions. The significance of technology in augmenting agricultural production has been highlighted by Smith et al. (1994) and Ceddia et al. (2014).

Numerous scholars have noted that the degree of economic and agricultural development in India is significantly linked to the presence or absence of adequate irrigation facilities, as evidenced by the works of Ninan and Chandrashekar (1993), Singh and Singh (1995), Sharma (1997), and Alauddin and Quiggin (2007).

Singh and Singh (2007) conducted a case study on the region of Mirzapur in Uttar Pradesh, highlighting the significant impact of factors such as land holding size, irrigation availability, agricultural intensiveness, and commercialization on the process of agricultural mechanisation.

## **VI. RESEARCH METHODOLOGY**

The current investigation pertains to the utilisation of districts as the primary unit of analysis. For the sake of consistency throughout the study period, the 2011 administrative map has been chosen as the foundational map. Since 1960-61, there have been alterations to the boundaries of the study area. The data has been modified to account for these alterations. The notifications issued by the governments of Punjab and Haryana regarding the modifications in district boundaries were taken into account for comprehending the aforementioned alterations. The Census of India's General Population Tables were referenced, with a specific focus on Table Series A1's Appendix A1. This table displays the territorial changes in the area of districts over the course of a decade. To align data with district boundaries, various sources such as Census Village directories, State Abstracts, District abstracts, and Block at a glance reports were utilised. The task at hand is rather intricate and for certain attributes, comprehensive data was not readily obtainable. Therefore, proportional data based on district area was utilised to derive an estimated value. Great attention was paid to prevent any mistakes.

The present investigation incorporates both primary and secondary data. However, the investigation is predominantly founded on secondary data procured from diverse governmental entities. The present research has utilised primary data collected from field surveys as a supplementary source of information. The regions of Punjab and Haryana have been classified into seven distinct agro-climatic zones. The objective was to randomly choose a minimum of two districts from each agro-climatic zone. Ten questionnaires were randomly distributed in a selected village from each district. Ultimately, a total of 18 districts out of 41 were encompassed, yielding a return of 178 questionnaires.

The statistical information was computed, tabulated, and analysed utilising appropriate cartographic techniques. The preparation of the maps was carried out using the ArcGIS 10.1 software. Several visual aids such as bar charts, line graphs, and pie charts have been generated. The current study has utilised conventional statistical techniques such as mean values, proportions, and percentages to assess agricultural input and output intensities, as well as other relevant attributes.

## **VII. RESULT AND FINDINGS**

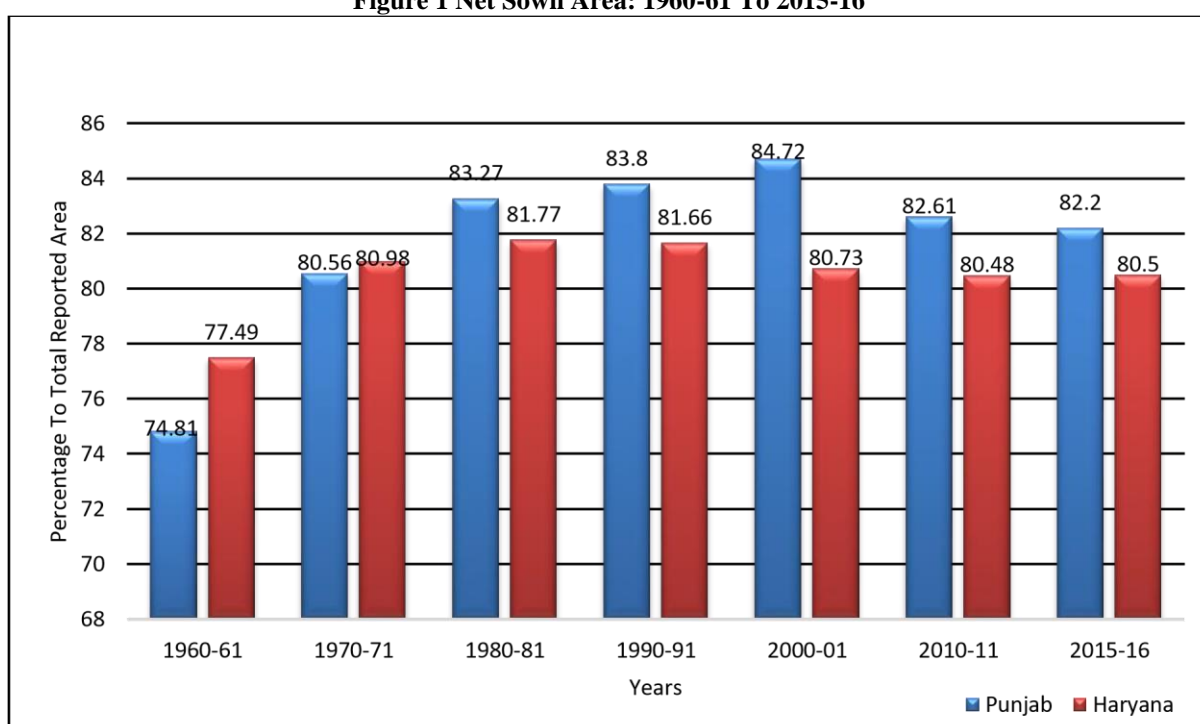
The present study takes the initiative of studying agricultural intensification in selected study area along with its implications. The study begins with introducing the theme and then reviewing the need for selected theme. The objectives, hypotheses are put forward and the research methodology is discussed. It then moves onwards towards introducing the physical environment of the study area, the relief, physiographic regions, drainage, soil, climate, etc. because from the agricultural point of view the climatic as well as physical factors play an important role. It is found that the selected study area is suitable from the point of view of agriculture. Next a picture of socio-economic attributes of study area is presented. Population dynamics is discussed and attributes like decadal increase, density of population points out towards the population pressure which has been instrumental in intensification of land cultivation in the study area. Then from the rural agricultural background perspective, the

number of agricultural workers, cultivators, labourers, and economic and political conditions of the study area and relations among these two states are discussed.

We have also discussed the number of landholdings and it was observed that from 1970-71 to 2015-16, the total number of landholdings have declined in Punjab and increased in Haryana. This is also reflected in the dominant category of landholdings on the basis of size group. In 1970-71 in Punjab as well as Haryana marginal category of landholdings dominated whereas in 2010-11 in Punjab semi-medium category of landholding and in Haryana still marginal category of landholding dominates. On analyzing the land tenure patterns, it was observed that wholly owned and self-operated is the dominating tenancy pattern.

The land use of study area has been divided into Forest land, Land Not Available for Cultivation, Other Uncultivated Land except Fallow Land, Fallow Land and Net Sown Area categories and then discussed. From this discussion we are able to evaluate land sparing versus land expansion arguments related to agricultural intensification as presented in the review of literature. Land sparing concept emphasizes that with intensification farmers will spare land for nature. But in certain cases it has been observed that agricultural intensification because of increase in crop yields motivates farmers into extending area under cultivation.

**Figure 1 Net Sown Area: 1960-61 To 2015-16**



Source: Statistical Abstract of Punjab (S.A.P). 2016; and Statistical Abstract of Haryana (S.A.H). 2016-17

It can be concluded that in the case of study area, intensification has not lead to land sparing but to cultivation of land many times in a year as visible from maximum increase in net sown area. From 1960-61 to 1990-91, the increase in net sown area occurred in Haryana, whereas in case of Punjab this trend continued till 2000-01. This occurred as state governments and farmers were interested in reclaiming land for agriculture instead of sparing land for nature. The later decline has been due to use of agricultural land for non-agricultural purposes. So in the study area expansion of net sown area has occurred due to agricultural intensification.

On analysis of cropping pattern, it has become clearly visible that the area under wheat and rice crops has increased in the study area by reducing area under other traditional crops for whom assured marketing is not available. Recently, the Punjab and Haryana state governments have started promoting other region specific crops to wean off farmers from rice in an effort to reduce area under it. Vegetables and fruits are being promoted in Punjab and oilseeds and pulses in Haryana.

Measures of agricultural intensification selected for present study can be broadly categorized into three categories. The cropping intensity is at its highest, and the availability of land per capita is showing a decreasing trend and these are the measures that points towards land use intensification. Next are the agricultural input intensification measures like area under H.Y.V. of seeds, use of agrochemicals, means of irrigation used and mechanization trends. The percentage area under H.Y.V. of seeds has risen to hundred percent in Punjab, while in Haryana from 2010-11 to 2015-16 the percentage area under H.Y.V. of seeds has declined as the area under rice cultivation has declined marginally. The extent of irrigation is quite high in these states. Consumption of

chemical fertilizers and tractor density has also increased dramatically. Tube well density had reached its climax in Punjab by 2010-11 and started to decline later, although it is still increasing in Haryana. The intensification of inputs is therefore growing in an attempt to further enhance the agricultural productivity in the agro-ecosystems of the present study.

Intensification of agricultural output is evident in the case of wheat, rice, maize and sugar cane, as overall yield increases were recorded from 1960-61 to 2010-11. But from 2010-11 to 2015-16, both states have reported a fall in average wheat yields. Similarly, from 2010-11 to 2015-16, several districts reported declines in rice yields. So, now the seed yield deflation has set in even though input intensification has increased. Thus sustaining current crop yields in future doesn't seem possible unless we bring about changes in our cultivation methods.

### VIII. CONCLUSION

In Punjab and Haryana states the majority of area is flat, bountiful and generally considered desirable for agriculture. Through this research the aim was to study that how the shift in agriculture occurred in the two states to help our nation in achieving food security. Farmers in these states were engaged in traditional cultivation methods producing a variety of crops for subsistence of their families, workers and only excess reached markets. Their agriculture was mainly dependent on monsoon rainfalls and so prone to effects of drought. The Green Revolution and accompanying input intensive technology modernized the agriculture and increased yield of wheat and rice. But the newly introduced H.Y.Vs of seeds were favoured for only few crops resulting in decline in agro biodiversity. Also in the study area soils were extremely rich and appropriate for large scale agricultural production. But due to lack of consideration for nature, decline in following fallow practice by farmers, decline in crop reduction the soils are now dependent on fertilizers and inconsiderate practices are leading to soil erosion, salinity and waterlogging issues. Soil are becoming deficient in macro and micro nutrients, as a result we might have abundance of food grains but these food grains nutritional values have reduced. The present study has tried to evaluate the concept of agricultural intensification in the study area, and region specific measures like per capita availability of land, cropping intensity, extent of irrigation, tube well and tractor densities and finally crop yield all point out that input intensification is occurring and till 2001 corresponding yield increase was occurring. But now yields are staggering and resources being consumed are exhausting and we might not be able to recover the loss.

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