ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 10, Issue, 06(C), pp. 32881-32885, Jun, 2019

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

FACTORS INFLUENCING SUSTAINABILITY OF INDO-GERMAN WATERSHED DEVELOPMENT PROGRAMME IN THE STATE OF MAHARASHTRA, INDIA

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DOI: http://dx.doi.org/10.24327/ijrsr.2019.1006.3560

ARTICLE INFO

Article History:
Received 4th March, 2019
Received in revised form 25th April, 2019
Accepted 18th May, 2019
Published online 28th Jun, 2019

Key Words:

Sustainable watershed; factors influencing watershed sustainability; social, economic and ecological indicators.

ABSTRACT

The new generation watershed development programmes in India have created remarkable impact on both environment and residents of the watershed. However, the studies in past have indicated that the sustainability of the benefits has been in question. A lack of research studies after substantial amount of time post project was also observed. Indo-German Watershed Development Project (IGWDP) in the state of Maharashtra, India was studied to find out the factors influencing sustainability of watershed development projects in India. From the sustainability study of 72 watersheds conducted by an organizationBAIF Development Research Foundation, 36 watersheds (from Phase-I and Phase-II of IGWDP) were assessed for social, economic and ecological sustainability using new sustainability framework. The key factors influencing sustainability of Indo-German Watershed Project included the social, institutional, management and maintenance mechanisms and capacities of institutions (Kakade, 2017). The other factors studied for sustainability included the size of watershed, age of watershed project post its completion, project implementing organization and the Agro climate zone in which watershed is located. The larger the size, more was the sustainability and higher the age, weaker was the sustainability. The reputed implementing organizations found to have positive influence on sustainability. Although a correlation was observed in sustainability fund created, used and managed by watershed committee and level of sustainability, but was statistically insignificant.

INTRODUCTION

Post-implementation of new generation watershed development programmes in India, i.e. the programmes after 1994 national watershed guidelines, European aided and programmes by NABARD (National Bank for Agriculture and Rural Development), several impact studies have been conducted by the research institutes. There has been notable impact of the projects and at the same time, there have been issues of sustainability of these impacts.

Impact of Watershed Development Programme in India

A study of six IWDP (Integrated Wasteland Development Programme) watersheds revealed that various mechanical and biological measures could reduce surface runoff by 58%. Soil losses from watersheds were reduced by 52% (Sharda, Samra and Dogra, 2005). An evaluation by the State Water Conservation Mission in Andhra Pradesh state of India showed that out of 2000 watersheds, water level rise was seen in 90% watersheds, despite a fall in the rainfall by about 28%. About 0.17 MHa of additional area was brought under cultivation. The out-migration of labour from the project areas was found to be declined by 10 to 40% (TARU, 2001). A cost-benefit analysis of eight watersheds located in different parts of Gujarat state was conducted by Development Support Centre (DSC). The study came out with higher Benefit Cost Ratio (BCR) figures in the range of 4.06 to 15.72 (Chaturvedi, 2005). ICRISAT's (International Crops Research Institute for the Semi-Arid Tropics) 'meta-analysis' of the 311 case studies of watershed programme found that the Benefit Cost Ratio (BCR) was around 2.14. About 15% of the watersheds studied had BCR >3. The mean Internal Rate of Return (IRR) was estimated at 22%. The maximum IRR was 94% and 35% of the watersheds had IRR >30% (Joshi, P.K , et.al., 2005). These results show that the investment in the watershed programme is justified, despite the fact that the watershed programmes were undertaken in the in the fragile and uncertain environments.

Watershed development is the most appropriate solution for development of the rainfed areas, especially the upland areas where there is very less scope for centralized water resource development and supply for irrigation. Recognizing its importance, both Central Government and State Governments have implemented watershed development programmes through various schemes over a period of past four to five

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decades. However, from longer term sustenance point of view, they experienced disappointing results due to adoption the technological approaches used in Sukhomajri, Ralegaon Siddhi, and Pani Panchayat, but none of them incorporated lessons related to institutional arrangements. They lacked collective actions to solve uneven cost and benefit issues but just relied on *Sarpanch* (village head) in the ICAR (Indian Council of Agricultural Research) watersheds or a trained technician in the NWDPRA (National Watershed Development Project for Rainfed Areas) and used inflexible technologies (Kerr, 2002). The long term impact has been threatened by the inadequate space for landless and inequity in the benefits of watersheds (Shrama, 2003). This the impact of watershed programmes across different geographies has been evident, but the sustainability of the ecosystem health and the benefits accrued through the developed watersheds is in question.

European bilateral agencies established major watershed initiatives in early 90s. These programmes tried to draw strengths of GO-NGO. Indo-German Programme in Maharashtra and the Indo-British in Karnataka, drew on some of the NGOs' approaches to promote benefit sharing, and they tried to implement on a large scale the associated institutional approaches. Later the common guidelines issued in 2008 were comprehensive building upon the past experiences. The watersheds implemented through comprehensive guidelines were expected to be more sustainable.

Watershed Sustainability

Sustainable Development can be envisioned as utopianism; a perfect society in which justice prevails, the people are perfectly content, the people live and flourish in harmony with nature and life moves along smoothly, without abuses and shortages (Jabareen, 2006). However, operationally feasible dimensions have been identified in various studies on sustainability. Catton (1986) cited by Ciegis*et.al.,* (2009) defines the sustainable development as "the improvement in the population's quality of life while taking into consideration the ecosystem's regenerating capacity that can be described as the maximal continuous load on the environment". A wider concept of sustainability provided by Radermacher (1997) include a) globalization, b) a long period of time, c) external effects, d) environmental policy and e) the approach "from cradle to grave". Human being is at the center-stage of this concept. "Sustainability literally means the ability to sustain, or a state that can be maintained at a certain level. The term has been used to express the state in which levels of harvest in agriculture, fishery and forestry are maintained within the capacity of the ecosystem, which is therefore recoverable. In that sense, sustainability means environmental sustainability; in other words, sustainability of the eco-system's function to provide us with food, fish and other products and services." (Kajikawa, 2008). A specific definition for agriculture sector is available from the Consultative Group on International Agricultural Research (CGIAR). While conceptualizing sustainable agriculture a Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) treated sustainability as a dynamic concept and defined, "Sustainable Agriculture should involve the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources" (TAC, CGIAR, 1991). The definition used in Brundtland commission's report 'Our Common Future' (1987) was a specific turning point from previous inclination of "growth or environment" towards complimenting each other –the "economic growth and environment". The concept emphasizes not only quantity but also the quality of economic growth and people's well-being (Ciegis, 2009).

The sustainability concept for watershed management by Vishnudas, *at. al.,* 2005 is "The management of watershed system with sustainable technological options, which may ensure the sustainability of land, agriculture and forestry or its combinations to conserve natural resources with adequate institutional and economic options".

Objective of the Study

The objective of the study is to find out the factors influencing sustainability of watershed development projects in India undertaking sustainability analysis of Indo-German Watershed Development Project in the state of Maharashtra, India.

About Indo-German Watershed Development Project (IGWDP), Maharashtra

Phase-I of Indo-German Watershed Development Project (IGWDP) Maharashtra was started in 1990-91 with the grant of INR 266.7 million for 26 projects and completed in 1999-2000. Total area treated through various soil and water conservation measures was 38,180 ha. Phase-II commenced in 1999-2000 with a grant support of INR 574.86 million. Total area treated in this phase was 64,255.77 ha through 69 projects. Phase-III was started in 2005-06 with the grant support of INR 1200.1 million, 110 projects were completed and area treated is 1,57,000 ha (NABARD, 2014).

Impact assessment study of IGWDP was conducted by AFPRO in 2008 of 10 watersheds selected from Western Ghats, Central Maharashtra and Marathwada regions of Maharashtra with stratified sampling of families in upper, middle and lower reaches of watershed. Physical impact was mainly in terms of reduced runoff and soil loss and increased water availability. Perennial wells increased from average two per watershed to 13 and seasonal wells from 46 to 68 post watershed. Area under rabi season was increased from 1.5 times to five times compared to pre watershed situation. Satellite images of pre-watershed and 2008 showed reduction of wasteland by minimum of 5.26 percent to maximum of 35.14 percent. Socio-Economic impact reported by AFPRO include increased cropping intensity, crop productivity rise of minimum of 37.2% in paddy and maximum of 118% in gram, and all other crops were in between this range. Reduction of non-descript cattle was 25.1% and rise in crossbreed cattle of 83.3% during post watershed period. The increase in buffaloes was 31% while goats were increased by 16%. Bullocks were also found more by 9.5%. No reverse trend was observed after withdrawal of Project Implementing Agencies (PIAs). A major shift in sources of income was observed post watershed and the trend continued after completion upto three to seven years. Share of agriculture increased from 60.1% to 78.1% (at completion of watershed development) and 80.6% (2008); share of livestock reduced from 30.7% to 13.3% and 10.5% and reduction in share of wages from 9.2% to 8.7% to 8.3%. A substantial shift or increase was observed in availing loans from banks and

credit societies. Compared to 14.5% before watershed, 58.2 % households had availed credit from banks, district cooperative societies and even private money lenders (AFPRO, 2008). There were two major institutions created in IGWDP, oneVillage Watershed Committees (VWC) and other SamyuktaMahilaSamitis (SMS), the women group federation. The state of affairs of these two institutions was found to be poor.

Experimental Section

Although an impact of IGWDP was found to be very good, it was important to know the sustenance of the benefits. BAIF Development Research Foundation (henceforth referred as BAIF) with the support of NABARD studied the IGWDP to find out the sustainability of the benefits, and plan for revitalisation of watershed projects if necessary. From the sustainability study of 72 watersheds conducted by BAIF, 36 watersheds (from Phase-I and Phase-II) were assessed for social, economic and ecological sustainability using new sustainability framework (Kakade, 2017).Project locations are superimposed on agro-climatic map of Maharashtra to know the coverage of agro-climatic zones. It is observed that five agro-climatic zones are covered out of total nine zones. Refer Location Map of study area in figure 1.

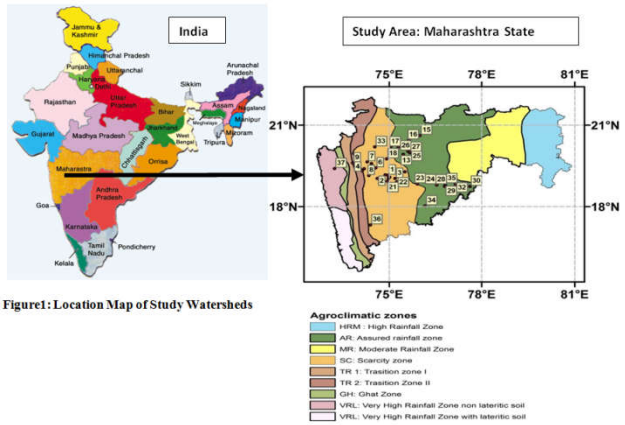

Figure1: Location Map of Study Watersheds

The indicators used for sustainability analysis are as given below:

***Social Indicators*:** Awareness of community and institutions about maintenance, Gender equity i.e. attendance of VWC meetings by women members, Reach of benefits across watershed area, Nature of deliberations in meetings and decision taken and conversion into action, Awareness (%) of VWC members about their roles and Role of VWC in water management, VWC's role in implementation of government schemes related to resource conservation, Maintenance system in place or not, % of the Present Maintenance Fund (MF) against originally created MF.

Economic Sustainability Indicator: There was only one proxy indicator, % area under irrigation against gross cropped area assuming 75% GCA (Gross Cropped Area) of total watershed area, which was used for assessment of economic sustainability.

Ecological Sustainability Indicators: The indicators and data used included, % of watershed area treated, % structures doesn't require desilting, % area under drip/sprinkler and rise or fall in ground water level, % change in vegetation cover (change as in the year 2018 against the status of vegetation in 2008 and all the projects were closed by then).

RESULTS AND DISCUSSION

The study of sustainability assessment using cluster analysis shown that out of 36 sample watersheds, seven watersheds (19.44%) were found to be sustainable mainly through strong social and ecological sustainability and medium level of economic sustainability. While about eight watersheds (22.24%) were found to be at a medium to low level of social and ecological sustainability but very poor in economic sustainability. Remaining 21 watersheds (58.33%) found to be strongest in terms of economic sustainability but weaker in ecological and poor in social sustainability. This group appears to have been exploiting the resources without regulations and maintenance. *The social parameters were found to be the dominant contributor towards sustainability* (Kakade, 2017).

Factors Influencing Sustainability

Watershed sustainability scores were derived from the cumulative standardized values of indicators and their respective weights derived from predictor importance analysis.

Social and Institutional factors

The key influencing factors were found to be social parameters. There were also the commonly observed initiatives by VWCs in the better performing watersheds including convergence of Govt. schemes for various development activities, protection of community lands, regulation and control on water use, introduction of water efficient technologies and control or ban on water intensive crops. This also shows the capacity of VWCs of these watersheds. The communication and coordination of VWC with other political and developmental agencies, Govt., departments also appears to be good. The other key factors influencing the sustainability are given below.

Age of Watershed Project

Cluster wise average age of watersheds as on 2015 has been worked out and presented in a graph as given in **figure 2** below. The age is considered as the number of years after completion of the project up to the year 2015.

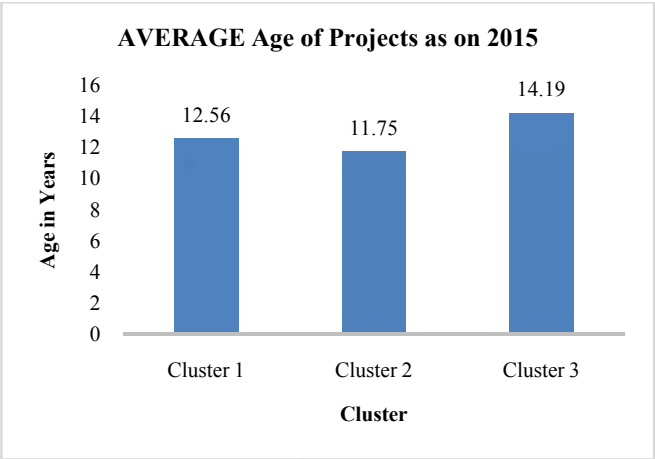

Figure 2 Average Age of Watersheds in respective clusters

Age of best performing cluster - cluster 2 is less than cluster 1 by 0.88 years and it is less by 2.44 years than cluster 3. Similarly the average age of medium performing cluster, i.e. cluster 1 is less than cluster 3 watersheds by1.63 years.

The ANOVA in respect to age indicate that there is no significant difference between cluster 1 and 2 (mean age difference = 0.94 years), and cluster 2 and 3 (mean age difference = 1.3 years) whereas there is significant difference between cluster 1 and 3 (mean age difference = 2.3 years). This indicate some influence of age of watersheds on sustainability. However, it needs to be validated further with a study over some more years say 5 to 10 years down the line.

Size of Watershed

Although all the watersheds of IGWDP were micro-watersheds, the size of each watershed was different as per the local geographical situations. The cluster-wise average geographical area of watersheds is given in figure 3.

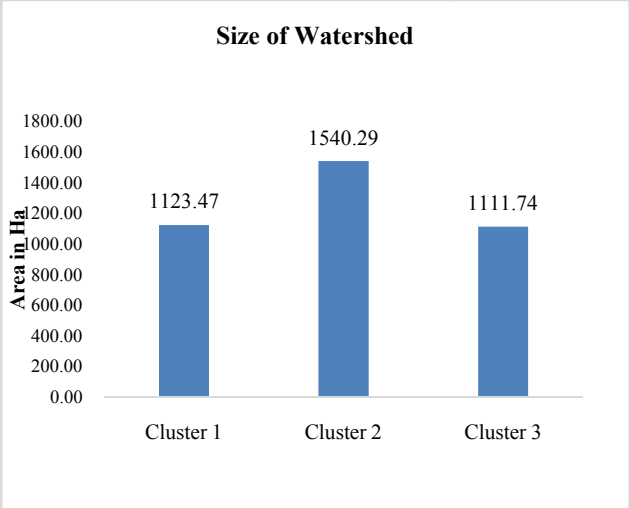

Figure 3 Size of Watersheds

The highest scoring watersheds in cluster 2 are bigger in geographical area. The lowest scoring watersheds of cluster 3 are relatively smaller in size compared to watersheds in cluster 1 and 2. Although Cluster 3 watersheds are economically better, due to smaller size, there is likely to be less availability of resources compared to cluster 2 watersheds.

ANOVA in respect to watershed area, there is a significant difference between cluster 2 and 3 (mean area difference = 428 Ha). No significant difference between cluster 1 and 2 and 1 and 3 (mean area difference = 416, 11 Ha respectively).Thus in addition to socially strong indicators, the size of watershed is directly proportional to sustainability.

Sustainability Fund (SF) Management

IGWDP projects had to create sustainability fund during the project implementation to the extent of about 16% of the cost of project measures. This fund was expected to be managed, used for repair and maintenance and also as a revolving fund for any developmental initiatives in the watershed. Figure 4 shows the status of SF in the watersheds. The figure shows the amount of SF at the end of project completion, the amount of SF used after project period for maintenance of water conservation measures, the amount used as revolving fund and the balance of the SF at the time of study during the period 2015 to 2017.

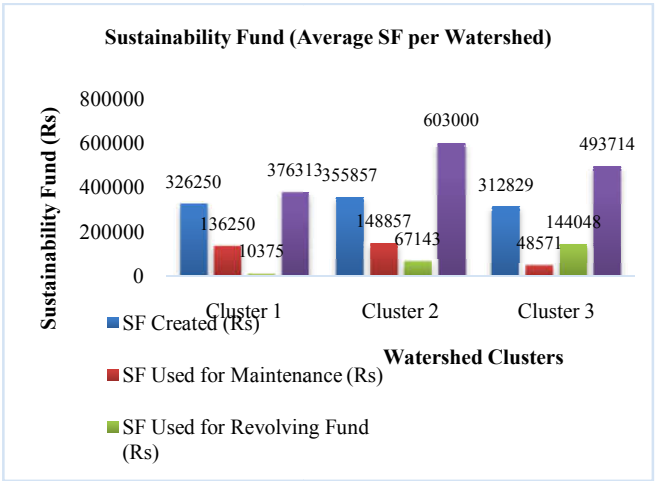

Figure 4 Status of Sustainability Fund in the watersheds

The higher ranked watersheds in cluster 2 had created highest level of sustainability fund. It is important to note that the VWCs of these watersheds had used the highest amount of fund for undertaking the repair and maintenance works post-project, which is likely to have ensured continued benefits of these measures to the community. These watersheds also had higher amount of balance with them (VWCs). That means these VWCs could invest and manage the funds very well. The second best group of watersheds in terms of sustainability scores in cluster 3 were also the second best in terms of creation of SF as well as using SF for repair and maintenance. Cluster 3 appears to have focused more on economic activities as these watersheds are highest in using SF as revolving fund and generating higher returns. This shows direct correlation of higher sustainability scores with higher amount of SF along with its use for repair and maintenance. However, ANOVA shows no significant difference between any of the clusters, hence the influence of sustainability fund management on watershed sustainability appears to be insignificant.

Project Implementing Organisations

The organizations DilasaJanviskasPratishthan, BAIF and Watershed Organisation Trust (WOTR) were the RSOs (Resource Support Organizations) for IGWDP Maharashtra, appointed by NABARD based on the experience of these organisations in watershed development and their track record in rural development. They had played a role in training and facilitation of other project implementing agencies (PIAs). The watersheds implemented by these three organizations fall in cluster 2, which has highest scoring watersheds. This indicates that the implementing organization play an important role in developing the sustainable watersheds.

Location of the project

Regarding the relation of geographical factor and sustainability, there appears to be a commonality among the higher performing watersheds. All cluster 2 watersheds are located in the districts of Aurangabad, Ahmednagar and Beed, which are drought-prone areas of Maharashtra and also fall in the scarcity areas of agro-climatic zones. This could be due to better management and maintenance of these watersheds by people who were sufferers of frequent droughts.

CONCLUSIONS

The dominant factors influencing sustainability of Indo-German Watershed Project include the 'Awareness of community and institutions about maintenance', 'Role of Village Watershed Committee (VWC) in water management', Attendance of VWC meetings by women members(Gender equity) , 'VWC's role in implementation of government schemes related to resource conservation' and 'Maintenance system in watershed'. The stronger the factor, more sustainable is the watershed. The sustainability of watershed found to be weakening over a period after certain years post project; which needs to be examined further to find out the threshold period of sustainability. The size of watershed found to be directly proportional to sustainability. Another important parameter is the sustainability fund. Sustainable watershed projects had higher amount of SF created, it was used for repair and maintenance of water conservation structures and it was better managed; however it appeared to be insignificant in terms of sustainability of watersheds. It is also evident that people in scarcity area had maintained and managed their watersheds better and hence found to be more sustainable compared to other Agro-climatic zones.

Acknowledgement

Sustainability study was undertaken by BAIF Development Research Foundation through the support of National Bank for agriculture and Rural Development (NABARD), Regional Office, Maharashtra, India. Author acknowledges both BAIF and NABARD and also the contributions by BAIF team for collecting the information, especially the efforts of Late Mr. BalwantThorat are deeply appreciated.

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How to cite this article:

Bharat Kakade., 2019, Factors Influencing sustainability of indo-German Watershed Development in the State of Maharashtra, India. *Int J Recent Sci Res.* 10(06), pp. 32881-32885. DOI: http://dx.doi.org/10.24327/ijrsr.2019.1006.3560

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