

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: - www.journalijar.com</p> <h2 style="text-align: center;">INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</h2> <p style="text-align: center;">Article DOI: 10.21474/IJAR01/20524 DOI URL: http://dx.doi.org/10.21474/IJAR01/20524</p>	
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RESEARCH ARTICLE

INCLUSIVE CLIMATE ACTION: ADDRESSING AGRICULTURAL CHALLENGES FOR LOW AND HIGH-INCOME FARMERS

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Manuscript Info

Manuscript History

Received: 28 December 2024
Final Accepted: 31 January 2025
Published: February 2025

Key words:-

Agriculture, Climate Change, Production Challenges, Income Categories

Abstract

The world has witnessed a massive shift in climate change since the last century. These climate changes are severely impacting the global agricultural economy to a great extent because agriculture is primarily reliant on climate. Repercussions of climate change in agriculture are felt to varying degrees among the rich and poor. Large-scale diversified farmers can adapt to changed climatic circumstances by employing the latest agricultural developments, which is not the case for others. There is a wide income disparity among farmers, especially in the case of India, which necessitated an income-wise comparative study between farmers regarding the implications of climate changes on agriculture. Farmers from lower-income, middle-income and higher-income strata were selected proportionately for conducting the study. The study shows that environmental problems influence agricultural production. Floods, drought, soil erosion, land degradation, crop failure, and increased farming costs affect them. The intensity of ecological challenges is severe among low-income farmers, found comparatively less among higher-income categories. The differences between various income groups regarding environmental and production challenges are highly significant. The study suggests adopting a comprehensive approach from society to mitigate climate issues and bridge the gap between various income categories.

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Introduction:-

India is one of the largest agricultural economies in the world. About 70% of its population is engaged in agriculture and related activities for their livelihood in India. Besides, India is the leading exporter of agricultural goods in the world. India recorded substantial growth in the production of crops, animal husbandry, aquaculture, etc., in the last two or three decades. Nowadays, the Indian agricultural sector is facing a severe threat from climate change and associated risks. Flash floods, frequent droughts, landslides, pest attacks, etc., are the major threats that Indian farmers face. Overcoming these challenges possess a significant threat to the world. Not all farmers can compensate the climate risk, here, their socio economic conditions matter. Latest developments in technology can offset these

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challenges to a certain extent. Farmers who are cultivating in a large scale with higher return can adapt to these challenges by employing technology, this is not the case for lower income category farmers.

It is evident from numerous studies and reports that wide income disparities exist among the working-class population. These disparities are also apparent in the farming sector, where farmers engaging in bulk-level commercial production earn more profit than small and medium-scale farmers. The repercussions of climate change affect farmers at different income levels in different volumes and intensities. To understand these differences, this study is proposed. The following are the objectives of the study.

Review of Literature:-

Environment degradation is a growing concern for the world. Complexities of climate change are evident in almost all sectors of the economy. Agriculture is highly related to climate, and climate change impacts the world's agricultural sector more severely than any other sector. India, an agro-dominant nation, has much to worry over the repercussions of climate change. Numerous studies have been organised worldwide to explore the threats of environmental degradation to agricultural productivity. There are several causes of environmental degradation; even agriculture contributes to ecological threats. In certain localities, shifting cultivation is prevalent, which degrades soil fertility, clears natural vegetation, increases weed growth, etc. Socio-economic backwardness of farmers is the major cause of adopting shifting cultivation practices (Kumari, N, 2016). Increased frequency of high rainfalls results in flash floods, severely affecting the country's hilly terrains. Natural disasters in the form of landslides harm the lives of farmers in these undulating terrains. There are some seasonal crops which will ripen only in a particular season. Indian Himalayas are famous for apple cultivation, which has immense export value. Unpredictable snow conditions in these terrains since the last decades threaten the production, which severely affected many small and medium scaled farmers (Anil Kumar et al., 2020). The invasion of large-scale producers in hilly regions resulted in groundwater exploitation, which reduced the groundwater table and availability of water for cropping. Small-scale farmers are at risk of spending more to ensure adequate water supply to their lands. (Satish et al., 2020). These regions depend upon natural water sources and rainfall. Erratic rainfall is a concern for them, requiring people to install a high-cost mechanised irrigation system (Donkor et al., 2021). Hilly regions are even disadvantaged with acidic soil, and water erosion. It is advised to implement soil protection, horticulture development and cash crop planting mechanisms to ensure a sustainable farming system in these high-altitude terrains (Datta, 2017).

In one locality, the rain lashes severely; on the other side, inadequate rainfall and rising temperatures pose a threat to farmers, mostly belonging to plains. People tend to move from their cultivable land due to insufficient rainfall and increasing temperature (Anburaja & Nandagopalan, 2013). One common agricultural practice in our country is the wide-ranged mono-cropping practice. It will pose a threat to the environment by reducing flora in that region, subsequently eliminating the biodiversity (Tapan Kumar et al., 2014). Monoculture practice leads to the increase of weeds and planthoppers (Betz., 2015). After effects of climate change and deforestation are the decline in farming revenue and the outmigration of farmers from their natural habitat to unfamiliar urban environments (Anooja Chacko, 2017). Global environmental challenges have a bearing on farmers' production costs. The cost of cultivation will be increased (Brigit & Joseph K, 2005). Farmers nowadays need to invest more in agriculture (Subhasis et al., 2017), which will be unaffordable for low-income groups. Research and developments in agriculture brought up HY Variety crops, which are more climate resilient. Adopting this HY variety crops further increased the production cost by increasing expenses for inputs like fertilisers and pesticides (Mohammed & Mohammed, Kamal, 2018).

An extensive review of available literature identified a research gap. Numerous environmental challenges exist, but how they will affect agricultural production is a matter of investigation. Income disparity is severe in the Indian economy, so an investigation to seek answers to how these environmental challenges are impacting agriculture production between different income groups is found relevant.

Statement of the Problem

Since the last century, the most growing concern for the global world has been the rising climate challenges. The effect of climate change is evident in all spheres of life. People depending on climate and environment for their subsistence are the primary group affected by climate concerns. The farming sector is one sector which is fully reliant on climate. Climate change affects agriculture in several ways, such as: erratic rainfall, infections of crops and plants, increased farming expenses and perishability. Addressing these challenges is a concern for farmers. Farmers merely engaged in small-scale subsistence-level agriculture are more affected by these climate issues (Arifa et al., 2021). They are not wealthy enough to counter these challenges. Climate-resilient, technologically developed

systems are now available to address these issues at a particular level. Here, the income of farmers will be a decisive factor (Matsane et al., 2017). Lower-income farmers cannot cope with these changes, whereas high-earning, diversified farmers can adapt. How these income differences reflect their farming activities is a matter of concern that needs to be investigated (Hegdeet al., 2000). A comprehensive, quantitative, and descriptive study is thus proposed here to address the problem.

Objectives of the Study:-

1. Identify the environmental challenges in farming and associated risks in the production of agricultural goods.
2. To find out the difference between various income categories with regard to environmental challenges and production risk

Research Question

1. What are the different environmental challenges and production challenges faced by farmers?
2. Is there any difference between various income categories with regard to challenges in farming?

Hypothesis of the study

- H₀: There is no significant difference in environmental challenges in farming across different income categories
 H₀: There is significant difference in production challenges in farming across different income categories

Methodology of the Study:-

The study is both descriptive and analytical in nature. Both primary and secondary data were employed to conduct the study. Purposive sampling method is adopted to select respondents. Primary data was collected from farmers residing in Kerala. A total of 180 samples were collected for analysis. Based on income, farmers are categorised into low-income, medium-income, and higher-income categories. Sixty samples from each three categories constitute 180 total samples. Registered and unregistered farmers were considered for the study, so the population is unknown. Descriptive statistics and Non-parametric statistical tools of Kruskal Wallis test were used for the study.

Analysis and Interpretation:-

Here, certain environmental challenges and associated challenges with agricultural production are identified. Farmers belonging to different income categories are classified as lower income. Middle income and higher income. Farmers who earn up to 100,000 annually through agriculture are treated as lower income group, whereas farmers who earn between 100,000 to 300,000 in the middle-income category and more than 300,000 in a year as higher-income farmers. Descriptive statistics are used to identify environmental and production challenges. Results are depicted in table 1:

Table 8.1:- Descriptive statistics.

Challenges in Agriculture	Lower Income		Middle Income		Higher Income	
	\bar{x}	SD	\bar{x}	SD	\bar{x}	SD
Environmental issues						
Periodic droughts and floods	3.10	1.217	2.52	1.556	2.51	1.680
Land Degradation in Marginal Areas	2.84	1.371	2.45	1.052	2.39	1.201
Deforestation and climate instability	3.93	1.023	4.48	.959	4.33	1.221
Resilience to Pests and Diseases	2.22	1.367	2.74	1.436	2.87	1.372
Increased Soil erosion	4.55	.675	2.89	1.808	3.30	1.520
Frequency of animal raids in the fields increased	4.90	.303	3.13	1.698	3.52	1.456
Introduction of non-native species that can outcompete local flora and fauna.	4.47	.747	4.30	.882	4.25	1.027
Production issues						
The risk of crop failure increased.	3.88	1.166	3.36	.817	2.30	.823
Increased Energy Demand for Irrigation	3.87	1.200	3.38	.969	2.36	.913
Necessity of Increased Capital Investments	4.12	1.027	3.84	.840	2.90	.473
More insecticides and fertilisers are required for	3.90	1.175	3.74	1.015	3.77	1.116

HYV varieties.						
Disrupted Agricultural Calendar	3.82	1.000	4.13	.903	4.28	.951
Exorbitant prices for farming supplies and equipment	3.65	1.039	4.11	1.066	3.66	.854
Reduced Productivity of Traditional Varieties	3.32	1.432	4.07	1.223	4.25	1.150

Source: Primary data

Table 1 shows the descriptive statistics of various environmental issues and production issues associated with agriculture. Lower-income category farmers have the highest environmental issue of increasing wild animal attacks on farm fields (\bar{x} 4.90, S.D \pm 1.027), followed by invasive non -native species (\bar{x} 4.47, S.D \pm .747), which outcompetes the local flora and fauna. They are comparatively less affected by resilience to pests and diseases (\bar{x} 2.22, S. D \pm 1.367). Farmers belonging to the middle -income category (\bar{x} 4.48, S.D \pm .959) and higher -income category (\bar{x} 4.33, S.D \pm 1.221) mostly face the issues associated with deforestation and climate instability. Environmental problems have many repercussions in the production process as well. It is observed from the study that lower-income category farmers are getting badly affected in production because environmental issues are highly affecting them. Environmental issues tend to increase production costs , necessitating them to invest more in agriculture (\bar{x} 4.12, S.D \pm 1.027). Production problems associated with climate change are affecting middle-income and higher-income farmers almost similarly. Both complained that climate change severely interrupted their agricultural calendar pattern (\bar{x} 4.13, S.D \pm .903), (\bar{x} 4.28, S.D \pm .951).The risk of crop failure is comparatively less among higher-income farmers (\bar{x} 2.30, S.D \pm .823). Here, the descriptive statistics provided the various environmental issues and associated challenges in agricultural production. To test the significance of differences between various income categories in terms of challenges in agriculture concerning climate change, the Kruskal Wallis H test is conducted using the following hypothesis.

H_0 : There is no significant difference in the challenges in agriculture across various income categories

H_1 : There is a significant difference in the challenges in agriculture across various income categories

Table 8.2:- Kruskal Wallis test.

Challenges in Farming	Mean Rank			χ^2	P value
	Lower Income	Middle Income	Higher Income		
Environmental Challenges	118.56	85.02	71.36	25.943	.000
Production Challenges	105.69	104.73	64.31	24.634	.000
Environmental Challenges					
Periodic droughts and floods	107.03	84.46	83.27	8.229	.016
Land Degradation in Marginal Areas	104.10	85.68	84.62	5.562	.062
Deforestation and climate instability	102.12	99.44	72.63	14.796	.001
Resilience to Pests and Diseases	100.89	95.84	77.55	7.089	.029
Increased Soil erosion	120.40	80.54	74.03	30.577	.000
Frequency of animal attacks in the fields increased	125.60	78.64	70.82	46.663	.000
Introduction of non-native species that can outcompete local flora and fauna.	96.23	89.73	88.62	.921	.631
Production Challenges					
The risk of crop failure increased	121.06	101.46	52.47	58.163	.000
Increased Energy Demand for Irrigation	118.12	101.26	55.56	49.830	.000
Necessity of Increased Capital Investments	118.53	103.66	52.75	57.783	.000

More insecticides and fertilisers are required for HYV varieties.	97.62	90.04	86.94	1.437	.487
Disrupted Agricultural Calendar	105.75	89.39	79.32	8.818	.012
Exorbitant prices for farming supplies and equipment	104.21	96.96	73.03	13.109	.001
Reduced Productivity of Traditional Varieties	103.90	98.86	71.41	15.235	.000

Source: Primary data

All the p values obtained are less than 0.05 since the null hypothesis is rejected with 95% confidence. There is a significant difference in the challenges of agriculture across different income groups. Environmental issues affect farmers of varying income classes in different manners and intensities. Climate-related issues severely affect lower-income farmers (\bar{x} 118.56, P 0.00). The intensity of environmental challenges is comparatively less among middle (\bar{x} 85.02, P 0.00) and higher-income category farmers (\bar{x} 71.36, P 0.00). Environmental problems are found to be the cause of barriers to agricultural production. It is observed from the study that production challenges are similarly higher among lower-income farmers (\bar{x} 105.69, P 0.00) and low among higher-income farmers (\bar{x} 64.31, P 0.00). The difference between them is significant, so the alternate hypothesis is retained.

Discussion:-

A comparative analysis is carried out among farmers of different income categories to identify the nature and intensity of the effect of climate change on agricultural production. Farmers who earn an annual income of lower than 100,000 are treated as a lower income category; farmers who earn between 100,000 and 300,000 are a middle-income group. Farmers whose earnings from agriculture are more than 300,000 are higher-income farmers. A number of climate-related challenges in agriculture are identified. It is found that farmers belonging to lower income strata face the most critical issue of frequent wild animal attacks into their farm fields and destruction of ripened crops, which endanger their lives and livelihoods. Farmers of moderate- and higher-income categories consider deforestation a serious threat, and the repercussions of deforestation cause severe harm to climate and climate-resilient agriculture. Climate change results in the development and spread of new forms of unfamiliar invasive species, ultimately harming farmers' crop productivity. This issue is significantly affecting all farmers, irrespective of their income levels.

Environmental challenges are considered the root cause of the reduction in agricultural productivity. Several production problems associated with environmental problems are identified, like crop failure, increased spending for energy and inputs, disruptions in the agro calendar, replacement of traditional crops, etc. All these challenges affect farmers of various income categories in significantly different intensities. It is evident from the study that the lower income classes suffer mostly in comparison to higher income groups. A comprehensive approach is thus necessary on the part of governments, agricultural cooperatives, NGOs working in the primary sector, and environmental protection, as well as the public at large, to overcome these challenges, as suggested by the study.

Findings and Suggestions:-

- Environmental challenges are the leading cause of lower agricultural productivity. As climate change issues rise, associated hype in production challenges will also occur.
- There is a noticeable difference between farmers of various income categories regarding challenges in production due to climate change. Farmers belonging to lower-income strata struggle more than middle—and higher-income category farmers to cope with climate change-related issues in agriculture.
- Depletion of natural water sources and food in forests leads to animal encroachments on human settlements in search of food and water. Low-income farmers, who mostly reside in hilly and forested terrains, face the threat of increased wild animal attacks on farm fields, which threaten their lives and livelihoods.
- Flash floods and long-lasting droughts deplete soil quality and fertility, reducing productivity.
- To mitigate climate challenges, farmers incur high farming and maintenance costs, which are unaffordable for lower-income groups.
- Climate resilient agricultural practices should be adopted. More and more scientific research in climate-resilient agriculture should be encouraged. Crops that can adapt to changed climatic conditions should be developed and disbursed among farmers.
- High-income class farmers have multiple ways of marketing their goods. So, government-led initiatives to procure small-scale farmers' products must be implemented.

- Proper implementation of Subsidy schemes, MSP, and value-addition schemes are necessities of the hour
- Stringent laws should protect forests, natural resources, and climate, especially in climate-sensitive regions. Penal actions must be taken against violators of law under forest laws and other legislations of government
- Persuade farmers to cultivate in plain lands rather than opting for hilly terrains bordering with forests. The repercussions of climate change are more intense in hilly, high-altitude terrains, and losses can be contained to a certain extent by cultivating in plain terrains.

Conclusion:-

The study titled 'Inclusive Climate Action: Addressing Agricultural Challenges for Low and High-Income Farmers' is a comprehensive report of emerging environmental issues and how they affect the farming sector. There exists a wide income disparity in India, so the repercussions of climate change are affecting farmers of different income categories in significantly different ways. This research article provides insight to policymakers to adopt a climate-resilient agricultural practice while considering the socio-economic realities of the farmer population. Bridging the gap between poor and rich is of utmost importance through effectively implementing existing agricultural schemes and framing new ones as needed by considering environmental realities. R&D initiatives must be promoted in the agricultural sector to cope with changing climate conditions. The study suggests measures to adapt to changed climatic and socio-economic conditions, which will bear fruitful results in the farming sector.

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