

ENVIRONMENTAL STUDIES

Comparative Analysis of Qualitative and Quantitative Research Methods in Environmental Studies

Aruna Alasa, Oluwafunmilayo Loromeke Ojeo, Magnus Ojeifo

Ambrose Alli University, Ekpoma, Edo State, Nigeria

Published October 2026

Abstract

This paper presents a comparative analysis of quantitative and qualitative research methods within the context of environmental studies. The objectives of the study were to identify the types of qualitative and quantitative techniques used in environmental studies, examine qualitative and quantitative approaches to environmental research and examine the areas required for use in research. Data used were got from secondary sources such as books and articles in journals and the data collected were analyzed descriptively. The result of the comparative study shows that both types of research methods have their theoretical foundations, applications, strengths, and limitations. For qualitative method, two sets of measure that is, measure of central tendency and measure of dispersion were mainly the approach to solving statistical problems. Data collected using this approach were usually presented graphically and numerically. For quantitative approach is concerned mainly with measurement and expression of values of features in terms of quantity. This research type measures the properties of variables and makes precise measurement, determine trends or changes over time and compare trends on items. Inferential statistical methods such as correlation, regression, analysis of variance, chi-square and factor analysis are often used. In environmental studies, these research approaches are often used. However the type of research and the nature of data required determines the approach that is suitable for use. The study has recommended that both approaches are suitable and should be used in studies in environmental sciences.

Keywords: quantitative; qualitative; environmental; research methods

1 Introduction

Environmental studies is a field characterised by complexity and uncertainty. It has become one of the most critical interdisciplinary fields in the twenty-first century, addressing pressing global challenges such as climate change, biodiversity loss, sustainable resource management, and urban resilience. As environmental issues cut across ecological, social, cultural, and economic domains, the selection of appropriate research methodologies becomes central to producing knowledge that is both scientifically rigorous and socially relevant (Creswell & Plano Clark, 2018; Bryman, 2016).

The study of environmental phenomena demands a methodological approach that adequately captures both the measurable dimensions of ecological processes and the lived experiences of human communities embedded within these environments. In environmental studies, the complexity of interactions between natural systems, built environments, and human societies necessitates an ongoing dialogue between qualitative and quantitative research traditions (Creswell & Plano Clark, 2018; Bryman, 2016). While quantitative approaches emphasize measurement, prediction, and stat-

istical generalization, qualitative approaches privilege contextual understanding, depth of meaning, and the interpretation of human-environment interactions (Denzin & Lincoln, 2018).

The choice of research methodology plays a crucial role in shaping the outcomes and contributions of a study (Gamage, 2025). Historically, environmental research leaned heavily toward the natural sciences and quantitative methods, reflecting a positivist orientation that privileges measurement, prediction, and statistical generalization. However, the growing recognition of the social dimensions of environmental change such as power relations, cultural practices, values, and perceptions, has elevated the role of qualitative research. Scholars such as Bullard (2000) in environmental justice and Berkes (2018) in indigenous ecological knowledge have demonstrated that numbers alone cannot capture the meanings and politics of environmental issues.

Articles on the comparative analysis of qualitative and quantitative research methods in environmental studies discuss how these different approaches are used to understand environmental issues, with qualitative methods focusing on in-depth, non-numerical data to explore experiences and meanings, and quantitative methods employing numerical data to identify patterns, test relationships, and make predictions. Many environmental studies use mixed-methods approaches, combining qualitative interviews and observations with quantitative surveys and data analysis to gain a more comprehensive understanding of complex environmental phenomena.

1.1 Aim and objectives

The aim of this paper is to comparatively evaluate qualitative and quantitative research methods in environmental studies.

The objectives of this paper are to identify the types of qualitative and quantitative techniques used in environmental studies, examine qualitative and quantitative approaches to environmental research and examine the areas required for use in research.

2 Methods of study

The study adopted a desk review approach and relied basically on secondary sources of data. These include books, peer-reviewed journals and conference presentations and academic databases such as Scopus, Web of Science and other internet sources. A comparative analytical framework was used to evaluate the philosophical foundations, methods, strengths, limitations, and areas of applications of both methods.

3 Literature review

Quantitative and qualitative research methods have emerged as dominant paradigms, each offering distinct perspectives on environmental phenomena.

3.1 Qualitative methods of research

Qualitative research methods are defined as a set of investigative techniques used to explore and understand the depth and complexity of any phenomenon, relying on non-numerical data such as textual, visual, or verbal information. Qualitative research is rooted in interpretivism and constructivism, which assume that reality is socially constructed, context-specific, and understood through meanings rather than numerical measures (Lincoln & Guba, 1985). Qualitative research is concerned with feelings, ideas, or experiences. Qualitative research methods emphasize context-

specific knowledge, community experiences, and indigenous perspectives (Adger et al., 2013). The main goal of the data collection is finding insights that can result in testable hypotheses, which is frequently done in narrative form (Ugwu & Eze, 2023). Based on its definition, qualitative research is the study of the nature of phenomena, which includes their quality, different manifestations, the context in which they appear, or the perspectives from which they can be perceived, but excludes their range, frequency, and place in an objectively determined chain of cause and effect (Philipsen and Vernooij-Dassen, 2007). To better understand ideas, opinions, or experiences, qualitative research involves gathering and analyzing non-numerical data (such as text, video, or audio).

Qualitative approaches are particularly valuable in environmental research for exploring community perspectives, governance systems, and cultural dimensions of environmental issues. They also emphasize reflexivity and researcher positionality (Caggiano & Weber, 2023).

3.2 Approaches to qualitative methods of research

Qualitative research is used to comprehend how individuals perceive their surroundings with its numerous approaches sharing a tendency to be adaptable and focusing on preserving rich meaning when interpreting data (Ugwu & Eze, 2023). Grounded theory, ethnography, action research, phenomenological research, and narrative research are examples of common methodologies. Despite some similarities in these approaches, they emphasize various goals and viewpoints of Qualitative research (Bhandari, 2022). These approaches are vital in understanding how communities perceive risks, mobilise adaptation strategies, and negotiate conflicting values in environmental decision-making.

3.3 Methods of qualitative data collection

Qualitative research methods are designed in a manner that helps reveal the behavior and perception of a target audience with reference to a particular topic. The primary goal of qualitative data collection techniques is to gather textual data for research and analysis, such as thematic analysis. Qualitative research methods use primary data sources. There are different types of qualitative methods used to collect data, these methods include in-depth interviews, focus groups, ethnographic research, case study research, participant observation, and content analysis. Lim (2024) added archival method as one the methods of qualitative research. In qualitative research two sets of measure that is, measure of central tendency and measure of dispersion were mainly the approach to solving statistical problems. Data collected using this approach were usually presented graphically and numerically. The strength of this method of research is that it provides depth and captures meanings that statistics cannot. Its limitation is its generalisability and potential researcher Subjectivity (Denzin and Lincoln, 2018).

3.4 Quantitative methods of research

Quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques (Panda et al., 2025). Quantitative research is expressed in numbers and graphs and used to test or confirm theories and assumptions (Streefkerk, 2023). The objective of quantitative research is to develop and employ mathematical models, theories and hypothesis pertaining to phenomena.

Quantitative research is the dominant research framework in the environmental studies, grounded in positivism, the belief that reality is objective, measurable, and governed by universal laws (Creswell,

2014). This orientation underpins much of climate science, environmental epidemiology, and GIS-based land-use studies.

Grounded in Positivism, quantitative research enables researchers to isolate variables, establish causal relationships, and generate generalizable results. Quantitative research methods are essential because they provide a methodical way to look into and evaluate phenomena using numerical data (Zyoud et al., 2024).

Quantitative methods are frequently more appropriate when researchers want to quantify relationships between variables, test hypotheses, or make predictions based on numerical data (Zyoud et al., 2024). Quantitative research is conceptualized as emphasizing measurement, objectivity, and replicability, allowing for the detection of general patterns in environmental variables such as greenhouse gas emissions, deforestation rates.

Quantitative methods are widely used in environmental studies for modeling environmental processes, analyzing climate data, and measuring pollution levels. These methods allow researchers to generalize findings across large populations and predict future environmental trends (Emon, 2024).

Common approaches to quantitative research include survey research, experimental research, correlational research, and causal-comparative research (Apuke, 2017; Queirós et al., 2017; Taherdoost, 2014; Williams, 2007).

3.5 Methods of quantitative data collection

Quantitative research methods involve collecting and analyzing numerical data to identify patterns, averages, test hypotheses, and generalize results to wider populations. Common methods include surveys, experiments, structured observations, and longitudinal studies. Each method has its own strengths and limitations in terms of time, cost and quality of data. **Quantitative research use** mostly inferential statistical methods such as correlation, regression, analysis of variance, chi-square and factor analysis. The strength of the quantitative approach lies in its ability to measures the properties of variables and makes precise measurement, determine trends or changes over time and compare trends on items. Its limitation is inability to comprehend social cultural differences in data acquisition between and among different societies which affect and influence data collected.

Even with the limitation, studies of Alenkhe and Odudu (2019), Ayo-Odifiri et al. (2021), Ekhaese (2024), Dimuna and Olotuah (2020) and Morse and Niehaus (2016) have clearly shown that both methods are vital to attending to research problems in environmental studies.

4 Discussion

The analysis reveals a clear difference in approach to solving a research problem. Quantitative methods are best suited for measuring, modeling, and predicting environmental processes. Qualitative methods are essential for understanding the human dimensions: perception, culture, governance, and justice. For complex problems like urban flooding or climate adaptation, neither approach alone is sufficient. A regression model can explain 85% of variation in residential satisfaction using green space and noise levels, but only interviews can explain why residents value green space (Dimuna & Olotuah, 2020).

4.1 Comparative analysis of qualitative and quantitative methods

It is generally accepted that there is a difference between qualitative and quantitative research. Several literatures have demonstrated that the divide between qualitative and quantitative research is murky, inadequate, and hence of low use and that its popularity runs the risk of having unfavourable effects. Quantitative methods focus on numerical measurement and statistical analysis, while qualitative methods emphasize interpretation, context, and human experience.

4.2 Paradigmatic differences

The distinction between quantitative and qualitative methods extends beyond techniques to underlying assumptions about knowledge and reality. Quantitative approaches prioritize objectivity and measurement, while qualitative approaches emphasize subjectivity and meaning-making. However, recent scholarship argues that these paradigms are complementary rather than conflicting, and their integration can enhance research outcomes (Pilcher & Cortazzi, 2024).

5 Conclusion and recommendations

This paper has explored the fundamental differences between qualitative and quantitative methods research designs. This paper concludes that qualitative and quantitative research methods are foundational in evidence-based decision-making in environmental studies. Each of these approaches provides in-depth insights into the complexities of human behavior and experiences in solving complex problems. Qualitative approaches place more emphasis on understanding depth and richness than quantitative methods, which prioritize objectivity and generalizability.

Researchers must carefully consider the research problem and objectives when deciding which approach to use. Build confidence in both methods and embrace methodological pluralism. Mixed-methods studies that integrate scientific data with community voices to ensure policies are both effective and socially just should be funded and prioritize.

References

- [1] Adger WN, Barnett J, Brown K, Marshall N, O'Brien K (2013). Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change*, 3(2), 112–117. <https://doi.org/10.1038/nclimate1666>
- [2] Alenkhe OA, Odudu S (2019). Cultural dynamism and household sustainability in Benin City. *Port Harcourt Journal of History & Diplomatic Studies*, 6(2).
- [3] Apuke OD (2017). Quantitative research methods: A synopsis approach. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 6(10), 40–47.
- [4] Atedhor P, Odjugo P, Udiri A (2011). Changing rainfall and anthropogenic-induced flooding: Impacts and adaptation strategies in Benin City, Nigeria. *Journal of Geography and Regional Planning*, 4(1).
- [5] Ayo-Odifiri S, Alasa A, Emeana R, Fagbami A, Duruanyim H (2021). Assessment of urban sprawl in Benin metropolis, Nigeria. *International Journal of Research and Innovation in Applied Science (IJRIAS)*, 6(7).
- [6] Berkes F (2018). *Sacred ecology* (4th ed.). Routledge.
- [7] Bhandari P (2022). What is qualitative research? *Methods & examples*. Scribbr.
- [8] Bryman A (2006). Integrating quantitative and qualitative research: How is it done? *Qualitative Research*, 6(1), 97–113.
- [9] Bullard RD (2000). *Dumping in Dixie: Race, class, and environmental quality* (3rd ed.). Westview Press.
- [10] Caggiano H, Weber E (2023). Advances in qualitative methods in environmental research. *Annual Review of Environment and Resources*, 48, 793–811. <https://doi.org/10.1146/annurev-environ-112321-080106>

-
- [11] Cirella G, Iyalomhe F, Adekola P (2019). Determinants of flooding and strategies for mitigation: Two-year case study of Benin City. *Geosciences*.
- [12] Creswell JW (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). *Sage*.
- [13] Creswell JW, Creswell JD (2017). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). *Sage*.
- [14] Denzin NK, Lincoln YS (2018). The Sage handbook of qualitative research (5th ed.). *Sage*.
- [15] Dimuna KO, Olotuah AO (2020). Analysis of residents' satisfaction levels with housing and residential environment of six occupied housing estates in Benin City, Edo State, Nigeria. *Academic Journal of Interdisciplinary Studies*, 9(1).
- [16] Ekhaese EN (2024). Go-ahead element of domestic architecture: Socio-economic and cultural characteristics of the residents in Benin. *Journal of Civil Engineering and Architecture*.
- [17] Emon MMH (2024). Research approach: A comparative analysis of quantitative and qualitative methodologies in social science research. *Preprints*. <https://doi.org/10.20944/preprints202412.1128.v1>
- [18] Gamage A (2025). A comparative analysis of qualitative and mixed methods research: Strengths, limitations, and practical applications. *World Journal of Advanced Research and Reviews*, 25(3).
- [19] Greene JC (2007). Mixed methods in social inquiry. *Jossey-Bass*.
- [20] Lim W (2024). What is qualitative research? An overview and guidelines. *Australasian Marketing Journal*, 33(2).
- [21] Lincoln YS, Guba EG (1985). Naturalistic inquiry. *Sage*.
- [22] Moon K, Brewer TD, Januchowski-Hartley SR, Adams VM, Blackman DA (2019). A guide to qualitative research in ecology and conservation. *Biological Conservation*, 238, 108186.
- [23] Morse JM, Niehaus L (2016). Mixed method design: Principles and procedures. *Routledge*.
- [24] Panda S, Panigrahy S, Shah H, Mahapatra M (2025). A numerical study of the effect of the nose cone geometry on the performance of the centrifugal compressor in a micro-turbojet engine.
- [25] Philipsen H, Vernooij-Dassen M (2007). Qualitative research: Useful, indispensable and challenging. In: *Qualitative research: Practical methods for medical practice*.
- [26] Pilcher N, Cortazzi M (2024). Qualitative and quantitative methods and approaches across subject fields: Implications for research values, assumptions, and practices. *Quality & Quantity*, 58, 2357–2387. <https://doi.org/10.1007/s11135-023-01734-4>
- [27] Queirós A, Faria D, Almeida F (2017). Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*, 3(9), 369–387.
- [28] Streefkerk R (2023). Qualitative vs. quantitative research: Differences, examples and methods. Scribbr.
- [29] Taherdoost H (2014). Exploratory factor analysis: Concepts and theory. *Advances in Applied and Pure Mathematics*, 375–382.
- [30] Tashakkori A, Teddlie C (2010). Sage handbook of mixed methods in social & behavioral research (2nd ed.). *Sage*.
- [31] Ugwu CN, Eze VHU (2023). Qualitative research. *IDOSR Journal of Computer and Applied Sciences*, 8(1).
- [32] Williams C (2007). Research methods. *Journal of Business & Economics Research*, 5(3).
- [33] Zyoud M, Bsharat T, Dweikat K (2024). Quantitative research methods: Maximizing benefits, addressing limitations, and advancing methodological frontiers. *ISRG Journal of Multidisciplinary Studies*.