



A Scale to Measure Performance Effectiveness of Biodiversity Management at Grama Panchayats in Kerala

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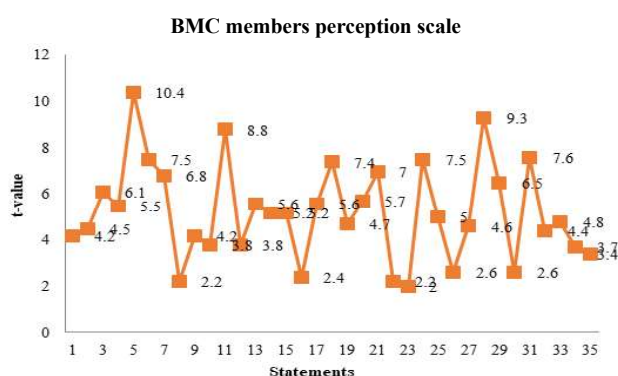
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HIGHLIGHTS

- The study innovatively identified and structured five dimensions for assessing biodiversity management performance at Grama Panchayats.
- Through a robust validation process including relevancy tests and item analysis using 't' values, the research ensured the scale's reliability and validity
- The developed scale will also offers potential applicability in other regions facing similar challenges.

GRAPHICAL ABSTRACT



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ABSTRACT

Context: The Western Ghats region is an intrinsic part of Kerala's biodiversity, characterized by year-round greenery and an abundance of evergreen forests. The favorable climate, soil conditions, and physical factors have contributed to the state's biological richness.

Objective: Against this backdrop, a study was conducted to develop a scale for measuring the performance effectiveness of biodiversity management at Grama Panchayats in Kerala.

Methods: Five dimensions were identified based on a literature review and expert opinion, facilitating easy classification and measurement of the performance effectiveness of the Biodiversity Management Committee (BMC). These dimensions include conservation, sustainable use of biodiversity and access and benefit sharing (ABS), documentation, biodiversity education awareness.

Results and discussion: A total of 120 statements were gathered under the five dimensions of the performance effectiveness of BMC. Those items that secured a relevancy score of 80 and above were selected. Out of 120 statements 54 consistent statements were selected through the relevancy test. Out of these, 35 statements were chosen for the final scale, based on 't' value of more than 1.76. The correlation of the reliability coefficient ($r = 0.907$) was significant at the 0.05 level of probability. The reliability and validity of the scale indicate the consistency and precision of the results.

Significance: The scale was found to be reliable and valid, providing a valuable tool for measuring the performance effectiveness of the Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala.

Kerala is often referred to as "God's Own Country" due to its lush and ecologically diverse landscapes, rich cultural heritage, and unique ecosystems. Kerala's biodiversity is unrivaled, encompassing a wide range of ecosystems, from the Western Ghats mountain range with its dense tropical rainforests and diverse wildlife to its intricate network of rivers, backwaters, and coastal regions teeming with unique flora and fauna. The state is home to a multitude of species, some of which are endemic and found nowhere else on Earth. These ecosystems provide vital ecosystem services, such as clean air, fresh water, pollination, and climate regulation, which are essential for human survival and well-being.

However, despite its picturesque scenery, Kerala faces unprecedented challenges due to human activities and climate change, posing a threat to its complex web of ecosystems. Therefore, biodiversity conservation in Kerala is of paramount importance, not only for the state but also for the entire planet.

The Biological Diversity Act (2002) and rules (2004) heralded a pivotal moment in India's approach to preserving, overseeing, and ensuring the just and equitable distribution of biological resources and related knowledge. These legal measures also serve to fulfill India's commitments as a party to the Convention on Biological Diversity (CBD), emphasizing its dedication to biodiversity conservation and responsible resource management (GOI, 2013).

The National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), and Biodiversity Management Committees (BMCs) are the operational arms for the Biodiversity Act and its associated rules at the national, state, and local levels. As per Section 41 of the Biodiversity Act 2002, Section 22 Sub Division (1)-(11) of the Central Biological Diversity Rule 2004, and Section 20 Sub Section (1)-(17) of the Kerala Biological Diversity Rule 2008, all Local Self-Government Institutions are mandated to constitute BMCs within their area of jurisdiction. This is crucial for implementing the Biodiversity Act and ensuring effective management of biodiversity at the local level (GOK, 2023).

The Biological Diversity Act has given local bodies the authority to promote conservation, sustainable use, and documentation of biological diversity. This includes the preservation of habitats, land races, folk varieties, cultivars, domesticated stocks, breeds of animals and micro-organisms, and the recording of knowledge

related to biological diversity. The BMCs play a pivotal role in this process by preparing, maintaining, and validating the People's Biodiversity Register (PBR) in consultation with the local community. Furthermore, the BMCs keep a register that contains information about the details of biological resources and traditional knowledge available within their jurisdiction. It is essential to note that the BMCs have an important responsibility to ensure the protection of our natural resources and the promotion of sustainable practices (KSBB, 2023).

It is important to note that civic heads who are the heads of Panchayat often have a plethora of day-to-day activities to attend to within their local bodies, leaving minimal time for the functioning of the BMCs. Additionally, there may be instances where the agendas of biodiversity conservation and development clash, causing the conservation agenda to take a back seat compared to the development agenda of local bodies. It is critical to find a balance between these two agendas and ensure that both are given equal consideration in the decision-making process.

Therefore, the development of a scale for analyzing the performance effectiveness of biodiversity management at the Gram Panchayat level in Kerala is of utmost importance. Using this scale as a valuable tool for comparing and researching agricultural extension is in line with established methods (Likert, 1932; Edmondson, 2005; Singh, 2019; Zala and Kalsariya, 2022). It is anticipated that the outcome of this study will contribute significantly to the enhancement of the duties and responsibilities of BMCs, thereby promoting more efficient and effective management of biodiversity.

METHODOLOGY

Collection of items : The first step in developing a scale is the collection of a number of statements/items, that delineate the dimension of performance effectiveness of biodiversity management. Based on the review of relevant literature, consulting with Scientists, and discussion with experts in Kerala State Biodiversity Board (KSBB), the following five dimensions were identified for easy classification and measuring the Performance effectiveness of BMC at Gram Panchayat level in Kerala namely: conservation, sustainable use of biodiversity & Access And Benefit Sharing (ABS), documentation, biodiversity education awareness and capacity



Fig. 1. Study area map

building and administrative and advisory function. The primary purpose of this section is to discuss the construction of a scale that measures the Performance effectiveness of BMC at Gram Panchayat level in Kerala (Latitude: 10° 00' N Longitude: 76° 25' E). A suitable well-structured pre-tested interview schedule was prepared and administered to the respondent groups. The scale development process involved two crucial stages: i.e., statements or items generation and item analysis.

Collection and editing of items: The statements were edited following the criteria suggested by Edwards (1957). Statements that were vague, overlapping, ambiguous and irrelevant were eliminated. All possible statements that discriminated the positive and negative performance effectiveness of BMCs were collected and included in the scale. A total of 120 statements under the above five dimensions of the performance effectiveness of Biodiversity Management Committee (BMC) were collected covering the almost entire universe of content. The scientists from Kerala Agricultural University, experts in Kerala State Biodiversity Board (KSBB), and the scientists from M S Swaminathan Research Foundation, Wayanad were also consulted for the selection of the statements under five dimensions.

Preliminary screening of the items by relevancy rating: The Performa containing 120 statements under 5 dimensions rated on a five-point continuum i.e., highly relevant, relevant, undecided, less relevant and not relevant with scores 5,4,3,2, and 1 respectively was sent through email and handed over personally to 60 judges. The judges were experts in the field of biodiversity conservation. The judges were asked to express their feedback or responses by putting a tick

mark on the appropriate continuum for each item. The judges were also requested to make required adjustments, necessary modifications, and additions or deletions if they desired so. Out of 60 judges, 40 responded within a period of one month. The scores from all the judges were added together for each item, and a relevancy test was worked out using the given formula (Kumar and Ratnakar, 2016)

$$\text{Relevancy Test} = \frac{\text{Total scores obtained on each item}}{\text{Maximum possible score}} \times 100$$

Items with a relevance score of 80 and above were chosen for inclusion. Out of the initial pool of 120 statements, a final set of 54 statements was selected. This selection process was guided by judges' ratings across five dimensions. The 54 statements selected after the relevancy test were then administrated to 50 non-sample respondents and the responses were collected in a span of one month.

Calculation of 't' Value (Item analysis) : BMC members were asked to respond to each statement in terms of their agreement or disagreement on a five-point continuum, Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA), and Strongly Disagree (SD) with scores 5, 4, 3, 2 and 1. The scoring procedure was reversed for negative statements. On receiving the responses, the respondents were arranged in descending order & ascending order based on the sum of the scores obtained for all the statements by each BMC member. The top 25 per cent of the respondents with their total individual scores were considered as high group and bottom 25 per cent as the low group, so that these two groups provided criterion groups in terms of evaluating the individual statements. The middle 50 per cent of the respondents were deleted for further analysis. The top 25 per cent were considered as high group and bottom 25 per cent were considered as low group to calculate the critical ratio i.e., 't' value for each statement (Rajesh and Smitha, 2023). The calculated 't' value for each statement was measured the extent to which the statement differentiates between the respondents of high group and low group. The response of the high and low groups of each statement were then analysed by working out 't-values' with the help of the following formula (Edward, 1957) followed by Kadian (2004), Deshmukh (2016), Sharma *et al.* (2021), Pordhiya *et al.* (2022), Patel and Sharma (2022), Chandran *et al.* (2023) and Meethal and Thomas (2024).

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum[X_H - \bar{X}_H]^2 + \sum[X_L - \bar{X}_L]^2}{n(n-1)}}$$

Where,

\bar{X}_H = The mean score on a given statement for the high group

\bar{X}_L = The mean score on a given statement for the low group

$\sum X_H^2$ = Sum of squares of the individual score on a given statement for high group

$\sum X_L^2$ = Sum of squares of the individual score on a given statement for low group

$\sum X_H$ = Summation of scores on a given statement for high group

$\sum X_L$ = Summation of scores on a given statement for low group

N = Number of respondents for in each group

\sum = Summation

The scale's reliability and validity were assessed through standardization. Reliability in this context means that the scale consistently yields consistent results when used by the same individuals on different occasions or with different sets of questions. To evaluate reliability, the split-half method was employed. This involved dividing the scale into two parts: one with odd-numbered statements (e.g., 1, 3, 5, 7, etc.) and the other with even-numbered statements (e.g., 2, 4, 6, 8, etc.). The reliability coefficient (R.C) was calculated using the Spearman-Brown formula based on the responses received (Srinivas *et al.*, 2018).

$$RC \text{ of test} = \frac{2 \times R.C \text{ of the half test, found experimentally}}{1 + R.C \text{ of the half test, found experimentally}}$$

RESULTS

In this section, the study's findings are organized into subsections, including a relevancy test, the t-value associated with the statements, the scale's standardization process, and the administration of the scale. From the 120 statements, total of 54 statements were selected through relevancy test, there by relevant items were retained based on judges rating under the five dimensions. After computing 't' values for all 54 statements, the statements with 't' values more than 1.76 were selected for the final scale. Thus, out of 54 statements, 35 statements with 't' value more than 1.76 were selected in the scale. The correlation of the

reliability coefficient (r = 0.907) was significant at 0.05 level of probability.

Standardization of the scale: It is imperative for a scale to accurately and consistently measure its intended construct, and as such, standardization is crucial prior to its implementation. To this end, the current scale was subjected to rigorous testing to ensure its reliability and validity.

Testing the Reliability of the Scale: The reliability of a scale is determined by its ability to consistently produce the same results when applied to the same sample. To assess the reliability of the current scale, a Co-efficient of reliability was calculated between its two halves. The correlation of reliability coefficient for both sets was also worked out, with a significant correlation coefficient (r = 0.907) at a 0.05 level of probability indicating that the scale was highly suitable for administration to BMC members due to its stability and dependability in measurement. The positive and significant correlation between the two sets of scores further highlights the high reliability of the test.

Testing the validity of the scale: Content validity is the representative or sampling adequacy of the content, the substance, the matter, and the topics of a measuring instrument. This method was used in the present scale to determine the content validity of the scale. The validity of the scale on the performance effectiveness of Biodiversity Management Committee (BMC) was obtained through content validity by taking the judge's opinion. The statements selected for the scale were evaluated individually and as a whole by the judges. The content of the scale was borne out by the method of collecting statements within the universe under the five dimensions of performance effectiveness of the Biodiversity Management Committee (BMC) viz., Conservation, Sustainable use of biodiversity & Access and Benefit Sharing (ABS), Documentation, Biodiversity education, awareness and capacity building, Administrative and advisory function influencing the BMC members, it may reasonably be assumed that the scale of performance effectiveness of Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala has content validity.

Administration of the scale: The final scale of each respondent can be calculated by summing the scores obtained on all the items. The obtained score on this scale ranges from 35 to 175. The higher score indicates that respondents had high levels of performance effectiveness and vice-versa. The final scale to measure the performance effectiveness of the Biodiversity Management Committee (BMC) comprised 35 statements under five dimensions viz.,

Table 1. Selected items with t values for the final draft of performance effectiveness of the Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala (Significant at 1% level)

S.N. Statements	t-value
1 At the grass root level BMC of the Panchayat act as environmental watch group.	4.2
2 BMC is not involved in the conservation of habitats, landraces, folk varieties and domesticated stocks and breeds of animals and microorganisms	4.5
3 Ex situ conservation of biodiversity in theme-based biodiversity gardens is not done by BMC	6.1
4 BMC respects and takes efforts to protect traditional knowledge of local communities related to biodiversity	5.5
5 BMC proactively deals with matters concerning environmental degradation, loss of biodiversity and habitat in their respective jurisdiction	10.4
6 BMC takes up and support studies on exploration of biodiversity-rich areas of the panchayat	7.5
7 BMC fails to manage heritage sites including heritage trees, animals, etc., sacred groves and sacred water bodies	6.8
8 BMC assists Kerala State Biodiversity Board (KSBB) with regard to providing approval to agencies for the commercial utilization of bioresources	2.2
9 BMC mobilises local communities to sustainably manage and utilize local biodiversity for their livelihood enhancement	4.2
10 BMC systematically maintains a register for the bioresources accessed from the locality, details of the collection fee imposed, and details about the benefits received and how they will be shared	3.8
11 BMC does not bother to collect fees from people accessing the biological resource for commercial purposes from their territorial jurisdiction	8.8
12 Timely public interventions of BMC ensures reporting of unauthorized entry of agencies involved in commercial utilization of bioresources	3.8
13 Bioresources are being taken outside the area of jurisdiction without the knowledge of the BMC and no action is being taken in this regard	5.6
14 Unauthorized utilization of bioresources is never getting reported to the BMC by the general public	5.2
15 Documentation of landraces, Folk varieties and cultivars are carried out by BMC	5.2
16 Documentation of domesticated stocks and breeds of animals and microorganisms is not carried out systematically by BMC	2.4
17 Documentation of traditional knowledge associated with biological diversity of the locality are being systematically carried out by BMC	5.6
18 Works related to electronic People's Biodiversity Register (e-PBR) is not initiated yet	7.4
19 Though PBR has been prepared it is not systematically updated	4.7
20 Interview with elderly persons and group discussion of local people has been undertaken in the preparation of PBR	5.7
21 BMC has taken the initiative to develop a database of biodiversity by means of e- PBR	7
22 BMC fail to promotes informal biodiversity education through biodiversity clubs	2.2
23 BMC organizes programmes with people participation to ensure that the water bodies in the panchayat remain in their natural conditions and ensure their sustainable conservation.	2.0
24 Awareness campaigns and environmental education programmes are organized for students in the panchayat	7.5
25 BMC members attend workshops on PBR preparation conducted by KSBB without fail	5.0
26 BMC hardly organize any seminars, discussions etc. in the panchayat due to the busy schedule of BMC office bearers	2.6
27 BMC takes initiative to create awareness about biological resources that are present in the locality, their ecological and economic importance and the need to protect them	4.6
28 BMC fails to create awareness among commercial users of biological resources and associated traditional knowledge for the effective implementation of ABS mechanisms	9.3
29 BMC is consulted by NBA and KSBB while granting approvals for obtaining biological resources and associated knowledge	6.5
30 BMC prepares annual reports and accounts and timely submit it to KSBB	2.6
31 BMC constitutes a minimum of 4 meeting in a year, and meet once at least in every 3 months.	7.6
32 Biodiversity related matters only stands second to infrastructure and related development agenda of the panchayat	4.4
33 Complaints reported to BMC regarding biodiversity related issues are normally responded at a slower pace	4.8
34 Regularity of meetings by BMC cannot be ensured due to busy work schedule of its office bearers	3.7
35 BMC seeks timely technical assistance from KSBB	3.4

conservation, sustainable use of biodiversity and Access and Benefit Sharing (ABS), documentation, biodiversity education awareness and capacity building and administrative and advisory function of which 19 positive statements and 16 negative statements measured on a five-point continuum viz., Strongly Agree (SA), Agree (A), Un decided (UD), Disagree (DA) and Strongly Disagree (SDA) with 5, 4, 3, 2 and 1 for positive statements and vice-versa for negative statements.

DISCUSSION

The selection of 35 statements from an initial pool of 120, guided by relevancy tests and t-value analysis, helped focus the scale on the most critical aspects of BMC performance. The reliability coefficient ($r = 0.907$) emphasizes the scale's ability to produce consistent results across different administrations, reinforcing its suitability for use among BMC members. This high reliability shows that the tool can be trusted for repeated evaluations.

The scale's content validity, established through expert judgment, underscores its relevance to BMC functions in Kerala's Grama Panchayats. By capturing five key dimensions of performance effectiveness, the scale addresses the broad and complex nature of biodiversity management, including both conservation efforts and the socio-economic aspect of Access and Benefit Sharing (ABS). Furthermore, the inclusion of both positive and negative statements adds balance to the instrument, ensuring that respondents' tendencies to agree with statements (acquiescence bias) are mitigated. The use of a five-point scale allows for nuanced responses, enabling more accurate assessments of BMC performance.

The final scale provides a comprehensive, reliable, and valid measure for evaluating the effectiveness of BMCs, which is critical for guiding improvements in biodiversity management and sustainable practices at the local level.

CONCLUSION

The final scale was developed and standardized here to measure the performance effectiveness of Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala, again checked by experts in extension division of KAU and Kerala State Biodiversity Board (KSBB) and experts from MS Swaminathan Research foundation, Wayanad for

their relevance and coverage. The final scale for the study consists of 35 statements under five dimensions viz., conservation, sustainable use of biodiversity and Access and Benefit Sharing (ABS), documentation, biodiversity education awareness and capacity building, and administrative and advisory function to measure performance effectiveness of Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala of which 19 positive statements and 16 negative statements measured on a five-point continuum viz., Strongly Agree (SA), Agree (A), Un decided (UD), Disagree (DA) and Strongly Disagree (SDA) with 5, 4, 3, 2 and 1 for positive statements and vice-versa for negative statements. The scale developed to measure the level of performance effectiveness of the Biodiversity Management Committee (BMC) at Grama Panchayats in Kerala was found to have high reliability and validity. The scale is not location-specific and can be used in any geographical area with slight modification. Furthermore, the results of the study can be utilized to establish and standardize additional parallel scales. The data obtained could be replicated elsewhere to understand the concern level of performance effectiveness of BMC, which in turn will help formulate policy prescriptions for alleviating the problems of BMC.

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Authors' contribution: The first author conceived the study, conducted data collection, collation, analysis, and interpretation, and contributed extensively to writing the manuscript. The second, third, and fourth authors contributed to the study's conception, data handling, and manuscript preparation, including revisions and editing.

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