Policy Brief :
Does Watershed Development Enhance Productivity

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Introduction

Watershed development in India is among the most important rural development interventions of the country. It is the largest programme under the Dept. of Land Resources (DoLR) where the allocation exceeded 2500 cores in 2012. The demands for grants for 2013-2014 is 4848.30 crores.[1]

A fundamental premise of this programme is that management and restoration of watersheds will increase agricultural and overall biomass productivity. This, in turn, is expected to reduce rural poverty. The present Integrated Watershed Development Programme evolved from the Hanumantha Rao Committee report in 1994 (**?**). This committee made a number of ground breaking recommendations to re-structure a gamut of earlier programmes on water and land resources management. The committee emphasised work through Panchayati Raj Institutions and mandated the involvement of local communities in the implementation of these programmes. In contrast, earlier programmes had a more top down and engineering oriented approach.

However, a recent review of literature reveals that the present programmes have, perhaps, swung too far away from the engineering and technical needs of watershed restoration. Researchers have questioned the very design of the programme and found that it is inherently iniquitous (**?**), over designed in terms of institutional arrangements (**?**) and fail to address functional aspects of watershed restoration (**??**). Some authors have also questioned the performance of the programme itself and found it below par (**?**).

There is, however, little information about the performance of the various watershed development programmes in terms of biological productivity. This, however, became possible with the on-line availability of aggregated information on the watershed programmes, and freely available imageries at reasonable resolutions.

Our Study

We present below the findings of a study involving the comparison of productivities between watersheds which were treated[2] under a DoLR programme between the years 2006 and 2010. The analysis extended to test whether performance of these programmes was superior in some states as opposed to other, whether ecological regions or bio-geographical zones had an impact on the success of the programmes or whether different basins performed better than other.

Performance was measured in terms of biological productivity which is best captured using the Normal Difference Vegetation Index (NDVI)[3]. This index is derived from the red and near-infra red band of imageries

Based on the paper: Bhalla, R. S., K. V. Devi Prasad, and Neil W. Pelkey. 2013. "Impact of India's Watershed Development Programmes on Biomass Productivity." Water Resources Research: n/a–n/a. doi:10.1002/wrcr.20133.

[1] http://indiabudget.nic.in/ub2013-14/eb/sbe84.pdf

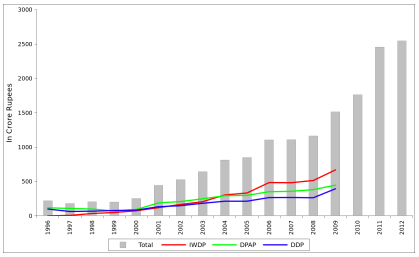

Figure 1: *Annual allocations to the various watershed development programmes in India since 1996.*

[2] Implying work had been completed in this period.

[3] $NDVI = (NIR - R)/(NIR + R)$

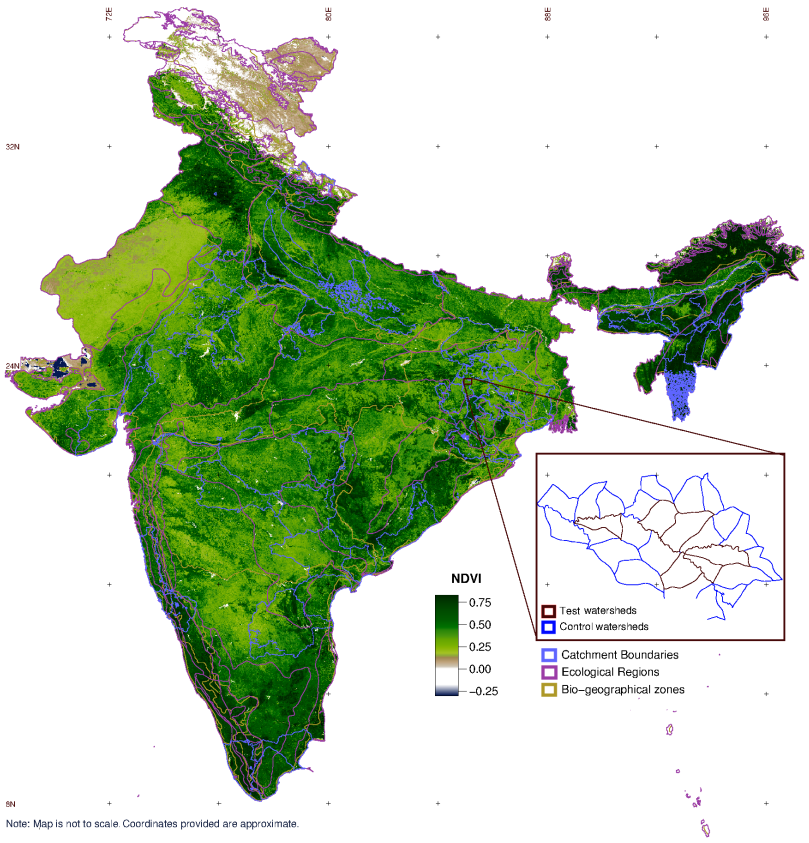

Figure 2: *Map of India showing the location of the different treated and untreated watersheds used for this study. Note the different regions which were analysed separately to test whether regional or climatic impacts influenced the results.*

and is used extensively in analysis of productivity and land cover change. We tested for a significant difference in NDVI values. Essentially if the NDVI before treating a micro-watershed were lower than after treatment, we would conclude that restoration had a positive impact. Using this logic we tested for three specific hypothesis. To ensure that the analysis covered seasonal variation, it was run separately for April (pre-monsoon), August (post-monsoon) and December (winter).

We ran this analysis for all the available records at the Watershed Programme Monitoring Information System (**?**) at the time. We then filtered out small micro-watersheds which would have given us less reliable results[4]. Finally we were left with 1,025 pre and post micro-watershed comparisons and 4,839 pairs of treated-untreated micro-watersheds[5].

Results

The results were counter-intuitive. There is no evidence that watershed development has resulted in an increase in productivities. These results held up for all the three hypothesis. In other words:

- The productivity of micro-watershed after watershed development is not significantly different that before it was taken up under the programme.
- There is no statistically significant difference in micro-watersheds which were treated under the programme and their neighbours which were not.
- There is no statistically significant difference between the productivities of pairs of watersheds (before and after treatment) whether they were developed under the programme or not.

The three hypothesis that were tested:

1. NDVI values for the treated watersheds should show a greater increase than untreated watersheds, or

   $\delta NDVI_{test} > \delta NDVI_{ctrl}$ where $\delta NDVI = NDVI_{post} - NDVI_{pre}$.

2. The NDVI values of treated watersheds should not differ from untreated watersheds before the treatment, but should be higher afterwards, or

   $NDVI_{test(pre)} \sim NDVI_{ctrl(pre)}$ but $NDVI_{test(post)} > NDVI_{ctrl(post)}$.

3. NDVI values of test should be higher post treatment, or

   $NDVI_{test(pre)} < NDVI_{test(post)}$

   but not so for the untreated watersheds, or

   $NDVI_{ctrl(pre)} \sim NDVI_{ctrl(post)}$.

[4] We were using satellite data where each pixel was 250 metres. Small watersheds (holding less than 30 pixels) would not have given us reliable results given the statistical tests we were conducting.

[5] The number is larger than the number of treated micro-watersheds because each micro-watershed could be the neighbour of more than one other untreated micro-watershed as shown in the figure.

Policy Implications

This study demonstrates that one of the largest rural development programmes in India has failed to deliver on a fundamental premise. The inability to differentiate between treated and untreated micro-watersheds in terms of biomass productivities is a sign of fundamental flaw in the manner in which the integrated watershed development programme is being implemented.

There is a long list of publications which have dissected the programme and its various facets. It is clear that this is a highly complex and ambitious project of the GoI with a large number of interacting components. This complexity has led to an over-designed implementation guideline which appears to have contributed to the failure of the programme.

Two and a half decades later, we continue to use minor modifications of the watershed guidelines of the Hanumantha Rao Committee. The various "revisions" have merely been a change in emphasis. Even though the guidelines profess to use modern technologies such as GIS and remote sensing, this is merely on paper. Selection criteria used for prioritising micro-watersheds are a contradictory mix of priorities even though it is eminently possible to identify areas with high water stress or regions which have the highest potential for restoration of ecosystem services.

It is time that a comprehensive and scientific review of the guidelines is undertaken. However rather than one single committee, it may be prudent to have experts from multiple disciplines roped in. Watershed development doesn't only need to deal with issues of rural poverty. There is compelling evidence that climate change is likely to trigger major changes in ecosystem services, it is therefore crucial that restoration of ecosystem function is treated as a separate component. Implementation mechanisms presently suggested are not capable to undertake interventions at scales presently required. Perhaps this is the correct time to split this programme into two streams, one looking at local and Panchayat or even hamlet scale interventions and the other at landscape level interventions targeting complete watersheds at landscape scales.