Asian Journal of Agricultural Extension, Economics & Sociology

Volume 42, Issue 10, Page 1-8, 2024; Article no.AJAEES.122899
ISSN: 2320-7027

Factors Affecting Crop Production due to Land Degradation in Jhajjar District of Haryana

Harshit Bansal [a++], Neeraj Pawar [a#], Keshav Kumar [b++*], Rohtash Kumar [c†], Ajay Singh [a++] and Bhupender [d++]

[a] Agril. Econ., CCS HAU, Hisar, India.
[b] Agril. Econ., MPUAT, Udaipur, India.
[c] ICAR-CSSRI, Karnal, India.
[d] Agril. Econ., SKRAU, Bikaner, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajaees/2024/v42i102556

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/122899

Original Research Article

Received: 05/07/2024
Accepted: 09/09/2024
Published: 12/09/2024

ABSTRACT

Land degradation, particularly through waterlogging and soil salinization, poses a significant threat to agricultural productivity, especially in arid and semi-arid regions. This study examined the economic impact of these issues on crop returns in Haryana, India, with a focus on Jhajjar district. The research assessed input utilization, crop yields, and profitability for Bajra and Mustard crops on both normal and degraded farms. Utilizing primary data from 60 farmers and employing tabular

[++] Research Scholar;
[#] Assistant Scientist;
[†] Senior Research Fellow;
**Corresponding author: E-mail: harshit.agecon@gmail.com;*

Cite as: *Bansal, Harshit, Neeraj Pawar, Keshav Kumar, Rohtash Kumar, Ajay Singh, and Bhupender. 2024. "Factors Affecting Crop Production Due to Land Degradation in Jhajjar District of Haryana". Asian Journal of Agricultural Extension, Economics & Sociology 42 (10):1-8. https://doi.org/10.9734/ajaees/2024/v42i102556.*

analysis and the Cobb-Douglas production function, the study found that soil salinity and waterlogging lead to significant reductions in crop productivity and profitability. For instance, Bajra yields on degraded farms resulted in lower gross returns and net profits compared to normal farms, primarily due to increased costs in field preparation and pest management. The Cobb-Douglas production function analysis further revealed that while fertilizers significantly enhance yields on normal farms, their effect is negative on degraded farms, likely due to over use of fertilizers. Mustard farming showed similar trends, with problematic farms incurring higher variable costs and achieving lower profitability. The study highlighted the urgent need for targeted policies to manage soil health and improve the economic outcomes of farming in degraded lands.

Keywords: Land degradation; waterlogging; salinity; cobb-douglas; MSP of crops.

1. INTRODUCTION

Land degradation is a major threat to our food and environmental security. The development of waterlogging and soil salinization in irrigated areas of arid and semi-arid tracts is a global phenomenon. Soil health related problems seriously undermine the productivity of one-third of the world's arable land. It has been estimated that the decline in yield is about 1.1 million tons each year due to water logging and salinity in developed and developing countries together [1]. Haryana is a water deficit state with respect to surface and groundwater resources and the state being part of fertile Indo-Gangetic Plains, the agriculture practice forms the major land use of the State. The total cultivable area in the State is 3.8 million hectare (86% of State area) of which 3.62 mha constitute the net cropped area. The northern portion of the State is characterized by good agricultural area due to fertile alluvial soils, marginal to good quality of groundwater, network of irrigation, canals, tube wells and relatively better natural drainage.

Salt affected land, scrub land, waterlogged land, barren land and sandy area constitute the main wasteland in the State. The majority of salt-affected lands are associated with waterlogged areas. These are mainly spread over the central and southern parts of the State in the districts of Karnal, Kaithal, Panipat, Sonipat, Jhajjar, Rohtak and Gurgaon. Absence of natural drainage outlet and use of poor-quality groundwater for agricultural purpose render highly fertile soils salt-affected. Barren lands are generally associated with Aravalli ranges in the districts of Faridabad, Gurgaon, Mahendragarh and Rewari. Major scrublands are found in the central part of Gurgaon district, southern parts of Mahendragarh district and in the northern parts of Ambala district. Scrub lands also exist at few places around townships of Gurgaon, Faridabad, Bhiwani, Hisar and Yamunanagar. In all these places, the land becomes barren with scrub due to loss of soil fertility caused by waterlogging and poor quality of groundwater [2].

The issues of population, environment and land resources have been drawing the attention of the government for the last three decades because of the rapid growth of population, urbanization and industrialization. Due to the constant rising process of all these aspects there is a great impact on the natural resources as well, particularly on land resources. Moreover, the land resources are also facing innumerable problems i.e. soil erosion, salinity, alkalinity and seepage. Therefore, there is a great need for the management of all natural resources in order to satisfy the needs of an accelerating population and for the environmental sustainability of the state.

A survey was conducted in the Jhajjar district of Haryana to determine the extent of land degradation problems. Farmers with both normal and degraded soils were interviewed to measure the impact of soil salinity and waterlogging on the productivity and profitability of crop production, specifically Bajra and Mustard. The findings revealed that soil salinity and waterlogging significantly constrain agricultural production, leading to decreased productivity, agricultural output, and income.

The primary goal of this research is to estimate the economic impact of land degradation at the field level. Other goals include:

I. Assessing input utilization, crop yield, total production value, and net profit at the field level.
II. Estimating crop returns owing to degraded land due to salinity and waterlogging.
III. Developing policy suggestion.

1.1 Scope of Study

Soil degradation due to salinity and waterlogging cause decline in crop productivity, profitability and the degradation of natural resource base. Hence, it is imperative that research is required to work out the impact on crop return owing to degraded land and suggest strategies for their remedies to the problem. The present study was conducted at the farm level using primary data. The study will help in policy making with regard to problems of villages in particular and region as a whole in general.

2. MATERIALS AND METHODS

The Haryana state was purposively selected. Further, district Jhajjar was selected on the basis of degraded land data from published source of NBSS & LUP. A complete list of all the villages in the selected district was prepared and two villages (Baghpur and Wazirpur) were selected on the basis of problematic land due to salinity, water depletion or waterlogging for the present study.

A complete list of all cultivating households was prepared for the sampled villages, using the information provided by concerned village *Patwari* and Krishi Vigyan Kedra (KVK) and a sample of 15 problematic farmers' and 15 non-problematic farmers' from each village were selected. Therefore, a total sample size for the study was 60 farmers. The data related to crop production were collected for the 2022-23 production year.

Tabular analysis: Tabular analysis was used to examine the costs and returns of Bajra and Mustard crops grown on normal and problematic farms with the help of simple percentages and averages.

Cobb-douglas production function: The Cobb-Douglas production function form was used to analyse the crops return owing to degraded land as it provides the best fit and is most widely used form of estimated agricultural production data because of its parsimony in parameters, ease of interpretation and computational simplicity [3]. Two production functions were estimated, one for normal farms and the other for degraded farms [4].

The form of Cobb-Douglas production function used for different categories of farms was:

$$Y_1 = a_1 X_1^{\beta 1} . X_2^{\beta 2} \ldots\ldots\ldots X_n^{\beta n}\, U \qquad (1)$$

$$Y_2 = a_2 X'_1{}^{\beta' 1} . X'_2{}^{\beta' 2} \ldots\ldots\ldots X_n'^{\beta' n}\, U \qquad (2)$$

The equation (1) and (2) are non-linear as the derivatives of Y with respect to the parameters are dependent on the parameter themselves. Ordinary Least Square (OLS) can be applied to estimate the model after linearizing the equation by taking natural logarithm on both sides. The equations were transformed in log-linear form and the analysis was performed in SPSS software:

$$\ln Y_1 = \ln a_1 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_n \ln X_n + e \qquad (3)$$

$$\ln Y_2 = \ln a_2 + \beta'_1 \ln X'_1 + \beta'_2 \ln X'_2 + \ldots\ldots + \beta'_n \ln X'_n + e \qquad (4)$$

Where,

Y_1 = output obtained on normal farms, Y_2 = output obtained on degraded farms,

a_1, a_2 are the intercept of normal and degraded farms,

β_1, β_2, …., β_n represents the regression coefficient or elasticity of production of factor inputs And X_1, X_2, …., X_n are the independent variables such as seed cost, field preparation and sowing, fertilizers, plant protection chemicals and irrigation [5,6].

Student's t-test: To compare the mean values of a variables between normal farms and problematic farms, student's t-test was applied as under:-

$$t = \frac{x_1 - x_2}{SE\,(x_1 - x_2)}$$

$$SE\,(x_1 - x_2) = S\sqrt{1/n_1 + 1/n_2}$$

$$S = \sqrt{\frac{SD_1^{\,2}(n_1-1) + SD_2^{\,2}(n_2-1)}{n_1+n_2-2}}$$

Where,

SE = standard error of mean difference, x_1= mean value in normal farms,
x_2= mean value in problematic farms, S = common standard deviation
SD_1= standard deviation in normal farms, SD_2= standard deviation in problematic farms
n_1= number of observations in normal farms
n_2= number of observation in problematic farms

3. RESULTS AND DISCUSSION

Bajra and Mustard was the major cropping patterns followed by farmers in Jhajjar district of Haryana [7].

The Table 1 analyzing the costs and returns of Bajra farming in Jhajjar District during 2022 compares the normal and problematic farms, highlighting key differences in their economic performance. Normal farms incurred a total cost of ₹58,596 per hectare, slightly higher than the ₹50,872 on problematic farms, but they achieved better returns due to more efficient production practices. However, when looking at variable costs alone, both types of farms had comparable expenditures, with normal farms spending ₹32,847 per hectare and problematic farms spending ₹31,942 [8,9].

As depicted from the Table 1 normal farms recorded a gross return of ₹65,400 per hectare, significantly higher than the ₹51,413 per hectare on problematic farms, with a gap of ₹13,987. This variation is largely due to the superior yields of both the main crop and by- products on normal farms, which benefited from better farming practices, including more efficient field preparation and sowing techniques [10].

Further, when considering returns over variable costs, normal farms earned ₹32,553 per hectare, whereas problematic farms managed only ₹19,471 per hectare, resulting in a notable difference of ₹13,082. This suggested that normal farms were more successful in managing their variable expenses, likely due to better resource allocation and more effective input usage, which enhanced their overall production efficiency [11,12].

Table 1. Costs and returns of Bajra during 2022 in Jhajjar District (in ₹ per ha)

S.No.	Particulars	Normal farms	Problematic farms	Difference	t-value
A.	**Variable cost**				
1.	Field preparation and Sowing	6,610 (11.28)	8,109 (15.94)	1,499	8.19*
2.	Seeds	1,215 (2.07)	1,460 (2.87)	245	7.15*
3.	Fertilizers	2,840 (4.85)	3,426 (6.73)	586	13.96*
4.	Irrigation	963 (1.64)	380 (0.75)	-583	-20.95*
5.	Plant Protection	4,080 (6.96)	4,469 (8.78)	389	6.87*
6.	Harvesting & Threshing	15,789 (26.95)	12,651 (24.87)	-3,138	-8.20*
8.	Interest on working capital+ misc.	1,350 (2.30)	1,447 (2.85)	97	41.49
9.	Sub-total	32,847 (56.06)	31,942 (62.79)	-905	2.26*
B.	Fixed cost	25,749 (43.94)	18,929 (37.21)	-6,820	-18.74*
C.	Total cost (A+B)	58,596 (100.0)	50,872 (100.0)	-7,725	-15.74*
D.	Gross return	65,400	51,413	-13,987	-20.76*
E.	Returns over variable cost	32,553	19,471	-13,082	-21.70*
F.	Net return	6,804	541	-6,262	-11.45*
G.	B:C ratio over variable cost	1.99	1.61		
H.	B:C ratio over total cost	1.12	1.01		

Note: Figures in parenthesis indicates the percentage to total cost
** indicates significance at 1 per cent level*

Table 2. Costs and returns of Mustard during 2022-23 in Jhajjar District (in ₹ per ha).

S.No.	Particulars	Normal farms	Problematic farms	Difference	t-value
A.	**Variable cost**				
1.	Field preparation and Sowing	8,336 (13.45)	9,380 (18.00)	1,044	8.77*
2.	Seeds	2,174 (3.51)	2,717 (5.21)	543	9.99*
3.	Fertilizers	3,433 (5.54)	4,940 (9.48)	1,507	5.99*
4.	Irrigation	1,136 (1.83)	618 (1.19)	-518	-14.25*
5.	Plant Protection	4,450 (7.18)	4,869 (9.34)	419	9.15*
6.	Harvesting & Threshing	10,880 (17.55)	8,754 (16.80)	-2,126	-4.00
8.	Interest on working capital+ misc.	1,321 (2.13)	1,518 (2.91)	196	27.66*
9.	Sub-total	31,730	32,796	1,065	3.88*
B.	Fixed Cost	30,255	19,308	-10,947	-24.59*
C.	Total cost (A+B)	61,985 (100.0)	52,103 (100.0)	-9,882	-25.95*
D.	Gross return	90,879	60,942	-29,937	-16.37*
E.	Returns over variable cost	59,148	28,146	-31,002	-9.17*
F.	Net return	28,893	8,838	-20,055	-4.25*
G.	B:C ratio over variable cost	2.86	1.86		
H.	B:C ratio over total cost	1.47	1.17		

Note: Figures in parenthesis indicates the percentage to total cost
** indicates significance at 1 per cent level*

Table 3. Cobb-douglas production function estimates for Bajra crop under different conditions in Jhajjar (in ₹ per hectare)

S.No.	Variables	Parameter	Normal farm	Problematic farm
1.	Constant	lnA	3.46* (0.64)	4.93** (1.83)
2.	Seed cost	β1	-0.01 (0.04)	-0.05 (0.48)
3.	Field preparation and sowing	β2	-0.11 (0.13)	0.42 (0.35)
4.	Fertilizers	β3	0.27* (0.09)	-0.58* (0.18)
5.	Plant protection chemicals	β4	0.03*** (0.02)	-0.02 (0.08)
6.	Irrigation	β5	0.17 (0.09)	-0.02 (0.08)
No. of observations			30	30
R^2			0.62	0.56
Adjusted R-square			0.38	0.31

Note: Figures in parentheses indicates standard error
** indicate significance at 1 per cent level*
*** indicate significance at 5 per cent level*
**** indicate significance at 10 per cent level*

The net return, which included both variable and fixed costs, were significantly higher on Normal farms at ₹6,804 per hectare compared to just ₹541 per hectare on problematic farms, reflecting a difference of ₹6,262. The lower net returns on problematic farms can be attributed to their higher expenditures on critical areas such as field preparation, sowing, and plant protection, which were necessary to mitigate the challenges they faced, like suboptimal soil quality or pest issues. Moreover, the Benefit-Cost (B:C) ratio also favored normal farms, with a ratio of 1.99 over variable costs compared to 1.61 for problematic farms, and 1.12 over total costs versus 1.01. This indicated that normal farms were more efficient in generating returns relative to their costs, underscoring the importance of effective cost control and favorable conditions for achieving better financial outcomes in Bajra cultivation.

The Table 2 provides insights into the cost-efficiency and profitability of mustard farming in Jhajjar District during the 2022-23 season, comparing normal farms with problematic farms. The total variable cost was slightly higher on problematic farms (₹32,796 per hectare) compared to normal farms (₹31,730 per hectare). The most significant components of variable costs on problematic farms included field preparation and sowing (₹9,380 per hectare), fertilizers (₹4,940 per hectare), and plant protection (₹4,869 per hectare). These elevated costs suggested that farmers on problematic farms incur additional expenses to manage issues such as poor soil quality or pest infestations.

The fixed costs, particularly the rental value of land, were significantly lower on problematic farms (₹14,474 per hectare) than on normal farms (₹25,194 per hectare). This reduction in fixed costs may be due to lower land values or rent in areas with degradation due to salinity or poor soil quality. Further, the gross return on problematic farms was ₹60,942 per hectare, significantly lower than the ₹90,879 per hectare on normal farms, leading to a net return of just ₹8,838 per hectare on problematic farms, compared to ₹28,893 per hectare on normal farms. The B:C ratio also reflected this disparity, with a ratio of 1.86 on problematic farms, indicating less favorable economic outcomes, compared to 2.86 on normal farms. These figures underscored the economic challenges faced by farmers on problematic farms, where higher variable costs and lower productivity significantly diminish profitability.

Table 3 presented the Cobb-Douglas production function estimates calculated using SPSS software for Bajra crops under normal and problematic farm conditions in Jhajjar. The analysis revealed how different inputs affected Bajra yields and returns under varying farming conditions.

Fertilizer use showed a significant positive coefficient of 0.27 for normal farms, indicating that appropriate fertilizer application significantly enhanced Bajra yields. In problematic farms, the fertilizer coefficient (-0.58) was significant at the 1% level, suggesting that fertilizer use negatively impacts yield, likely due to issues such as excessive fertilizer use or high fertilizer prices.

Further, it was found that plant protection chemicals (0.03) was significant at the 10 per cent level for normal farms, indicating a slight positive impact on yields. For problematic farms (-0.02), non-significant, suggesting that these chemicals did not significantly affected yields, possibly due to inefficiencies in pest and disease management practices.

The coefficient of determinations (R2) indicated that, largest proportion of variation in Bajra output was explained by the independent variables included in the function. The contribution of independent variables to the output was highest in normal soils (62 per cent) followed by problematic soils (56 per cent).

The estimated Cobb-Douglas production functions for mustard crop in Jhajjar on normal and problematic farm are depicted in Table 4 which were calculated using SPSS software. The coefficients of multiple determination for the problematic and normal farms indicated that about 53 and 64 per cent variations in mustard output was explained by variables included in the production functions.

The regression coefficients of expenses on field preparation & sowing and plant protection chemical & irrigation were found to be significant at 1 & 10 per cent level, respectively on normal farms. Other variables like seed cost and fertilizers were statistically non-significant. In case of problematic farms, all the input factors were found to be non- significant.

Table 4. Cobb-douglas production function estimates for Mustard crop under different conditions in Jhajjar (in ₹ per hectare)

S.No.	Variables	Parameter	Normal farm	Problematic farm
1.	Constant	lnA	10.28* (1.90)	13.05* (4.10)
2.	Seed cost	β1	-0.05 (0.23)	0.06 (0.22)
3.	Field preparation and sowing	β2	-1.73* (0.59)	-1.82 (1.19)
4.	Fertilizers	β3	0.14 (0.18)	-0.45 (0.52)
5.	Plant protection chemicals	β4	0.18*** (0.09)	-0.10 (0.10)
6.	Irrigation	β5	0.24*** (0.12)	0.01 (0.24)
No. of observations			30	30
R^2			0.64	0.43
Adjusted R-square			0.41	0.19

Note: Figures in parentheses indicates standard error
** indicate significance at 1 per cent level*
*** indicate significance at 5 per cent level*
**** indicate significance at 10 per cent level*

4. CONCLUSION

The study highlighted the economic disparities between normal and problematic farms in Jhajjar district of Haryana. Normal farms consistently outperformed problematic farms in terms of gross returns, net returns, and Benefit-Cost (B:C) ratios, reflecting better resource allocation, efficient input use, and effective farming practices. The analysis of Cobb-Douglas production functions further revealed that fertilizer application, field preparation, and irrigation played significant roles in influencing crop yields, particularly on normal farms. In contrast, problematic farms struggled with higher variable costs and lower productivity, largely due to soil quality issues and inefficient input usage. To address these challenges, the following policy suggestions are proposed:

1. **Soil Health Management Programmes**: Implement targeted soil improvement programs to enhance the productivity of problematic farms, including soil testing services, organic amendments, and better pest management practices.
2. **Subsidized Fertilizer and Seed Distribution:** Provide subsidies or financial assistance for quality fertilizers and seeds, especially for farmers managing problematic lands, to reduce input costs and improve yields.
3. **Capacity Building and Training:** Offer training programs for farmers on efficient farming practices, including optimal fertilizer use, pest control, and water management techniques tailored to specific soil conditions.
4. **Infrastructure Development:** Invest in infrastructure that supports better irrigation systems and drainage in areas prone to salinity or poor soil conditions, reducing the dependency on high-cost inputs.
5. **Risk Mitigation Schemes:** Develop and promote crop insurance schemes that specifically address the risks associated with problematic farms, ensuring that farmers are financially protected against potential losses.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Brown LR, Young JE. Feeding the world in nineties. State of the World, (Ed) W.W. Norton and Co., New York; 1990.
2. Planning Commission. Haryana development report, New Delhi; 2009. Available:https://niti.gov.in/planningcommission.gov.in/docs/plans/stateplan/sdr/sdr_haryana1909.pdf
3. Singh J, Singh JP. Land degradation and economic sustainability. Ecological Economics. 1995;15:77–86.
   Sinha JK. Economies of the factors affecting crop production in India: Analysis based on Cobb-Douglas production function. Sumerianz Journal of Economics and Finance. 2023;6(1):10-18.
4. Aryal JK, Sapkotas TB, Jat ML, Bishnoi DK. On-farm economic and environmental impact of zero-tillage wheat: A case of north-west India. Experimental Agriculture. 2014;51(1):1-16.
5. Datta A, Shrestha RP, Tun K. Assessment of land degradation and its impact on crop production in the dry zone of Myanmar. International Journal of Sustainable Development & World Ecology. 2015; 22(6):1-12.
6. Faruq-Uz-Zaman M. Contribution of factors affecting crop production in Bangladesh: An empirical analysis with production function approach. Economics and Business Quarterly Reviews. 2021;4(2):59-67.
7. Grewal SS, Lohan HS, Dagar JC. Potential agricultural practices in saline waterlogged areas of Haryana and their impact on socio-economic conditions of farmers-A synthesis. Journal of Soil Salinity and Water Quality. 2021;13(1): 109-133.
8. Kumar S, Chand R. Land use dynamics and cropping pattern: Case study of village in Karnal district of Haryana. Agricultural Science Digest- A Research Journal. 2012; 32(1):83-86.
9. Raju R, Thimmappa K, Kumar P, Kumar S, Tripathi RS. Adverse effect of land degradation on farm productivity and income in North-West India. Indian Journal of Economics and Development. 2017; 13(2a):490-495.
10. Thimmappa K, Singh Y, Reddy AA. Reducing farm income losses through land reclamation: A Case study from indo-gangetic plains. Journal of Soil Salinity and Water Quality. 2015;7(1):68-76.
11. Atis, E. Economic impacts on cotton production due to land degradation in the Gediz Delta, Turkey. 2006; 23:181-186.
12. Sinha, J. K. Economies of the Factors Affecting Crop Production in India: Analysis Based on Cobb-Douglas Production Function. 2023; 6(1): 10-18.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/122899