Assessing Environmental Awareness and the Effectiveness of Environmental Policies Implementation in South Punjab, Pakistan: Challenges and Opportunities for Sustainable Development

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Abstract

Rapid urbanization, industrialization and unsustainable consumption and management of resources have increased the environmental problems in the region of South Punjab in Pakistan leading to threats for sustainable development. The study evaluated the level of environmental awareness, the effectiveness of environmental policy implementation and pinpointed the challenges and opportunities for sustainable development. A combination of both qualitative and quantitative research designs was used. Descriptive analysis, Chi-square tests, Principal Component Analysis (PCA) and multiple regression analysis were employed to analyze data. The results indicated that the level of environmental awareness was moderate among 52.0%, high among 29.0% and low among 19.0% of the respondents. Most recognized environmental issues were air pollution (89.5%), water pollution (86.8%) and climate change (81.3%). Environmental awareness was significantly affected by education ($\chi^2 = 32.45$, $p < 0.001$) and the regression model accounted for 62.4% of the variance ($R^2 = 0.624$), with education being the strongest predictor ($\beta = 0.412$). PCA explained 80.8% of the total variance. Water scarcity (Mean = 4.61) was identified as the most pressing environmental issue and tree plantation campaigns (Mean = 3.71) were the activity that was most effective in addressing the environmental issue. The study found that building institutional capacities, effective policy implementation, EE, community involvement and sustainable use of resources are vital in enhancing environmental governance for sustainable development in South Punjab.

Keywords: Environmental Awareness, Environmental Policies, Sustainable Development.

Introduction

Environmental sustainability is currently one of the strongest and greatest concerns of the twenty-first century. Environmental degradation has drastically increased throughout the world

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due to rapid population growth, urbanization, industrialization, and the unsustainable use of natural resources (Kulkarni, 2024). The environment is facing many issues including air and water pollution, deforestation, biodiversity loss, land degradation and climate change, all of which have a significant impact on human health, economic and ecological development. Governments, international organizations and development agencies are increasingly focusing on approaches to sustainable development that have to consider economic development, social equity and environmental protection (Edo et al., 2024). The Brundtland Report introduced the idea of sustainable development and proposed that it is development that satisfies current needs without compromising the ability of future generations to satisfy their own needs (Fischer et al., 2023). Effective environmental governance, public participation, environmental awareness and good implementation of environmental policies are essential for achieving sustainability. Environmental awareness is especially significant because of how it affects the willingness of citizens to undertake environmental responsible activities, support environmental conservation efforts, and participate in environmental management decision making processes (Miao and Nduneseokwu, 2025). The effectiveness of a well-designed environmental policy in achieving desirable outcomes depends on its effective implementation, which can only be achieved through robust institutions, sufficient resources and engagement with stakeholders (Syed et al., 2024).

Pakistan is facing various environmental issues that pose threat to Pakistan's sustainable development path. The country is undergoing rapid and explosive urbanization with higher industrial activities, population pressure and over-exploitation of natural resources that cause environmental degradation. The environmental challenges of major cities are air pollution, contamination of surface and ground water sources, improper management of solid waste, deforestation, soil erosion and biodiversity loss, all of which are significant issues (Afridi, 2025). Although Pakistan produces just a small share of global GHGs, it is one of the most climate-vulnerable countries in the world. Climate-related disasters such as rising temperatures, changing precipitation patterns, prolonged droughts, heatwaves, floods, and others have a growing impact on livelihoods, agriculture, infrastructure, and public health (Masud & Khan, 2024). The vulnerabilities of the environment in Pakistan have been even more exacerbated due to climate change. Recent research shows that rising temperatures and irregular rainfall have brought more water scarcity, agricultural insecurities and ecosystem degradation across several parts of the country. The catastrophic floods that have swept the country in recent years and the repeated droughts have brought the need for climate adaptation and environmental resilience to the fore. Environmental experts emphasize that good climate governance and climate policy making are crucial to minimize environmental risks and to improve sustainable development outcomes (Hussain et al., 2020).

South Punjab is one of the most environment sensitive areas of Pakistan. Districts like Multan, Bahawalpur, Rahim Yar Khan, Dera Ghazi Khan, Muzaffargarh, Vehari, Lodhran, Bahawalnagar, etc. are characterized with varied ecological conditions, high agricultural activities, industrialization and weak desert ecosystems. The agricultural sector is the main livelihood source for many people, and the region is highly dependent on natural resources and climatic conditions (Mazhar et al., 2024). However, environmental issues such as water scarcity, soil degradation, desertification, air pollution, deforestation, and extreme weather events due to climate change are a reality in South Punjab. Environmental and socio-economic vulnerabilities in the region are further exacerbated due to the increased frequency of heatwaves, droughts, dust storms and smog events (Nadeem et al., 2024). Air pollution and smog have become one of the most important environmental issues of the South Punjab region, greatly affecting public health

and the quality of the environment. The quality of the air in urban and peri-urban areas is significantly affected by industrial emissions, vehicle exhaust, burning crop residues and burning brick kilns. Environmental education and public awareness have been emphasized as part of the solutions to the challenges of smog, as an important aspect of the policy reviews in recent years. Unfortunately, there is still lack of awareness, lack of educational programs and weak environmental law enforcement that stifles the effectiveness of environmental management efforts (Iram et al., 2025).

In recognition of the increasing environmental issues, Pakistan has enacted several environmental laws, regulations and environmental policy frameworks. The Pakistan Environmental Protection Act (PEPA) 1997 is the bedrock of environmental regulation and environmental protection mechanism in Pakistan (Imran et al., 2023). With the 18th amendment to the Constitution, more and more environmental governance functions were transferred to provincial governments, which established provincial environmental protection agencies and environmental management systems. Punjab has since launched a number of environmental projects, such as climate adaptation measures, pollution control and abatement projects, afforestation initiatives and environmental monitoring systems to increase environmental quality and environmentally sustainable development (Punjab Government, 2024). Within the framework of laws and policies regarding the environment, its implementation is difficult. Studies show that institutional weakness, financial constraints, technical limitations, inter-agency mismatch, political bias, and lack of public engagement are some of the barriers to environmental governance in Pakistan (Waheed et al., 2024). Additionally, there are often implementation gaps in environmental policies, as stakeholders do not understand the policy, or monitoring and enforcement is inadequate. These barriers also severely limit the effectiveness of environmental interventions and impede progress towards sustainable development goals (SDGs) (Al-Qassim et al., 2021).

Environmental awareness is a central issue to help solve these problems. Given this, people with higher knowledge of environmental issues are more likely to have sustainable lifestyles, save natural resources and advocate environmental policies. Public awareness also promotes accountability by making citizens watchdog the environment's performance and hold decision-makers accountable for effective policy implementation (Perea et al., 2025). In Southern Punjab, EE can be a very effective means of encouraging environmental stewardship and community involvement in environmental conservation. There is a growing emphasis on the importance of awareness creation campaigns, educational initiatives, media outreach, and community-based efforts to foster positive environmental attitudes and actions within the local community (Shoaib et al., 2025). In the face of rising environmental problems and the significance of public participation for sustainable development planning, measurement of environmental awareness and assessment of implementation of environmental policy have become a necessity in South Punjab. The information on public perceptions, awareness, and barriers to implementation gained from this survey can be used to help guide the development of environmental governance policy, environmental agencies, and environmental development organizations when strengthening environmental governance (González et al., 2023). Thus, the objective of the study was to assess the awareness of the environment among the people of South Punjab and the effectiveness of the implementation of environmental policy in the region. In addition, the study aims to identify the major obstacles and challenges that may be affecting the implementation of the policies, and identify opportunities to improve environmental governance, public participation and sustainable

development. The results are likely to help formulate evidence-based strategies to support environmental protection and sustainability in South Punjab, Pakistan.

Research Methodology

Study Area

The present study was conducted in South Punjab, Pakistan which comprised of the following districts of Multan, Bahawalpur, Rahim Yar Khan, Muzaffargarh, Dera Ghazi Khan, Vehari, Khanewal, Lodhran and Bahawalnagar. In terms of ecology, South Punjab has varied areas such as those of irrigated agricultural land, riverine areas, semi-arid and arid desert areas. Due to very extreme climatic conditions of high temperatures, low precipitation, frequent droughts, floods and growing climatic variability, the area is one of the environmentally vulnerable regions of Pakistan (Government of Pakistan, 2021; World Bank, 2024). Agriculture is the main economic activity in the region, and the region's major crops are wheat, cotton, sugarcane, rice, and mangoes. Yet, the environmental issues like groundwater depletion, water scarcity, soil salinity, industrial pollution, air contamination, deforestation and improper waste management etc., are becoming an increasing challenge affecting both environmental quality and agricultural productivity (Syed et al., 2022). Additionally, the rapid urbanization and industrialization in major cities like Multan and Bahawalpur have exacerbated environmental constraints and sustainability issues (Tahir et al., 2025). The study area was selected as an ecologically important area, which is vulnerable to climate change and also important for sustainable development planning. An environmental awareness assessment and policy implementation in South Punjab gives insights into the environmental governance and sustainability challenges in the region.

Research Design

The study used a mixed method research design combining the quantitative and qualitative research approaches. Mixed-method approach is known as the effective method to gain a comprehensive understanding of the complex social and environmental phenomenon as it integrates statistical analysis with in-depth contextual interpretation (Creswell & Creswell, 2023). The quantitative aspect was directed towards measuring the environmental awareness of the citizens, their perceptions of environmental problems and their knowledge about environmental policies in South Punjab. A sample representative of respondents was used for collecting numerical data with the help of structured questionnaires. The qualitative aspect consisted of semi-structured interviews with various environmental experts, policy makers, representatives of the Environmental Protection Agency (EPA), academics, agricultural extension officers, and members of non-governmental organizations (NGOs). These interviews were able to yield detailed insights into environmental governance, institutional effectiveness, policy implementation challenges, and opportunities for sustainable development (Saunders et al., 2023). With methodological triangulation, the integration of both approaches helped to increase the credibility and authenticity of the results, providing a more comprehensive picture of the effectiveness of policy implementation and the level of environmental awareness.

Environmental Policies Selected for Assessment

For the assessment of the implementation of environmental policies, the study focused on major national and provincial environmental policies, which are relevant to environmental management and sustainable development of South Punjab.

Pakistan Environmental Protection Act (PEPA), 1997

The Pakistan Environmental Protection Act (PEPA) 1997 is the main environmental law of Pakistan. The pollution control, environmental quality standards, federal and provincial environmental protection agencies (Government of Pakistan, 1997), and environmental impact assessment (EIA), and environmental governance mechanisms are the mechanisms provided for under the Act.

Punjab Environmental Protection Act, 2012

After the 18th Constitutional Amendment, responsibility for environmental management was transferred to the provinces. The Punjab Environmental Protection Act 2012 further enhanced environmental regulation and provided a mandate to the provincial government for controlling pollution, enforcing compliance and promoting sustainable management of resources in the province of Punjab (Government of Punjab, 2012).

National Climate Change Policy (2021)

The National Climate Change Policy lays down strategic directions for climate adaptation and mitigation measures in Pakistan. The policy emphasizes on climate resilient agriculture, disaster risk reduction, water resources management, promotion of renewable energy and conservation of ecosystems (Government of Pakistan, 2021).

Punjab Climate Change Policy Framework

The Punjab Climate Change Policy Framework seeks to mitigate climate vulnerabilities by implementing afforestation initiatives, sustainable land management, environmental monitoring systems and adapting to climate change. The framework enables provinces to prevent environmental degradation and increase their resilience to environmental risks caused by climate change (Government of Punjab, 2024).

National Environmental Policy

The National Environmental Policy sets out the strategy of environmental conservation and pollution control, biodiversity protection, and sustainable management of natural resources across Pakistan (Government of Pakistan, 2005).

Pakistan National Biodiversity Strategy and Action Plan

This policy framework supports the conservation of biodiversity, ecosystem restoration, wildlife protection and sustainable utilization of biological resources for ecological sustainability (Ministry of Climate Change, 2023).

National Water Policy 2018

Addressing water scarcity issues in South Punjab, the National Water Policy has taken the following issues into consideration: water conservation, groundwater management, water-use efficiency and integrated water resource management (Government of Pakistan, 2018).

Data Collection Methods

Primary Data Collection

Structured questionnaires were used to gather primary data. Using previous environmental awareness and policy evaluation studies (Dalati and Marx, 2018; Magaldi and Berler, 2020), a

structured questionnaire was formulated. The questionnaire assessed: Demographic characteristics, Environmental awareness levels, Knowledge of environmental laws and policies, Attitudes toward environmental conservation, Perceptions of Environmental Degradation, Evaluation of government environmental initiatives and Participation in environmental activities The questionnaire included closed-ended, multiple-choice, and five-point Likert scale questions (Creswell & Creswell, 2023).

Secondary Data Collection

The secondary data obtained were from various reliable sources such as Ministry of Climate Change reports, Punjab Environmental Protection Agency reports, Pakistan Bureau of Statistics publications, United Nations Environment Programme (UNEP) reports, United Nations Development Programme (UNDP) publications, World Bank environmental assessments, Environmental policy documents, Academic journals and conference proceedings and NGO reports and sustainability assessments. The following sources were used to gather supporting data on environment, policy, governance, and sustainable development activities in South Punjab (World Bank, 2024; UNEP, 2024).

Sampling Procedure and Sample Size

South Punjab was divided into various socio-economic and demographic groups, and a stratified random sampling was used to get a representative sample of society. Stratification by: District, Gender, Age, Educational level, Occupation and Urban-rural residence. The survey was conducted with 400 respondents. Saunders et al. (2023) stated that stratified sampling helps reduce sampling bias and be more representative in social science research. The sample size selected was thought to be adequate to produce statistically valid results on issues of environmental awareness and perception of environmental policies.

Table 1: Respondent Distribution

Category	Number of Respondents
Farmers	120
Students	80
Business Owners	60
Government Employees	50
General Public	90
Total	400

Data Analysis Techniques

Quantitative Analysis

The data collected in the survey was coded and analyzed with the Statistical Package for Social Sciences (SPSS Version 26). The statistical techniques used were Frequencies, Percentages, Mean scores, Standard deviations, Cross-tabulation analysis, Chi-square tests and Descriptive statistical analysis. These methods allowed for the evaluation of awareness, perception of environment and public opinion on the implementation of environmental policy (Field, 2023).

Qualitative Analysis

Thematic analysis was used to process data from the interviews according to Braun and Clarke (2023). The responses were then transcribed, coded and sorted into the following themes:

Environmental governance, Institutional effectiveness, Policy enforcement, Climate change adaptation, public participation, and Sustainable development opportunities. Thematic analysis helped to identify common themes and policy implementation issues highlighted by the key stakeholders.

Reliability and Validity of Research Instruments

The questionnaire was content validated by environmental science experts, policy specialists and academic researchers. A pilot study survey was done to evaluate the appropriateness of the contents of the questionnaire and determine any possible ambiguity. The internal consistency and reliability were measured using Cronbach's Alpha coefficient. A coefficient value of more than 0.70 was considered as acceptable for social science research (Field, 2023). Construct validity was created by matching the indicators of the questionnaire with the dimensions of environmental awareness and the variables affecting the implementation of environmental policies used in previous studies (Creswell & Creswell, 2023).

Ethical Considerations

The study adhered to international ethical standards for social science studies. The participation was voluntary and before the collection of data, respondents were informed of the purpose and objectives of the study. All participants have given informed consent, and personal information has been kept confidential. The subjects were assured that their answers would be given only for academic research and that their identities would be kept confidential. In addition, the researcher was transparent, objective and honest in data collection, analysis, and reporting.

Results and Discussion

Demographic Characteristics of Respondents

The survey was carried out in nine districts of South Punjab and 400 respondents participated in the survey. The respondents included a wide cross-section of society to provide broad coverage of environmental awareness and perceptions of environmental policy. Table 3.1 shows the demographic details of the respondents who were part of the study. The male-female participation was balanced with 58.0% males (232 respondents) and 42.0% females (168 respondents). As far as age composition is concerned, most of the respondents fell into the age group 31-45 (39.0%) and 31-30 (31.0%) indicating that most of the respondents were economically active individuals. In terms of education level, 29.5% of the respondents were secondary level followed by higher secondary (24.0%) and graduate (22.3%) respondents, suggesting that the respondents were reasonably educated to understand the environmental issues. Residence wise, 53.0% of the respondents were from urban areas and 47.0% were from rural areas. The urban-rural balance was used which helps to have a balanced basis for evaluating both environmental awareness and perception of environmental policy implementation in South Punjab.

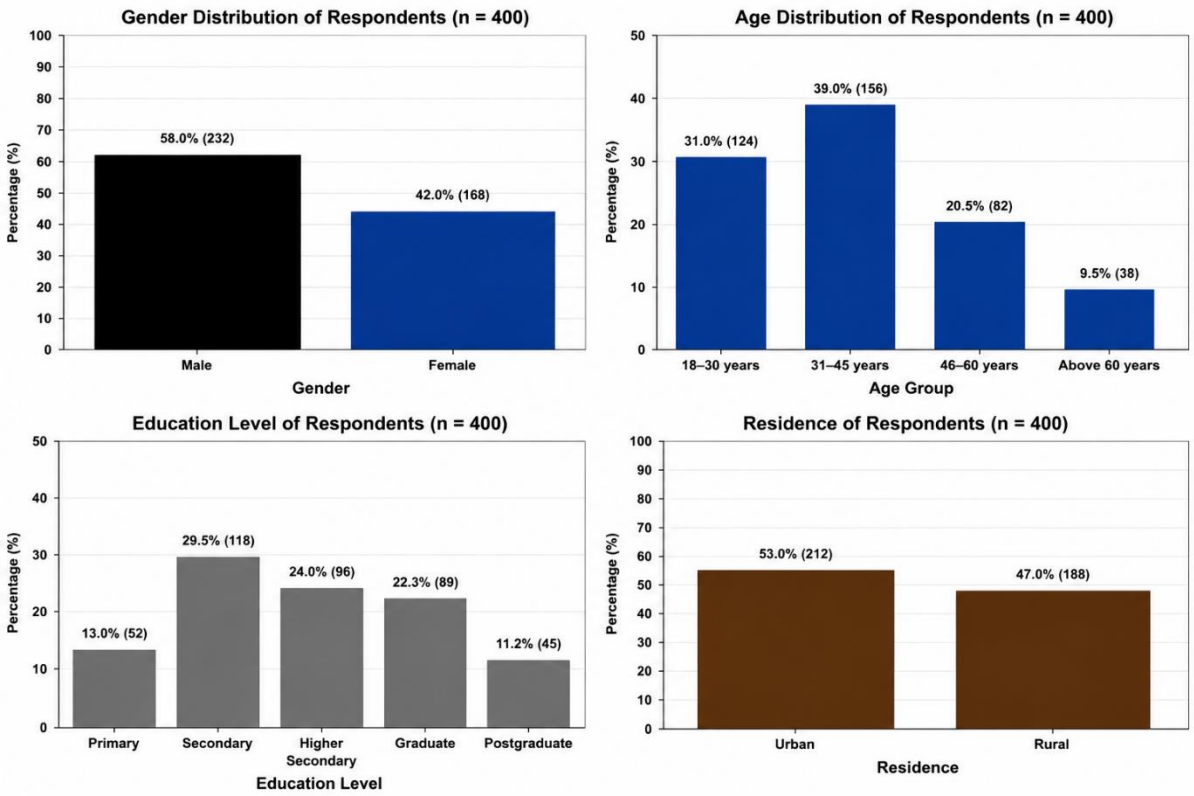
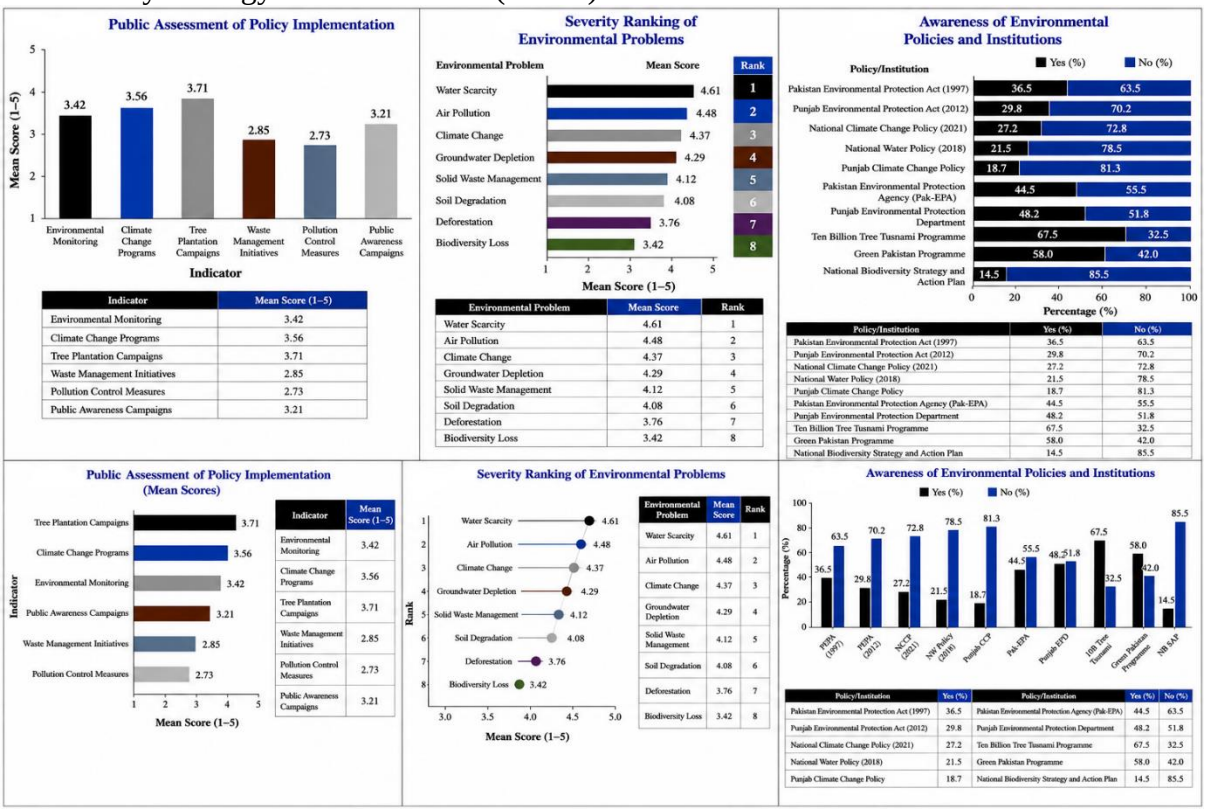


Figure 1: Demographic Profile of Respondents

Public Assessment of Policy Implementation, Environmental Problems, and Policy Awareness

The public evaluation on how the policy is implemented, environmental issues and awareness. Figure 2 represents the graphical presentation of respondents' perception about environmental governance, environmental challenges and their awareness about environmental policies and institutions in South Punjab. The results show a moderate confidence level in implementation of environmental policy. Tree Plantation Campaigns had the highest mean score (3.71), Climate Change Programs had a mean score of (3.56) and Environmental Monitoring had a mean score of (3.42) of the assessed indicators. The above findings indicate that public is positively aware of environmental programmes which are visible, especially afforestation programmes. The lower mean scores for Waste Management Initiatives (2.85) and Pollution Control Measures (2.73) suggest that people are not satisfied with the effectiveness of these interventions and there is a need to strengthen implementation and monitoring systems. The severity ranking of the environmental problems shows that Water Scarcity is considered as the most severe environmental problem (mean = 4.61), followed by Air Pollution (mean = 4.48) and Climate Change (mean = 4.37). The high scores reflect the region's general worry about environmental degradation and the lack of resources. Other major challenges identified were Groundwater Depletion (4.29), Solid Waste Management (4.12) and Soil Degradation (4.08). Deforestation (3.76) and Biodiversity Loss (3.42) were relatively assigned very low marks but are still very important environmental issues. Respondents' awareness of environmental policies and institutions varies considerably. The Ten Billion Tree Tsunami Programme (67.5%) and the Green Pakistan Programme (58.0%) received the maximum attention, as these are national programmes which are visible. The awareness of the institutional was moderate (48.2% and

44.5% respectively) with 48.2% of respondents aware of the Punjab Environmental Protection Department and 44.5% of the respondents aware of the Pakistan Environmental Protection Agency (Pak-EPA). On the other hand, there was limited awareness of formal environmental legislation and policy frameworks. A very small proportion of respondents knew about the Pakistan Environmental Protection Act (1997) (36.5%) and even less about the National Biodiversity Strategy and Action Plan (14.5%).



Indicator	Mean Score (1–5)
Environmental Monitoring	3.42
Climate Change Programs	3.56
Tree Plantation Campaigns	3.71
Waste Management Initiatives	2.85
Pollution Control Measures	2.73
Public Awareness Campaigns	3.21

Environmental Problem	Mean Score	Rank
Water Scarcity	4.61	1
Air Pollution	4.48	2
Climate Change	4.37	3
Groundwater Depletion	4.29	4
Solid Waste Management	4.12	5
Soil Degradation	4.08	6
Deforestation	3.76	7
Biodiversity Loss	3.42	8

Policy/Institution	Yes (%)	No (%)
Pakistan Environmental Protection Act (1997)	36.5	63.5
Punjab Environmental Protection Act (2012)	29.8	70.2
National Climate Change Policy (2021)	27.2	72.8
National Water Policy (2018)	21.5	78.5
Punjab Climate Change Policy	18.7	81.3
Pakistan Environmental Protection Agency (Pak-EPA)	44.5	55.5
Punjab Environmental Protection Department	48.2	51.8
Ten Billion Tree Tsunami Programme	67.5	32.5
Green Pakistan Programme	58.0	42.0
National Biodiversity Strategy and Action Plan	14.5	85.5

Figure 2: Public Assessment of Policy Implementation, Environmental Problems, and Policy Awareness

Adoption of Environmental Practices

Figure 3 presented the level of respondents' environmentally responsible behavior in their daily lives. The most common activity was energy saving (48.0%) followed by water saving (42.5%). Waste segregation and recycling on the other hand were the practices least adopted by the respondents, 49.4% and 58.7% respectively, stating that they did not practice waste segregation or recycling at all. Only 22.3% of the respondents engaged in tree plantation activities regularly, and 41.5% periodically. The results indicated that while there was a relatively high level of environmental awareness, the uptake of sustainable environmental behaviour is still low. The results showed that there was a difference between knowledge of the environment and its implementation, and that the infrastructure, incentives and environmental programs in the communities needed to be improved.

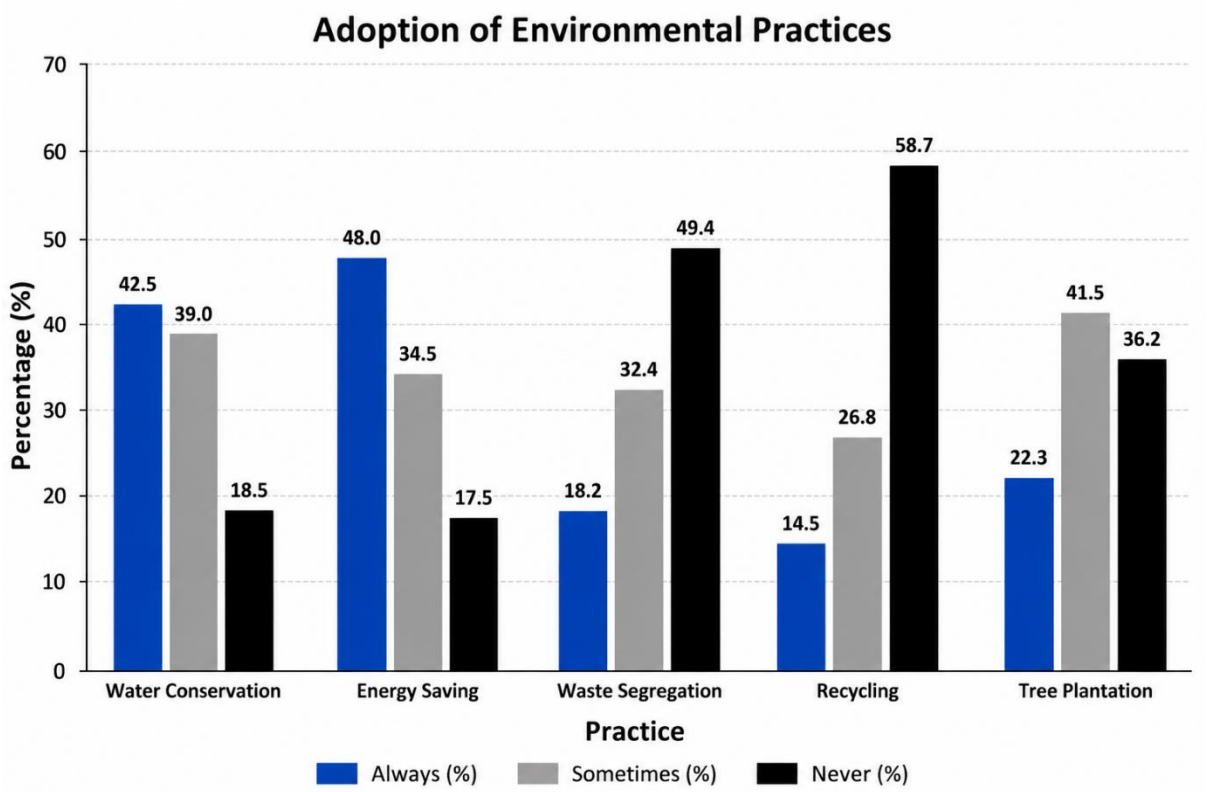


Figure 3: Adoption of Environmental Practices

Chi-Square Analysis, Principal Component Analysis (PCA), and Regression Analysis

Demographic variables were analyzed using a Chi-square analysis to assess the relationship between demographic variables and respondents' awareness of the environment. There was a significant relationship between educational status and environmental awareness as illustrated in figure 4 ($\chi^2 = 32.45$, $p < 0.001$). The finding showed that there was a relationship between problem awareness and the concepts of sustainable development among the respondents, which was very high among those holding higher education, while it was not so high among those who held lower education. In a similar way, dwelling place was significantly linked to environmental awareness ($\chi^2 = 12.68$, $p = 0.002$) indicating that generally urban residents were better informed about environmental issues than rural residents. Conversely, the gender and environmental awareness relationship was statistically insignificant ($\chi^2 = 3.14$, $p = 0.208$), which shows that there is not much difference among the respondents between male and female. A Principal Component Analysis (PCA) was conducted to determine the principal dimensions that influence environmental awareness and perceptions about the environmental policies. Table 3.7 shows the results of the factor analysis, which indicated that 4 main factors accounted for 80.8% of the total variance. Environmental Knowledge (PC1) (31.8%) was the highest contributor of variance, followed by Policy Awareness (22.3%), Environmental Behavior (15.7%) and Institutional Trust (11.0%). Based on these findings, it was found that there were many factors that affected environmental awareness and these factors have become interconnected with the most dominant variable being the knowledge-related factor. The factor loadings in Table 3.8 further demonstrated how each variable contributed to each component. The items that loaded strongly on PC1 were those related to air pollution awareness (0.82), water pollution awareness (0.79), and climate change awareness (0.75), respectively, suggesting their significant contribution to

environmental knowledge. Likewise, policy awareness (0.87) and knowledge of the Pakistan Environmental Protection Act (PEPA) (0.84) loaded strongly on PC2 indicating the importance of policy related understanding. The environmental behavior (PC3) was strongly correlated with recycling behavior (0.81) and waste segregation practices (0.79). Multiple linear regression was used to determine factors affecting the environmental awareness score. The results of the model summary showed that the model was indeed very significant (at $F = 51.27$; $p < 0.001$) and explained 62.4% of the variation in the dependent variable, which was environmental awareness ($R^2 = 0.624$). Education was the strongest predictor variable for environmental awareness ($\beta = 0.412$, $p < 0.001$), followed by social media exposure ($\beta = 0.287$, $p < 0.001$) and policy awareness ($\beta = 0.246$, $p < 0.001$). Urban residence ($\beta = 0.171$, $p = 0.001$) and income ($\beta = 0.094$, $p = 0.035$) also had significant positive effects. The age variable was, however, not statistically significant ($\beta = -0.041$, $p = 0.204$) with environmental awareness. The results revealed that among the respondents in South Punjab those who were more informed, those who had higher educational levels and those who were more aware of the environmental policies were the most significant determinants of environmental awareness.

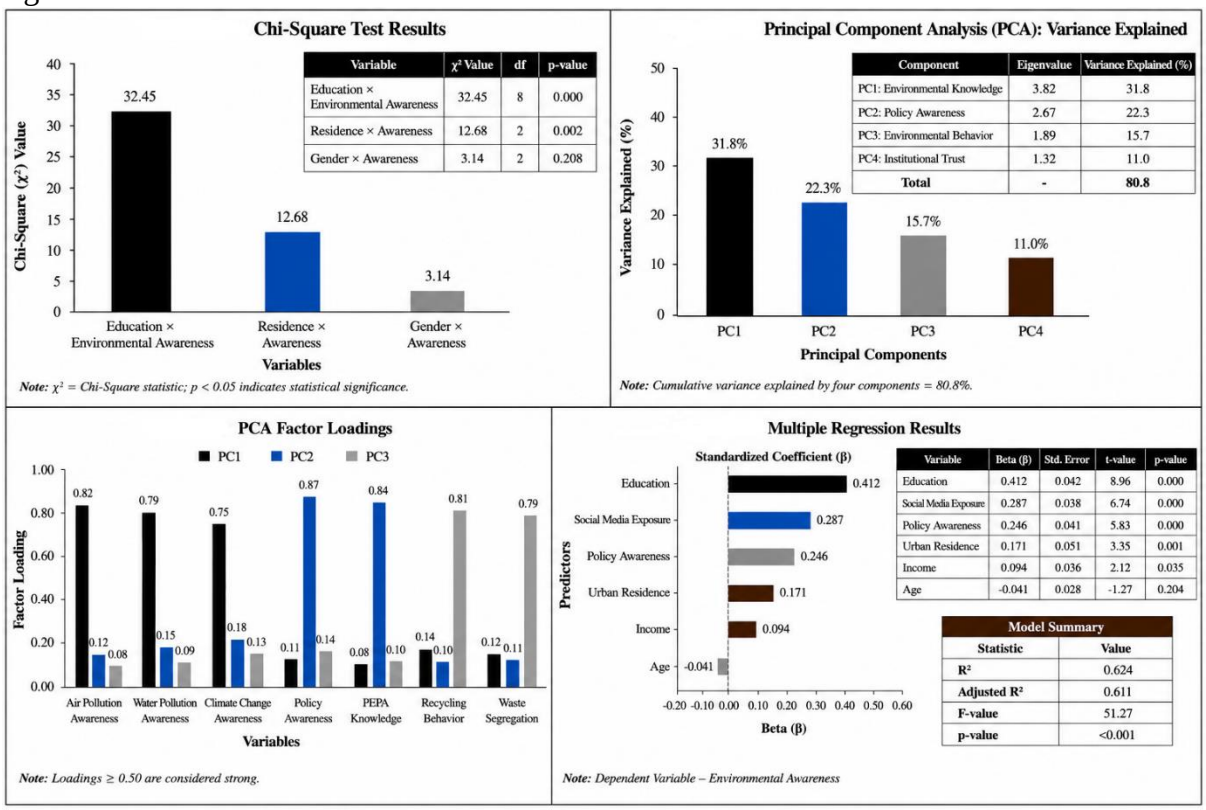


Figure 4: Chi-Square Analysis, Principal Component Analysis (PCA), and Regression Analysis

Environmental Governance, Awareness, Attitudes, Policy Effectiveness, and Determinants of Environmental Awareness in South Punjab

The findings gave an overall picture of the perception of environmental governance, environmental awareness, attitudes, effectiveness of policies and factors affecting environmental awareness among the respondents of South Punjab. The government is committed to protecting the environment was moderately affirmed by the respondents (Mean = 3.44). The mean scores for environmental laws implementation (2.81) and industrial compliance with environmental

laws (2.63) and citizen participation in environmental decisions (2.45) were relatively low, reflecting worries about the effectiveness of environmental governance and stakeholder engagement. The results showed that most of the respondents (52.0%) had moderate environmental awareness, 29.0% had high environmental awareness and 19.0% had low environmental awareness. This distribution implied that there was some knowledge of the environment in the population, but there was still considerable potential for improvement. The attitudes towards the environment were very positive. A large majority was the view that environmental protection is everybody's responsibility (89.0%) and that climate change is impacting South Punjab (82.3%). Moreover, 91.2% agreed that EE should be made compulsory, highlighting a high level of public support for EE and awareness-raising activities and campaigns.

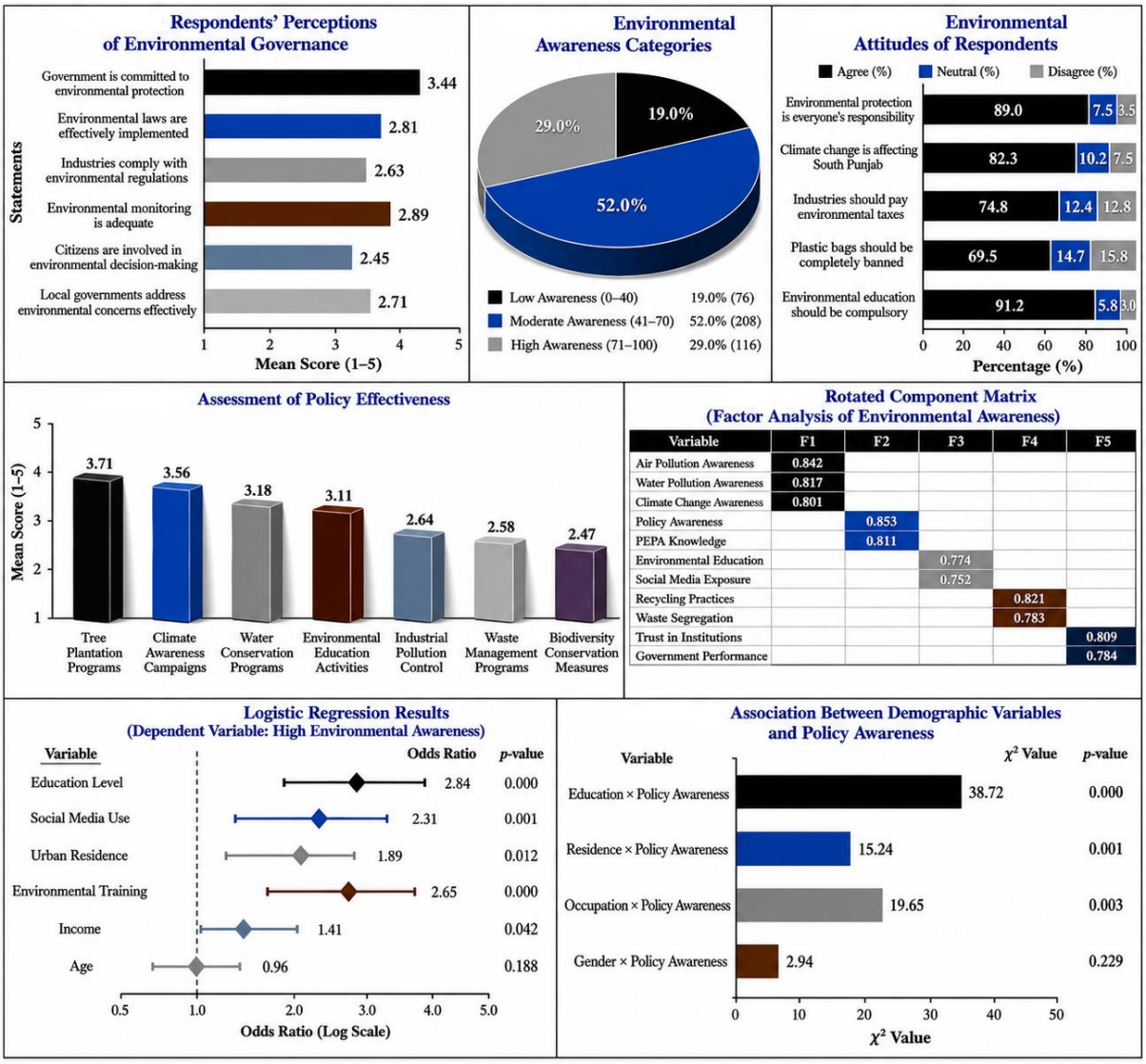


Figure 5: Environmental Governance, Awareness, Attitudes, Policy Effectiveness, and Determinants of Environmental Awareness in South Punjab

Tree plantation programs and climate awareness campaigns (Mean = 3.71 and 3.56, respectively) were rated as the most effective environmental policies. Contrary to that, the evaluations of biodiversity conservation measures, waste management programs and pollution control in industry were comparatively low (2.47, 2.58 and 2.64). Using the methodology of factor analysis, five dimensions of environmental awareness emerged: environmental knowledge, policy awareness, education and media exposure, environmental behavior, and institutional trust. The logistic regression showed that education level, environmental training, use of social media, urban living and income factors were significant factors in contributing to high environmental awareness, while age was not significantly related. Further, important relationships were found between education, place of residence, occupation and policy awareness, underscoring the influence that socioeconomic factors play on environmental knowledge and policy awareness for respondents.

Discussion

This study determined the awareness of environment and effectiveness of environmental policies implemented in South Punjab, Pakistan and also highlighted the challenges and opportunities for sustainable development. The results indicate that there is a moderate level of awareness about the major environmental problems (air pollution, water pollution, climate change and solid waste problems), but there are significant gaps in environmental legislation awareness, biodiversity protection and ecosystem services. These results are similar to the outcomes of earlier studies in Pakistan and developing nations that found that public awareness is limited to immediate environmental issues, and knowledge about environmental governance and policy is superficial (Salman and Wang, 2025). The demographic analysis showed that level of environmental awareness was significantly influenced by education. Higher education level was associated with higher level of knowledge of environmental problems and environmental protection measures. Regression analysis also showed that education was the most significant factor in predicting environmental awareness. Ahmad et al. (2023) reported the same results, stating that improving citizens' environmental knowledge and critical thinking skills, along with fostering pro-environmental attitudes, can be achieved through education. Knowledgeable people tend to have more sources for environmental information, to have a better understanding of policies, and to engage in environmental programs.

Another finding of the study was social media as an environmental information source among the respondents, especially for the younger generation. The rise of digital platforms has revolutionized environmental communication, enabling the swift and widespread dissemination of climate change-related information, pollution facts, conservation efforts, and environmental campaigns. The regression analysis results confirm that, as other recent studies have found, social media platforms have a positive link with environmental attitudes and intentions (Peiró-Signes, 2025). Social media can also pose challenges with respect to misinformation, and the importance of credible environmental communication strategies. Therefore, the use of digital platforms should be optimized for the governments and environmental organizations to share sound information about the environment and to engage citizens (Chen et al., 2023). Although the awareness rate was moderate, little adoption of environmentally responsible behaviors was found in the study, including recycling, waste segregation and engagement in conservation activities. However, past studies indicate that awareness may not always lead to behavioural change without the support of enabling infrastructure, economic incentives and institutional support (Benzehaf et al., 2025).

A key conclusion of this research is the lack of public knowledge about environmental policies and regulations. There was a significant portion of the respondents who did not know the major environmental policies like Pakistan Environmental Protection Act (PEPA) 1997, Punjab Environmental Protection Act 2012, National Climate Change Policy, and National Water Policy. Highlighting the gap in awareness of policies and programs is important, as citizens who are not aware of environmental rights and responsibilities are less likely to support environmental policies or hold institutions to account for implementing the policies (Mukhtar, 2023). The same issue of public awareness regarding the environmental laws has been cited by Syed et al (2024) that it poses a major problem in the environmental governance in Pakistan. The results also show that, in general, respondents rated environmental institutions as "moderately effective." Positive comments were received on the campaigns of awareness on climate change and tree plantation, mainly the ones related to massive afforestation campaigns. The results indicate that environmental interventions that are easily perceived can create public awareness and acceptance. Some of the afforestation initiatives, like the Ten Billion Tree Tsunami Programme, have garnered significant focus for their efforts in ecosystem restoration, carbon sequestration, and biodiversity conservation. Respondents were less satisfied with the waste management systems, industrial pollution control, and environmental regulations enforcement. These concerns show that there is still a lack of implementation of environmental policies, which is affecting their effectiveness (Idris, 2024).

A major hurdle in the realization of environmental policies in South Punjab was the lack of institutional strengths. The respondents and the key informants highlighted the following as being key challenges: lack of technical capacity, lack of staffing, lack of organizational efficiency and a lack of financial resources. Budget constraints are a common cause of challenge for environmental protection agencies in carrying out routine inspections, monitoring pollution levels and imposing environmental regulations. Other similar problems have also been reported in the governance literature, suggesting that the main requirement of policy implementation is the institutional capacity and resources for implementation, apart from the policy formulation (Syed et al., 2024). Environmental agencies are not well equipped to carry out their regulatory duties without proper resources and skills. Another major challenge indicated by the study was lack of financial resources. Environmental protection programs often come into conflict with other priorities for public action for limited resources. A lack of finances would hamper environmental programs and inhibit the ability of institutions to address new and evolving environmental hazards (Zahid and Khan, 2024). World Bank (2024) points out that the necessity to invest in environmental sustainability is crucial for ensuring the resilience of vulnerable areas like South Punjab to climate change and to drive sustainable future economic growth.

The public involvement was also identified as relatively low. Very few respondents mentioned that they participate in environmental decision-making processes or in conservation programs. Local communities need to be at the heart of efforts to achieve good environmental governance, as the environmental issues are often closely associated with the local behaviours and resource use practices (Abas et al., 2023). Community involvement helps to ensure that environmental policies are transparent, accountable, and accepted by the community. Previous research has shown the impressive effectiveness of community-based environmental management methods in enhancing conservation outcomes and the effectiveness of policy implementation (UNDP, 2024). In this regard, it is important to give importance to opportunities to involve citizens in the creation of policies and environmental institutions. According to the study, water scarcity is the most critical environmental problem in South Punjab. Water scarcity was perceived as more

important than air pollution, climate change and land degradation by the respondents. This is not unexpected, considering the agriculture-based economy of the region and growing demand for water. The water stress in the region has increased due to groundwater depletion, inefficient irrigation, population growth, and climate variability (Ali and Kamraju, 2024). Water scarcity has been identified as a serious issue and a challenge to socio-economic development of Pakistan in the National Water Policy (2018) and water resource management has been highlighted as an integrated approach. Therefore, there is a need for sustainable water management strategies such as using efficient water irrigation technologies, regulating groundwater usage, and implementing water conservation programs.

Air pollution was identified as environment's second most important issue. The sources of industrial emission, vehicles exhaust, burning of agricultural residue, brick kilns, and dust storms are also responsible for a significant amount of air pollution in South Punjab. Air pollution poses a significant threat to human health, causing various ailments such as respiratory diseases, cardiovascular disorders, and quality-of-life issues. A recent report of researchers has revealed increasing smog episodes in Punjab as a new environmental and public health challenge (Arshad et al., 2024). To tackle this problem, more robust air quality monitoring networks, more environmentally friendly production technologies and stricter emission limits must be implemented. Another key concern of respondents was climate change. Agricultural productivity and livelihoods of rural people are being increasingly impacted by rising temperatures, extended dry periods, abnormal weather conditions, and extreme weather events. Agriculture is the main source of income in South Punjab, and the region is especially vulnerable to climate-related hazards. The results corroborate the previous studies, which showed that climate change is increasing the vulnerabilities of the Pakistan's existing environment and socio-economic conditions (Kumari et al., 2026).

Conclusion

Conclusion and Recommendations Based on this study, the environmental awareness in South Punjab is moderate; however, there is a need for improving awareness of policies and sustainable environmental practices. Implementation of environmental policy is hampered by institutional capacity, limited resources, weak enforcement and low public participation. There is a need for more effective governance, improved environmental education, and joint action by government, communities and development actors in addressing key water-related challenges like water scarcity, pollution, and climate change. Community programs, universities and schools should all be places where environmental education is incorporated to raise public awareness. Policy enforcement, environmental monitoring and institutional capacity need to be improved by government agencies. Efforts in waste management, pollution control and water conservation infrastructure are crucial. Educating the public on the need for sustainable environmental management and development, as well as through community-based initiatives and public-private partnerships, should be encouraged.

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