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Impact of Watershed Development Projects Implemented in Kerala

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ABSTRACT

In the present study we look into the impact of 12 different watershed projects implemented in Kerala under the Western Ghats Development Programme on the water availability and soil conservation. The impact of the watersheds was assessed by examining the benefits that each watershed offered to the sample respondents, people participation in watershed programmes at different stages, budget utilization and target achieved with the help of a semi-structured interview schedule. The data collected were analysed using cluster analysis and ANOVA. The results of the data differentiate 12 watersheds into two different clusters with 4 watersheds in one cluster and the remaining watersheds in another. The results of the study found that there is a significant difference in people's participation with respect to different stages of project execution in different watersheds and also within each watershed. The study also pinpoints difference in achieving target and budget utilization among different watersheds.

Keywords: *Cluster analysis; Western Ghats Development Programme; Budget utilization; People's participation; Kerala*

INTRODUCTION

Watershed is a logical and rational unit for taking up natural resources management, for studying man-environment interaction, economic planning, eco-restoration etc. The development of watersheds is a major strategy for the holistic development of rural areas (Chinnadurai et al, 2019) and an integrated approach about optimum exploitation of water, land and bio-resources in watersheds are necessary for the meaningful development of the watersheds (Mwangi et al, 2016). While planning for the development and management of the watershed, an integrated approach is the most desirable and sustainability should always be kept in mind. In order to achieve this, it is necessary to have a thorough knowledge of the present condition of the watershed, the physical features, resource potential, social

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and economic factors, dynamics of causes and effects and inter-relationships among different factors to make improvement in land use, vegetation pattern, and water and bio-resources of a watersheds (Wang et al, 2016). A beginning in this direction was made in the country by adopting Watershed Development Projects under different programmes launched by the Govt. of India (Department of land resources,2010). Government of India has accorded the highest priority to the holistic and sustainable development of rainfed areas, wastelands, drought prone areas, hilly areas and degraded areas through integrated watershed management approach. Most of the WSM (Watershed Management) programmes envisage sustainable institutional arrangements at the watershed level by involving local level institutions as an integral component of these projects for promoting the participation of civil societies and ensuring sustainability. Different Government agencies and NGOs are also involved in the implementation of these WSM programmes.

Under Western Ghats Development Programme, many watershed development projects were implemented in the States of Maharashtra, Karnataka, Kerala, Tamil Nadu and Goa on eco-preservation and eco-restoration lines (Western Ghats Development Programme, 2014). As much as eighty-eight percentage of the total cropped area in Kerala is rainfed (ENVIS Centre: Kerala State of Environment and Related Issues, 2019). Frequent occurrence of droughts and floods in Kerala resulted in wide fluctuations in crop production. The production from such areas can be stabilized or even improved by reducing runoff through soil conservation measures or by providing supplementary irrigation. The in-situ conservation and harvesting of runoff water will help to mitigate drought and moderate floods. The management practices that control runoff will also reduce the loss of fertile top soil. Thus, the scientific land, water and biomass management practices can bring about ecological stability in the watersheds.

The impact assessment based on improvement in land use and land change, soil erosion, biomass, ground water table, irrigation area etc, of watershed is crucial for replication of best strategies for future watershed management projects (Thakkar et al, 2017). Based on the benefits that each watershed offers to the sample respondents, people's participation in watershed programmes at different stages, budget utilization and target achievement, the present study evaluates 12 different watersheds implemented in Kerala under Western Ghats Development Programme.

METHODOLOGY

The list of watersheds, where the development programmes were implemented was collected from the Western Ghats Cell and those watersheds completed were sorted out. Since the Western Ghats Development Projects were implemented mostly in the High land (> 75 MSL) and in the Midland (7.5 to 75 MSL) regions of Kerala, the selection of watersheds was purposive. Accordingly, six watersheds each from the midland (two each from Southern midland, Central midland and Northern midland) and six watersheds from the Highland region were selected for detailed investigation. The watersheds selected are given in Table 1. The data were collected through various measures such as primary and secondary data collection, reconnaissance survey, field observations using random sampling technique.

Table 1 List of Watersheds involved in the Study

Watershed No.	Name of the Watershed (District)	Sample size
w1	Ottasekharamangalam (Thiruvananthapuram)	106
w2	Kattachal (Thiruvananthapuram)	60
w3	Mupliyam (Thrissur)	159
w4	Punchakuzhy (Ernakulam)	185
w5	Karuvannur (Kozhikode)	306
w6	Orkkayam (Kannur)	209
w7	Eettichuvadu (Pathanamthitta)	129
w8	Payipra (Ernakulam)	258
w9	Edavanna (Malappuram)	276
w10	Peruthadi (Kasaragod)	83
w11	Mathaippara (Idukki)	161
w12	Panniyancode (Wayanad)	264

Stakeholders' participation at the time of planning a watershed programme is much needed to take decisions because the programme should be based on their needs (Bagdi and Kurothe, 2014). Active participation of people at every stage of watershed development programme i.e., planning, implementation, monitoring and evaluation is a must for effective development and sustenance of watershed activities. This also helps in building up of their capacity, sense of ownership and sense of responsibility. In order to assess the people's participation in all the 12 watersheds, measures such as Peoples Participation Index (PPI), community contribution to works/activities, participation in trainings/meetings etc. were studied and presented.

People's Participation can be measured using an interval scale having zero as its minimum to indicate no participation and an arbitrary maximum say 100 indicating maximum possible participation. Such a scale could be constructed by asking sample target beneficiaries of the programme concerned, a set of questions framed to measure participation. Each of the possible answer to a question should be assigned some arbitrary number ranging from 0 to 1 (indicating no participation and full participation). If there are more than 2 answers for a question the answers may be assigned numerical values separately. Each of a question could be assigned a weight showing its relative importance as a measure of participation. The sum of the weights assigned to all the questions should be 100 (Bocklisch et al, 2012) and thus the scale would assume values ranging from 0 to 100. Using this method, one could compute a score for each of the sample respondents and all the scores thus computed can be then added and divided by the number of sample respondents to compute mean (Mean) participation rate in the programme. The mean participation rate when expressed in percentage terms could be called as Peoples Participation Index.

The benefits of the watershed activities like increase in water level in the open wells (b1), reduction in peak surface runoff (b2), reduction in silt (b3), increase in soil moisture level (b4), improvement in soil fertility (b5), changes in land use (b6), increase in irrigation facility (b7), and increase in cropped area (b8) were considered to categorise and group the watersheds using Gap statistics method of K means clustering.

'K means clustering' is an iterative algorithm that tries to partition the dataset into k pre-defined distinct non-overlapping subgroups where in each data point (watershed) belongs to only one group (Raykov et al, 2016). After forming groups, the watershed inside a particular group is homogeneous with respect to the

characters under study, such that sum of the squared distance between the objects to centroid of cluster should be minimum and objects of different clusters should be dissimilar as possible (Naeem, 2018). Two-way Anova method was used to know the difference in level of participation among the respondents in different stages of watershed development and also among different watersheds (Siraw et al, 2018).

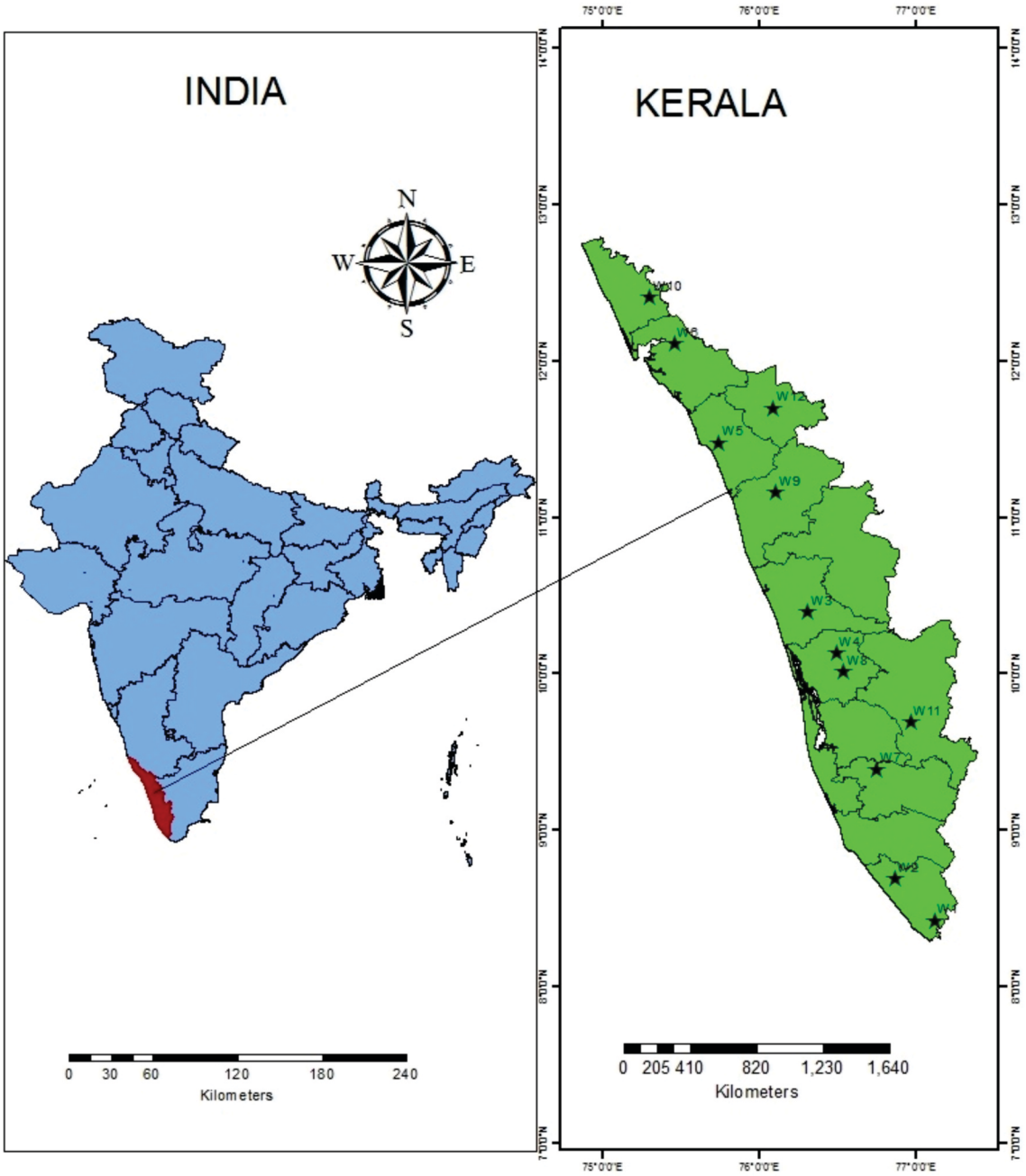

Figure 1 :Map of the study area.

FINDINGS AND DISCUSSION

To assess the improvement of watersheds, classification of watersheds was done using k means clustering considering different variable information with respect to technical, social and economic aspects. Out of the 12 watersheds considered for the study, 2 clusters are formed based on gap statistic method as per the figure 2A as the ratio of between sum of squares to the total sum of squares is more (75.2%), which indicates greater efficiency of clustering. Eight watersheds namely Ottasekharamangalam, Kattachal, Mupliam, Punchakuzhy, Karuvannur, Eettichuvad, Payipra, and Mathaippara formed one cluster and the remaining four watersheds like Orkkayam, Edavanna, Peruthadi, and Panniyancode formed the other as shown in Figure 2B, where mean percentage values of each cluster vary significantly for all the parameters as shown in Fig 2C. Furthermore, independent t-test value (-3.003*) also indicates a significant difference between the clusters about the considered parameters.

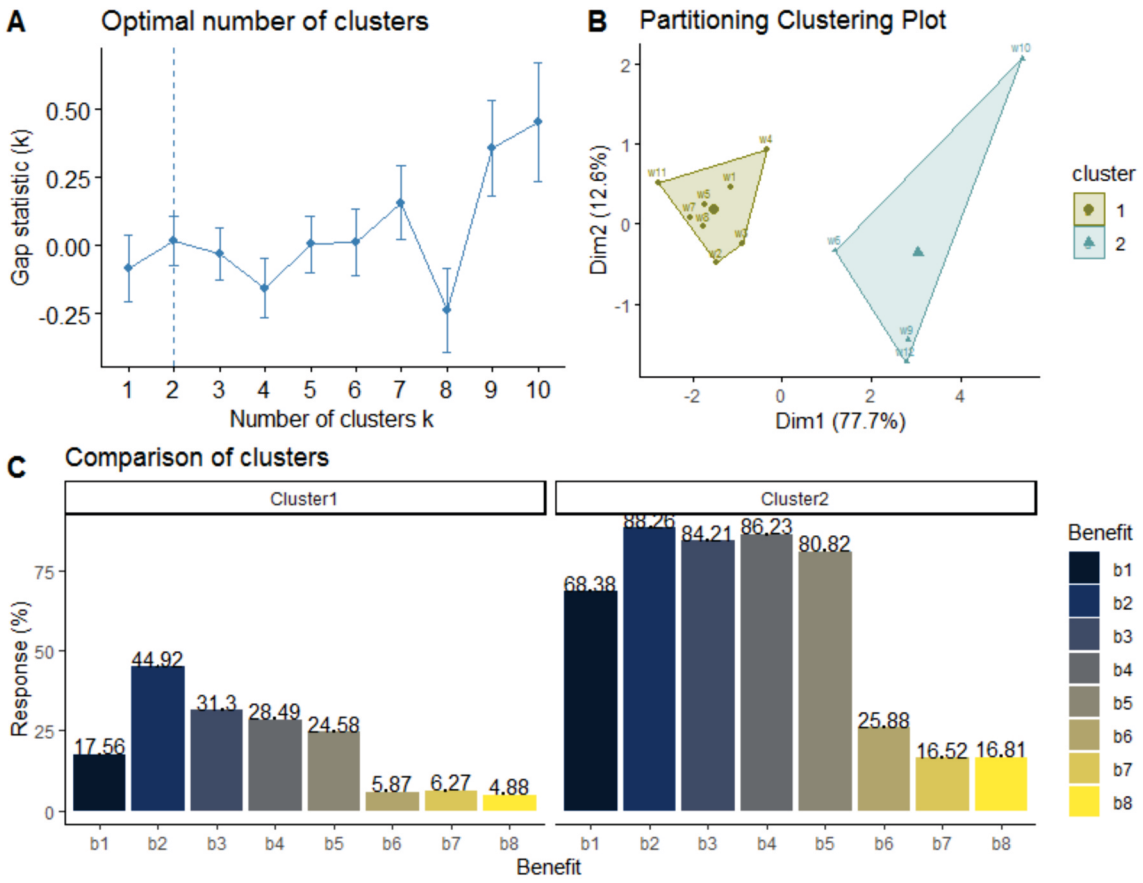

Figure 2: Classification of Watersheds using Cluster Analysis

It can be inferred from Fig 1 C that the benefits that the respondents received vary from cluster 1 to 2. Cluster 1 respondents i.e., those belong to Ottasekharamangalam, Kattachal, Mupliam, Punchakuzhy, Karuvannur, Eettichuvad, Payipra, and Mathaippara watersheds received less benefits with 44 percent noticed reduction in surface runoff (b2) as the major benefit that was found due to the interventions.

Cluster 2 respondents i.e., the respondents of Orkkayam, Edavanna, Peruthadi, and Panniyancode watersheds noticed a remarkable change in the reduction in surface runoff (b2), reduction in silt (b3), increase in soil moisture level (b4) and improvement in soil fertility (b5). More than 80 percent of the respondents agreed that the watershed activities helped in getting those benefits. Similarly, 68 per cent of the respondents of these watersheds noticed a visible increase in water level in the open wells (b1) due to the watershed interventions. Studies also found that the access to drinking water has improved because of water conservation measures implemented (Nagarajan et al, 2014)

Fig 3A indicates variation in each watershed with respect to different stages of project execution i.e., project planning (S1), project implementation (S2), project monitoring (S3) and project evaluation (S4).

The overall people's participation index revealed that the participation index ranges from 12-63%, which indicates greater variation in participation in different stages of project execution. Two-way analysis of variance with arc sign transformation was carried out by considering watershed and stages of execution as factors. The results of Fig 3A indicate that all the 12 watersheds (F-value=4.3, pvalue<0.01) were significantly different with respect to people's participation during different stages of project execution. The overall performance of watershed 12 (Panniyancode) during different stages of project execution were better compared to other watersheds. This may be due to the fact that people's participation was consistent in different stages of project execution. It is clear from the Fig 3A that watershed 10 (Peruthadi) is showing high response during project implementation stage but in other stages, people's response is very poor. Furthermore, it is clear that the people's participation was very low in Mathaippara (w11) followed by Punchakuzhy (w4). Vaithiyanath et al. (2018) in their study on Integrated Watershed Management Programme (IWMP) found that the participation of farmers in IWMP were at medium level followed by low and high.

Figure 3B indicates during different stages of project execution (F-value=10.62, pvalue<0.01), people participation is significantly different from one watershed to another. It is clear from the figure that all the watersheds performed very well in stage 1 of project execution i.e., project planning but as the project progressed the interest automatically came down. On the contrary, Peruthadi (w10) watershed had shown significant contribution in people's participation in project implementation stage compared to all other watersheds.

The mean performance of all the watersheds has taken a decreasing trend as the project stage proceeds as evident from the fig 3C. It may be due to the fact that the general tendency of an individual towards any new activity reduces as it proceeds. It is evident from the fig 3D that out of 12 watersheds, 11 watersheds (overall participation index rages from 12-39) indicates a low level of people participation during the process of project execution. However, in the Panniyancode watershed, the average people participation is 63 which indicates signs of better participation.

People's participation in watershed development projects can only be ensured through an effective institutional framework (Singh, 2017). In a few watersheds, especially where the NGOs were the PIA, proper care was given for organizational setup in implementing the programme (Eg. Panniyancode). Brahmagiri Development Society, an NGO which was the project implementing agency for Panniyancode watershed in Wayanad district had constituted several organizations from grass root level to watershed level for implementing the programme. The community organizers engaged by the PIA have developed constant contact with the inhabitants of the watersheds and hence they had achieved a high level of people's participation in the watershed development programme (Mondal et al, 2020).

The Figure 4A mentioned above revealed the budget utilization of all the watersheds and it could be seen that in the Panniyancode watershed, the entire amount was utilized completely. More than 90 per cent of fund utilization was noticed in Mupliyam, Punchakuzhy, Eettichuvad, and Mathaippara watersheds. Karuvannur and Peruthadi watersheds could utilize only less than 50% of the budget allocation as shown in fig 4B. Kimani (2014) found that where ever an NGO was involved in the project as PIA, there was a good progress in budget utilization as could be seen in the cases of Panniyancode, Orkayam, Mupliyam, Punchakuzhy, and Mathaippara. This may due to the fact that the team constituted at the beginning of the work will remain till completion and the NGO follows an involvement of all the stakeholders at the grass root level with frequent follow up

meetings about the programme monitoring. It was noticed during the field survey that the frequent transfer and posting of project implementation officers have adversely affected the progress of work (Eg. Peruthady). It could also be seen that there was no proper programme documentation, record/book keeping, accounting, and retrieval of the same in these watersheds. It was generally found that the allocation of project funds was done at the latter half of the financial year resulting in failure of timely execution of different interventions. Similar problems quoted by Subha et al. (2005) while implementation of Western Ghat Development Programme in Amachal Watershed in Kerala.

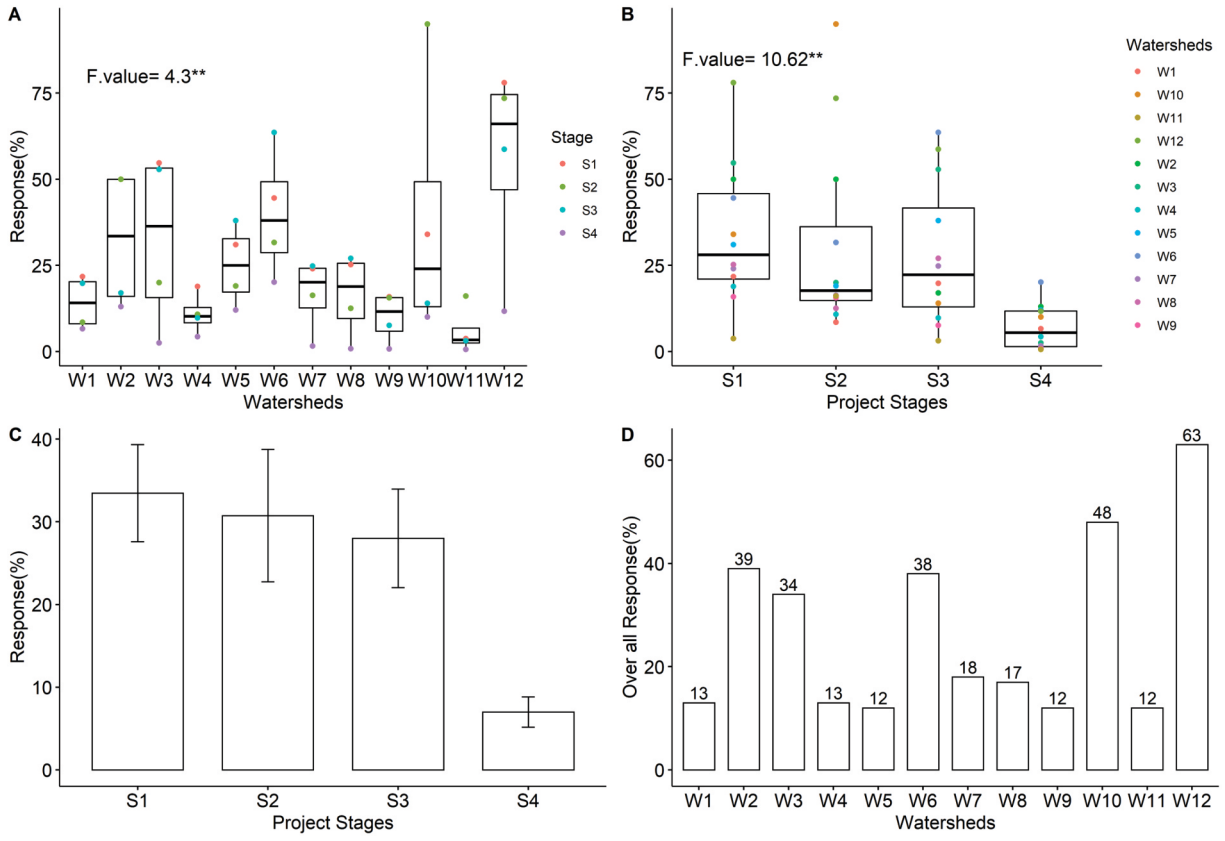

Figure 3: Comparison of People's Participation in Different Watersheds and Project Stages

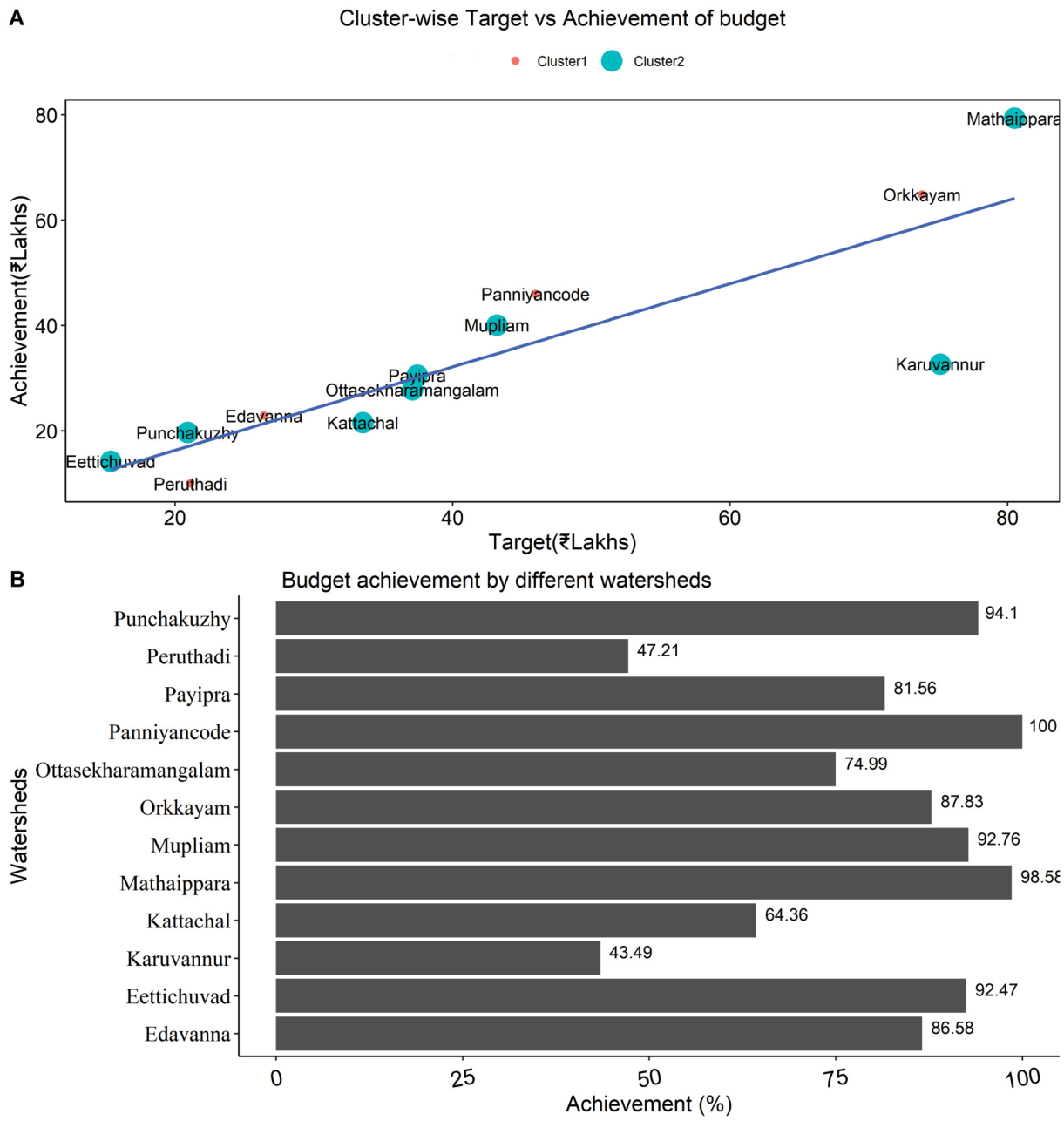

Figure 4: Budget utilization by Watershed development projects implemented under the Western Ghats Development Programme

CONCLUSION

As the topography of Kerala is highly undulating and all the watersheds under WGDP are located in midlands and highlands, the cost of implementation of different watersheds interventions will be much higher than the rated amount followed in other parts of the country. Due to the restrictions of the development fund to Rs 7500/- per ha, the implementation of the developmental activities was confined to a limited portion of the watershed and as a result the envisaged holistic, integrated development of the watershed could not be achieved.The entire watershed area has to be brought under the interventions to derive the envisaged benefits of the project. The scope of convergence with different departments/ schemes has to be fully explored. The results from the study revealed that the participation of people in different stages of project execution is limited. In order to increase participation of people, continued mass awareness on the benefits of different watershed activities should be ensured through various mass media channels. The State level Cell should be strengthened with adequate technical staff for effective planning and monitoring. As the study found that the frequent transfer of PIA's has adversely affected the progress of work (Eg. Peruthady), necessary Government orders may be issued to ensure that, officials involved in the project are retained in throughout the course of project execution. Measures should be taken by Government to eliminate procedural delay during the course of the project, so as to implement the work within the original scheduled timeframe.

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