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Perceived effectiveness of IWMP (Integrated watershed management programme) on NRM (Natural resource management) in Kerala

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Abstract
More than 60 per cent of India's population still reside in rural areas and depend on agriculture for livelihoods. Natural resources are the prime inputs for agriculture and allied activities. But ever increasing population pressure leads to land degradation which adversely affects resource productivity. In Kerala, 67 per cent of total geographic area has already been degraded mainly by soil erosion and soil acidity caused due to anthropogenic and natural factors (NBSS&LUP, 2014). To cope up with these situation, devolution of responsibilities for management of natural resources at the community level has been increasing over years at watersheds in rainfed tracts of the country. IWMP (Integrated Watershed Management Programme) is latest watershed programme initially launched by Government of India in 2009 and made as component of PMKSY (Pradhan Mantri Krishi Sinchayee Yojana) in 2015. With this background, present study was undertaken during the year 2021-2022 to analyze the effectiveness of IWMP in ensuring natural resource management (NRM) as perceived by 270 stakeholders in three micro-watersheds representing three geographics zones of Kerala. A composite index was developed by combining four dimensions namely bio-physical, socio-economic, institutional and sustainability to measure perceived effectiveness. Results implied that IWMP was effective in the three watersheds but in varying degrees. There were no much difference in pattern of responses for effectiveness as perceived by three types of stakeholders selected for study. Validity of the conceptual framework of perceived effectiveness index used for the study was confirmed by factor analysis. Bio-physical dimension had highest contribution towards effectiveness followed by socio-economic, institutional and sustainability dimensions.

Keywords: Perceived effectiveness, bio-physical dimension, socio-economic dimension, institutional dimension, sustainability dimension

Introduction
India is ranked 168th out of 180 countries in the Environmental Performance Index (EPI), 2020. The country needs to double the sustainability efforts with more focus on management of soil, air and water quality as well as biodiversity conservation (YU, 2020) [9]. This is a matter of serious concern as natural resources are basic inputs for agriculture which is primary occupation of more than half of the Indian population. Although human behaviour is the main driving force underlying many resource management concerns, it is not much recognized in the development of their management plans. Behavioural elements along with knowledge of natural assets play a major role in their management. For the past few decades, numerous efforts had been undertaken at international, national and regional levels for NRM. The nation had witnessed a paradigm shift in NRM strategies from individual farm based to the participatory mode. Participatory approach was evolved by restructuring the power relations between state and communities by the transfer of management authority to local level organizations.

Community based natural resource management through watersheds made a landmark in this approach. This provided a holistic approach for natural assets conservation and livelihood enhancement of rural population (Singh, 2017) [8]. The Common Property Resource Rights (CPRs) were incorporated for sustainability of developed resources, but the socio-economic issues and conflicts among stakeholders were limiting factors. The trend is not different in Kerala where IWMP is the recent watershed programme implemented in rain fed tracts. It is a centrally sponsored scheme under the Ministry of Land Resources, Department of Rural Development, Government of India. This is funded by central and state government in the proportion of 90:10.

Kerala has been implementing IWMP mainly through Department of Rural development. The ultimate objective of the IWMP is rural livelihood enhancement and is determined by evaluation of outcomes. The main highlight of the programme is provision of agricultural inputs and livestock units at subsidized rate of 5-20 per cent of total cost. Three phases of IWMP are preparatory, work and consolidation phases. The major components of IWMP are entry point activities (EPAs), natural resource management (NRM), production system and livelihood. For all components except livelihood, a beneficiary contribution of 10 per cent were collected to carry out the concerned activities. At the same time, only 5 per cent of beneficiary contribution was collected for creation of public assets. A watershed committee under Panchayati Raj Institution (PRI) is entrusted to implement project in watershed. Subsequent to approval of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), IWMP was subsumed as one of its components during 2015. As per the operational guidelines of PMKSY, IWMP is now being implemented as Watershed Development Component of PMKSY (WDC-PMKSY). In this backdrop, the study was indended to analyse the perceived effectiveness of IWMP in ensuring natural resource management by different stakeholders.

Methodology

The study was conducted in Kerala state. The sampling design adopted was stratified two stage random sampling. From the three geographic zones of Kerala *i.e.*, Northern, Central and Southern, Kasaragod, Thrissur and Pathanamthitta districts were selected respectively. Based on preliminary survey in above districts, a list of micro-watersheds was prepared where Integrated Watershed Management Programme (IWMP) was implemented during the period 2010-11 to 2017-18. From this list, one micro watershed from each district was selected randomly. The micro watersheds selected were Mundyanam (Parappa block), Allanchery padam-Kallan thodu (Kodakara block), Mamoodu (Ranni block) from Kasaragod, Thrissur and Pathanamthitta districts respectively. Project beneficiaries of the three watersheds and other stakeholders comprising of implementing officers and watershed committee (WC) members constituted the sampling frame. A sample of 50 project beneficiaries of NRM component each were selected randomly from project register maintained in respective block *panchayath* of three watersheds. Another sample of 40 other stakeholders, including 30 WC members and 10 implementing officers each were selected randomly from same project register. Thus a total of 150 project beneficiaries and 120 other stakeholders together formed sampling frame of 270 respondents or stakeholders.

Perceived effectiveness is operationalized as the combined effect of bio-physical, socio-economic, institutional and sustainability outcomes of watershed on natural resource management in project areas as perceived by different stakeholders. A composite index was developed to measure this construct and following steps had been adopted.

- Identification and operationalization of dimensions
- Item selection and scrutiny
- Validity measurement
- Reliability measurement
- Construction of composite index

Identification and operationalization of dimensions

The dimensions of construct were selected as per the guidelines provided by Ministry of Rural Development for assessing the effectiveness of watershed on natural resource management (GOI, 2015) [4]. The dimensions selected were operationalized as follow

Bio-physical dimension

This was operationalized as the changes in the bio-physical properties of soil and water resources in watershed area due to project interventions. Improvement in these properties would lead to development of natural resources. These mainly include changes in water table, agricultural productivity and soil erosion.

Socio-economic dimension

It was defined as the changes in socio-economic status of watershed stakeholders as a result of implementation of the project. For self-sustainable growth, it is essential to determine the outcome of watershed management projects on social and economic aspects of stakeholders in addition to the technical aspects. These consists of changes in average monthly income, employment opportunities and women participation in project area.

Institutional dimension

It refers to the outcome attained in watershed programmes through involvement of various institutions. The main roles of institution were to provide technical support, marketing facility, fund allocation and capacity building related to project. Institutional linkage is considered as critical factor for success of watershed programme.

Sustainability dimension

This dimension was operationalized as indicators for sustainability of developed assets and structures of watershed area in long run. Self-sufficiency in food, fodder, soil, water resources *etc.* throughout the year and maintenance of structure were viewed as major sustainability indicators.

Item selection and scrutiny of items

Perceived effectiveness core module questionnaire consisted of four dimensions and respective statements based on operationalization which covered all aspects regarding effectiveness of watershed programme. Statements were edited by Edwards (1957) [3] criteria. In order to determine the relative position of stakeholders' score, the responses to each item were rated on a 5 point continuum of strongly agree, agree, neutral, disagree and strongly disagree with scores 5, 4, 3, 2 and 1 respectively for positive statements and reverse for negative statements. All items were combined into scale which could measure degree of perceived effectiveness consisting of 4 dimensions with 9 items each. Total value of the scale ranged from 36 to 180.

Validity measurement

The competence of the scale to measure perceived effectiveness was assured by performing content validity. All dimensions and items under them were selected after consultation with subject matter specialists and experts.

Reliability measurement

Reliability of a scale is a measure of consistency and dependency. In this study, Cronbach's alpha was employed to determine the reliability of scale and is a measure of internal consistency (Cronbach, 1951) [2]. A value of '0.83' was observed which indicated high reliability of the construct.

Construction of composite index

The perceived effectiveness index was computed by summation of scores of each dimension and was represented by the formula given below

$$\text{Perceived effectiveness index (PEI)} = \sum_{i=1}^{4} \frac{\text{PE dimensions}}{n} \times 100$$

$\sum_{i=1}^{4}$ PE dimensions = sum of scores for dimensions of perceived effectiveness

n = total number of dimensions *i.e.* 4

Further respondents were classified as low, medium and high based on quartile range of index scores. A semi-structured interview schedule, focus group interviews, questionnaire surveys and non participant observations were used for collecting data. Kruskal-Wallis test was employed to compare perceived effectiveness of stakeholders in three watersheds. Factor analysis by Principal Component method was undertaken to validate conceptual framework selected for constructing perceived effectiveness index. The Kendall's coefficient of concordance test was carried out to rank each dimension according to their contribution towards overall effectiveness index. MS Excel 2015 and IBM SPSS 23 were software used to perform statistical analysis in this study.

Results and Discussion

Perceived effectiveness of IWMP on NRM by different stakeholders

An analysis of perceived effectiveness by means of an index with four dimension namely bio-physical, socio-economic, institutional and sustainability are depicted in Table 1.

Table 1: Status of perceived effectiveness index among stakeholders

Perceived effectiveness index	Beneficiaries (n=150)		WC members (n=90)		Implementing officers (n=30)		Total (N=270)	
	F	%	F	%	F	%	F	%
Low (<Q1)	36.00	24.00	6	6.67	5	16.67	47.00	17.41
Medium (Q1-Q3)	86.00	57.33	53	58.89	17	56.67	156.00	57.78
High (>Q3)	28.00	18.67	31	34.44	8	26.66	67.00	24.81
Q1=48.75, Q3=78.06								

It could be observed from the Table 1. that around 57.78 per cent of respondents were with medium perceived effectiveness index, followed by 24.81 per cent with high and 17.41 per cent with low index scores. This implied that IWMP was effective in three watersheds as more than 75 per cent of respondents were in medium and high category. This was in turn a reflection of effectiveness attained in four dimensions. It was noticed from table that there were not much difference in pattern for the responses from three types of stakeholders and they concisely opined regarding effectiveness. Majority of beneficiaries (57.33%), WC members (58.89%) and implementing officers (56.67%) were in medium category. Low category consisted of 24 per cent of beneficiaries, 6.67 per cent of WC members and 16.67 per cent of implementing officers. High category comprised of 34.44 per cent of WC members, followed by 26.66 per cent of implementing officers and 18.67 per cent of beneficiaries. The findings were in line with that of Chourasia *et al.* (2017) [1] and Palsaniya *et al.* (2012) [6].

Comparison of perceived effectiveness of IWMP stakeholders in three watersheds by Krukal-Wallis test

Perceived effectiveness index scores of respondents in three watersheds were compared by subjecting to Kruskal-Wallis test and results are presented below

Table 2: Kruskal-Wallis test statistic for comparison of three watersheds for perceived effectiveness of IWMP on NRM by stakeholders

Total N	270
Test statistic	44.01
d.f	2
Asymptotic Significance	<.001

Table 3: Pair-wise comparison of three watersheds for perceived effectiveness of IWMP on NRM by stakeholders

Watershed	Test statistic	Std. Error	Std. test statistic	Sig.	Adj. Sig.
Mundyanum and Allencherry	-40.450	11.639	-3.475	<.005	<.005
Allanchery Padam-Kallan Thodu and Mamoodu	-36.733	11.639	-3.156	<.005	<.005
Mamoodu and Mundyanum	-77.183	11.639	-6.632	<.001	<.001

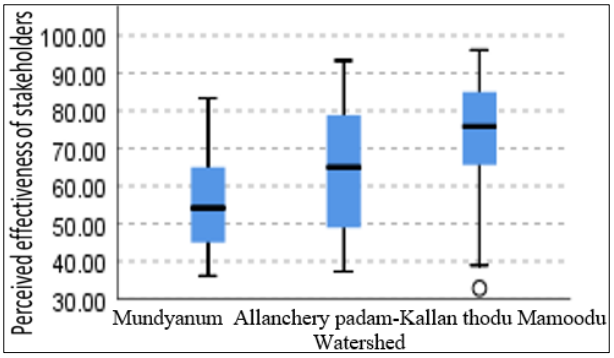

Fig 1: Box plot comparing perceived effectiveness of IWMP on NRM by stakeholders in three watersheds

Data presented in Table 2. had statistically proved that there was a significant difference between the perceived effectiveness index scores of three watersheds. A perusal of results from Table 3. showed that difference in the index scores existed between all three pairs of watershed stakeholders. It was evident from Fig. 1. that an increasing trend was observed for index scores of stakeholders from Mundyanum to Allanchery padam-Kallan thodu to Mamoodu watersheds. Relatively high extent of participation of stakeholders and more physical and financial target

achievement in NRM component of IWMP in Mamoodu watershed might be possible reasons. Mamoodu watershed comprised of comparatively more number of progressive farmers with large land holdings and average household monthly income which motivated them to participate in IWMP interventions. Thus overall extent of participation of stakeholders was fairly high in Mamoodu as compared to others which was crucial factor of effectiveness of a participatory programme. Hence it was concluded from all these above analysis that IWMP was more effective in Mamoodu followed by Allanchery padam-Kallan thodu and Mundyanum in achieving natural resource management.

Validation of conceptual framework used for development of perceived effectiveness index

In the study, factor analysis was employed to validate conceptual framework used for construction of perceived effectiveness index and following results are obtained

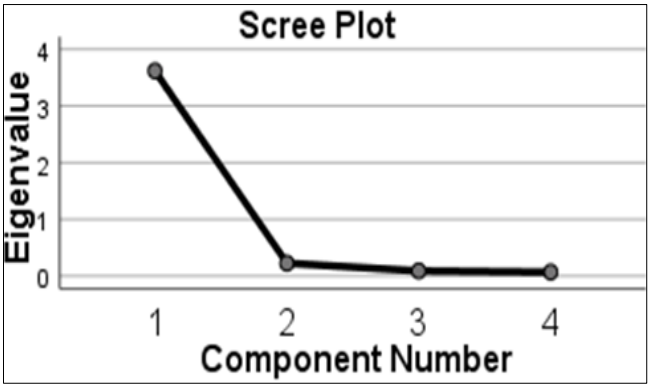

Fig 2: Factor scree plot of perceived effectiveness index of stakeholders

Table 4: Factor statistic of perceived effectiveness index of stakeholders

Factor	Eigen value	Variance	Cumulative variance	Components of factor extracted	Rotated factor loading
1	3.619	90.469	90.469	Bio-physical	0.940
				Socio-economic	0.962
				Institutional	0.963
				Sustainability	0.940

Scree plot in Fig 2. was exhibiting the components with their eigen values. The components with eigen value more than one and accounted for at least one per cent of total variance was selected as determining factors. As per the scree plot, one component satisfied above mentioned criteria and consisted of four dimensions of perceived effectiveness index. It was found from Table 4. that the single component extracted, accounted for 90.469 per cent of total variance, with eigen value of 3.619 and very high factor loadings. These inferences were clear indication of validity of the conceptual framework of perceived effectiveness index adopted for the study.

Contribution of dimensions towards perceived effectiveness index in three watersheds

Relative contribution of dimensions towards the effectiveness index in watersheds were determined by employing Kendall's coefficient of concordance test and the findings are given in Table 5.

Table 5: Kendall's Coefficient of Concordance test for dimensions of perceived effectiveness index

Kendall's Coefficient of Concordance		Dimension	Mean rank
Total N	270	Bio-physical	3.62
Kendall's W	0.878	Socio-economic	3.03
Test statistic(Chi-square)	710.897	Institutional	1.75
d.f	3	Sustainability	1.30
Asymptotic Significance	<.001		

It was revealed from Table 5. that there was a strong agreement among respondents of three watersheds to rate the dimensions in the order of bio-physical, followed by socio-economic, institutional and sustainability. This is due to the fact that NRM interventions of IWMP had direct effect on bio-physical dimensions such as reduction in soil erosion, increase in agricultural productivity *etc*. and were easily visible in short run when compared to others. This biophysical effectiveness would in turn leads to socio-economic, institutional and finally sustainability dimensions or effectiveness in long run. These were in accordance with findings of Reddy *et al.* (2012) [7].

Summary and conclusion

The critical analysis of findings of the study ascertained that more than fifty per cent (57.78%) of stakeholders opined medium effectiveness of IWMP on NRM in three watersheds and similar pattern were displayed by three categories of stakeholders. This inferred that IWMP was effective in accomplishing NRM in the three watersheds under study, whereas increasing trend was observed from Mundyanum to Allanchery padam-Kallan thodu to Mamoodu. This was mainly accounted for physical and financial target attainment in NRM component of IWMP in watersheds which was highest in Mamoodu followed by Allanchery padam-Kallan thodu and Mundyanum. Apart from these, Mamoodu had relatively more number of progressive farmers with large land holdings and average monthly income which inspired them to exhibit better participation in project interventions which resulted in effectiveness. Composite index developed for computing perceived effectiveness index was also validated. The bio-physical dimension or outcome had significant contribution towards the effectiveness in three watershed. These were outcomes easily visible to stakeholders in short

span of time and other outcomes or effectiveness dimensions were dependent on biophysical dimension. Findings of the study recommended for the implementation of these programmes in other deprived and rainfed tracts of Kerala for natural assets conservation which is critical for rural development. Efficiency of the programme could be improved by involvement of local leaders who are trusted by various stakeholders where former would encourage them to participate. For sustainability of the programme, regular monitoring and evaluation of weather parameters are also to be executed by concerned officials.

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