Comprehensive Assessment of Watershed Programs in India

Proceedings of the Inception Workshop
6–7 June 2006

International Crops Research Institute for the Semi-Arid Tropics

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Organizing Committee

SP Wani (Chair)	Prabhat Kumar (Co-chair)
TK Sreedevi	KV Raju
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Editors

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Background

The task force on hunger of the Millennium Project recommended increasing the agricultural productivity of food-insecure farmers through improvement of soil health, expansion of small-scale water management systems, improvement and accessibility of quality seeds, diversification of farm enterprises and establishment of an effective extension service (Sanchez et al. 2005). Rainfed agriculture in India occupies an important place in the development initiatives as, 66% of 142 m ha arable land is rainfed and productivity is low($\approx$ 1 t ha^{-1}) although potential is quite high (Wani et al. 2004). The Government of India (GOI) has undertaken strategic investments through watershed approach for development of rainfed areas in the country for sustainable management of natural resources in the region. A second Green Revolution in India is urgently needed to achieve sustainable food security in rainfed areas. Integrated watershed management programs have shown the potential of doubling the productivity of rainfed areas while sustaining the natural resource base (Wani et al. 2003). However, the success of watershed programs is limited and there is a need to assess the impact of watershed programs in the country and bring in necessary changes in approach, institutions, guidelines and implementation in order to enhance the effectiveness of these programs for reducing poverty in the country. To date a comprehensive assessment of watershed programs in India is lacking.

Watershed programs in India have not generated the desired impact, though there are a number of bright spots where substantial impacts are recorded. Impact of watershed programs could be enhanced through a comprehensive assessment of these initiatives and by synthesizing the lessons and learnings from successful projects as well as from the lesser ones. **The overall project goal is to enhance the livelihoods of rural poor and conserve the natural resources through efficient and sustainable management of watersheds development in India.** Hence, a multi-level assessment will focus on identifying and quantifying impacts of watershed programs in India. Some of the most critical dimensions to be looked into are – the drivers of success, ways/means to prevent bottlenecks/constraints and enabling policies and institutions for potential impacts of watershed programs in the country.

The identification and synthesis of biophysical and socioeconomic constraints will enrich future options for improving watershed programs in the country through more inclusive technological interventions mainly – convergence, institutional arrangements, funding and implementing guidelines. The proposed approach to undertake this complex and exhaustive study will be a combination of macro and micro-level studies. It will also include detailed analysis of secondary data from the published literature as well as primary data collection through detailed case studies. The project will attempt to deliver a *State of the Art Knowledge Report* detailing a comprehensive account on the spatial and temporal progress of watershed development in the country. This report will synthesize existing manuals/studies on integrated watershed management and provide answers to some key questions about watershed programs and their impact in India. Another important output of the project will be a Databank for Watershed Development Programs in India. The Comprehensive Assessment Project inception workshop held on 6–7 June 2006, in New Delhi, emphasized on delivering these key messages to a number of stakeholders.

Inaugural Session

Chair : *Radha Singh*

Rapporteur : *Rosana P Mula*

Prabhat Kumar welcomed **Radha Singh**, IAS, Secretary, Department of Agriculture and Co-operation, other dignitaries from the Ministries of Rural Development, Forestry and Environment and all the participants. In his welcome note he described the plight of Indian farmers as 'farmers live in debt and die in debt' and therefore there is an imperative need to improve the livelihoods of poor farmers residing in rainfed areas.

This was followed by a presentation from **SP Wani**. He anchored the rationale and objectives of the workshop on:

- Emphasizing the challenges of the drylands, malnourishment, water scarcity, land degradation, population pressure and poverty.

He described the vast potential of rainfed agriculture yet to be harnessed by using the data sets from the long-term (30 years) on-going experiment at ICRISAT. The point was further strengthened using yield gap analysis approach using current farmers yields, research station or on-farm demonstration trial yields (achievable yield) and simulation modeling using historical weather data sets with rainwater as the source (potential yield) for major dryland crops in the districts. The role of farmer-centeric watersheds as an entry point activity for improving livelihoods in rainfed areas was highlighted. This approach espouses the integrated genetic and natural resource management (IGNRM) paradigm, which builds further to attaining sustainable livelihoods through empowerment and knowledge sharing. The entire process revolves around the four Es (empowerment, equity, efficiency and environment), which are addressed by adapting specific strategies prescribed by the four Cs (consortium, convergence, cooperation and capacity building). He highlighted the importance of rainfed agriculture in India and strongly presented a case stating that rainfed agriculture holds the key to addressing the challenges of poverty, equity, food security and inclusive development. The result of meta analysis study based on 311 case studies was discussed identifying the biophysical drivers of success as well as drivers of collective community participation. On-site and off-site impacts of watershed programs were discussed using specific case studies.

Project Purpose

Purpose of the Comprehensive Assessment of watershed programs in India was to undertake critical evaluation of the benefits (tangible and non-tangible) and impacts of the past 15 years, its challenges and possible solutions. The specific objectives of the Comprehensive Assessment (CA) were to:

- critically assess the impact of various watershed development programs in India
- identify the drivers of success from the bright spots in terms of targeted objectives, enabling policies and institutions contributing towards achieving greater impact
- develop suitable institutional and technical recommendations, policy guidelines and suitable database for sustainable and efficient management of the present watershed programs

The overarching question for the assessment – How could watershed programs be made more effective and manageable to:

- increase agricultural productivity
- help to enhance incomes and reduce poverty
- protect environment for sustainable development

This Comprehensive Assessment deals with multiple temporal and spatial scales, drivers of success, constraints and enabling policies and institutions.

The **specific approach** to commence the Comprehensive Assessment will be one of – consortium and convergence along with:

- macro and micro level studies
- detailed analysis of secondary data
- specific case studies and
- use of new science tools like GIS and remote sensing.

The **Comprehensive Assessment will identify**:

- Impact indicators
- Drivers of success
- Impact pathways
- Institutional, policy and social options
- Gaps: Knowledge, technology, policies, funds, etc.

The **expected outputs** from the Comprehensive Assessment:

- State-of-the-art knowledge review
- Guidelines and institutional mechanisms
- Manuals on IWM
- Synthesis report
- Communications and outreach

The **objectives of the Inception Workshop were to:**

- discuss and finalize strategies for undertaking the Comprehensive Assessment of Watershed Programs in India.
- identify the consortium team and work out the data needs and emphasis of assessment, responsibilities and timeline for undertaking the comprehensive assessment.

Remarks from two major key players in the watershed projects of India are given below:

- **Rakesh Behari**, Joint Secretary of the Ministry of Rural Development, acknowledged ICRISAT's emphasis on the drivers of success specifically on factors contributing to scaling activities and the way in which the issue of sustainable livelihood is addressed. He also emphasized the causative factors and drivers of success for reducing wastelands in India which need to be addressed urgently. He highlighted how wastlelands can be used for improving the livelihoods of people dependant on waste and degraded lands. According to him, these are significant issues and the comprehensive study should examine it minutely
- **Prem Narain**, IAS, Joint Secretary of the Ministry of Agriculture, imparted, that the group should not be prejudiced by the results of past studies. He made suggestions that the assessment should also be done at the state level and that representation/participation of organizations involved in watershed projects should be considered. He highlighted the importance of wasteland development programs in India and emphasized the need for the consortium to include this aspect in its assessment.

The keynote address by **Radha Singh**, IAS, Secretary, Department of Agriculture, Government of India (also a member of the ICRISAT Governing Board) stressed the importance of watershed programs in contributing to the management of natural resources, environment and in addressing the challenge of meeting the Development Goals. Likewise, she appreciated the concept of watershed as an entry point in development works since this provides a platform for the convergence of interventions and resources, addresses issues of social dimension, and provides the venue for a participatory approach, to optimize the impacts. She regarded the ICRISAT initiative on the Comprehensive Assessment and the Workshop through the leadership of SP Wani with esteem. Radha Singh concluded by stating the importance of the Comprehensive Assessment as contributing critical inputs for enhancing rainfed agricultural growth rate in the country.

Proceedings of the Session

Technical Session I

Chair : *David Radcliffe*

Rapporteur : *P Pathak*

The chairperson **David Radcliffe** in his initial remarks mentioned that this initiative of 'Comprehensive Assessment of Watershed Programs in India' is timely and appreciated the approach of involving several institutions from its inception stage. He elaborated on the impact assessment of watershed program, which is a complex and difficult task, but it is imperative as a large amount of money is being invested in these programs. The watershed benefits are often multi-faceted, including economic, environmental and social gains across different scales. Hence, these benefits are often externalized and not entirely captured. The management of externalities complicates impact assessment of watershed projects. The challenges are also associated with interrelationships among natural resources, spatial and temporal dimension of impact, and valuation of the associated economic and environmental benefits and costs. Finally, he mentioned that the impact assessment should not be static but be dynamic in nature. By giving examples of climatic change, he stressed on the future impacts of the various watershed programs in India.

In this technical session, five presentations covering various aspects of impact assessment were made. The highlights of the presentations and key discussion points are given below:

- The first presentation by **K Palanisami** on 'Methods of Impact Assessment' portrayed the background of watershed programs in India. The methodological challenges for assessing the impact of watershed interventions were highlighted. Due to various complexities the relevance of some of the existing tools and methods was presented. Various specific indicators for assessing the impact of watershed interventions were listed. The speaker suggested the use of the 'watershed performance index', which was initially developed for evaluating tank system in Tamil Nadu. The need to include risk factor in the assessment was highlighted particularly due to rainfall variation. There is a need to redefine the benefits from the watershed programs because some benefits may not be necessarily due to watershed interventions. He gave an example of groundwater where natural recharge due to rainfall, needs to be distinguished from the groundwater recharge due to various structures.
- This was followed by **Amita Shah's** presentation on 'Impact Assessment of Watershed Development: Some Methodological Issues'. She spoke of

the complex and difficult task (particularly the social aspects) of assessing the impact of watershed programs. She highlighted three aspects of impact assessment: Biophysical, Socioeconomic and Institutional. Often these three aspects are taken in isolation, which does not give a clear picture of the impacts. She also raised the issue of missing information (particularly the baseline data), which made impact assessment very difficult. She described two post-facto studies, viz, rapid assessment and detail assessment, with which she was currently involved.

- The third presentation on 'Watershed Impact Assessment' was by **Harbir Singh**, co-authored by **PK Joshi** from IFPRI. His presentation was based on five questions, viz, why an impact assessment is needed? What are the impact indicators? What are the methods? What data sets are needed? And the methods to be followed for an impact assessment? He emphasized that impact assessment plays an important role in setting priorities and provides useful feedback to improve the efficiency and effectiveness of investments. Three levels of impact indicators were explained. These included farm, regional and national level indicators. He further elaborated on various impact assessment methods, viz, benefit-cost analysis, econometric approach, economic surplus approach and meta analysis; highlighting the usefulness of meta analysis in the impact assessment.
- **TK Sreedevi**, co-authored by **SP Wani** and **PK Joshi**, made a presentation on 'Drivers for Success of Watershed Programs'. She explained that integrated watershed program in India envisages a tremendous opportunity for improving the productivity, profitability and sustainability of dryland areas. She presented the results from meta analysis, which used data from 311 watersheds across India. The biophysical drivers of success were also presented. In comparison she highlighted the various activities and achievements of Adarsha watershed, Kothapally in Ranga Reddy district, Andhra Pradesh. A new science-based farmer participatory consortium model was used in the Adarsha watershed. Results from this watershed clearly showed that with appropriate interventions and proactive participation of the community, watershed management could substantially improve the livelihoods of the poor in dryland areas. She presented the drivers (biophysical, socioeconomic and institutional) of success in Adarsha watershed which included tangible benefits, knowledge-based entry point, low-cost structures, equitable sharing of benefits and capacity building. The drivers of success from Powerguda watershed were also presented which included social cohesion, empowerment of women, good leadership, technical support, government support and tangible benefits.
- The last presentation of the Technical Session I was made by **NK Sanghi** on 'Post project Sustainability under Watershed Development Programme'. In his presentation, he highlighted the sustainability of watershed programs

– particularly after the funding had ended. Based on the critical analysis he presented the watershed interventions, which have high and low-medium chances of sustainability. He gave the example of how a cluster of parameters can be successfully used to assess the sustainability of soil and water conservation structures. (The cluster of parameters used for assessing the project management phase was also presented.) Finally the framework for parameters based assessment of sustainability of watershed interventions was explained in detail.

Presentations were followed by interactive discussions. Some of the key points raised during discussions were:

- Participatory impact assessment
- Time frame for various activities
- Missing baseline data
- Separating the other factor's contributions
- Sampling methodologies for a large number of watersheds

Technical Session II

Chair : *Kanchan Chopra*
Rapporteur : *Rosana P Mula*

Kanchan Chopra moderated the interactive session on the strategies for conducting comprehensive assessment. Her opening remarks underscored the timeliness of the assessment since watershed programs have been central in addressing the poor performance of agriculture in the 90s.

The presentation of **KV Raju** outlining the broad framework of the assessment provided a knee-jerk for an active interaction. Much of the discussion revolved around the overarching question of the conceptual framework of the assessment, which resulted in an agreement for crafting boundaries for a comprehensive assessment.

Output of this interactive session was used as an input in the succeeding session.

After the technical sessions Working Groups were formed to address the specific issues and recommend appropriate measures to undertake the CA.

Group Discussions

SP Wani discussed the mechanisms and expected outputs from each group; Three Working Groups along with the facilitators and members were listed. For the first round of discussions the three Working Groups selected were:

Working Group I	Conceptual framework	-	Kanchan Chopra
Working Group II	Impact indicators	-	Suhas Paranjape and Amita Shah
Working Group III	Sampling methods	-	PG Diwakar and K Tirupataiah

The second set of issues were also addressed through Working Groups and the facilitators for the three working groups were:

Impact	-	K Palanisami and Amita Shah
Policy and institutions	-	Kanchan Chopra and DK Marothia
Approaches, best-bet options and case studies	-	PG Diwakar

Group – I:

Members: CM Pandey, KR Dhandapani, DK Marothia, BC Barah, RP Mathur, V Shankar Rao, Kanchan Chopra, TK Sreedevi and SP Wani.

Group – II:

Members: DS Kushawaha, M Dinesh Reddy, Ravi Shankar Kumar, Harbir Singh, RL Shiyani, RRBR Thobah, Vinod Verma, KP Raverkar, Suhas Paranjape, Amita Shah and P Pathak.

Group – III:

Members: J Bhattacharjee, PP Kumbhare, NK Sanghi, J Sandeep, VN Sharda, PG Diwakar, Rosana Mula and BR Prasad.

Group I: Sampling Strategy and Methods

PG Diwakar

A multidisciplinary team discussed elaborately and identified the crucial elements of sampling strategy to enable best possible assessment of the watershed development programs in India. The salient points addressed in the group discussion were:

- Noting the fact that there are multiple criteria involved in conducting sampling in the various programs taken up in the country, it was decided to adopt a multi-stage stratified random sampling approach.

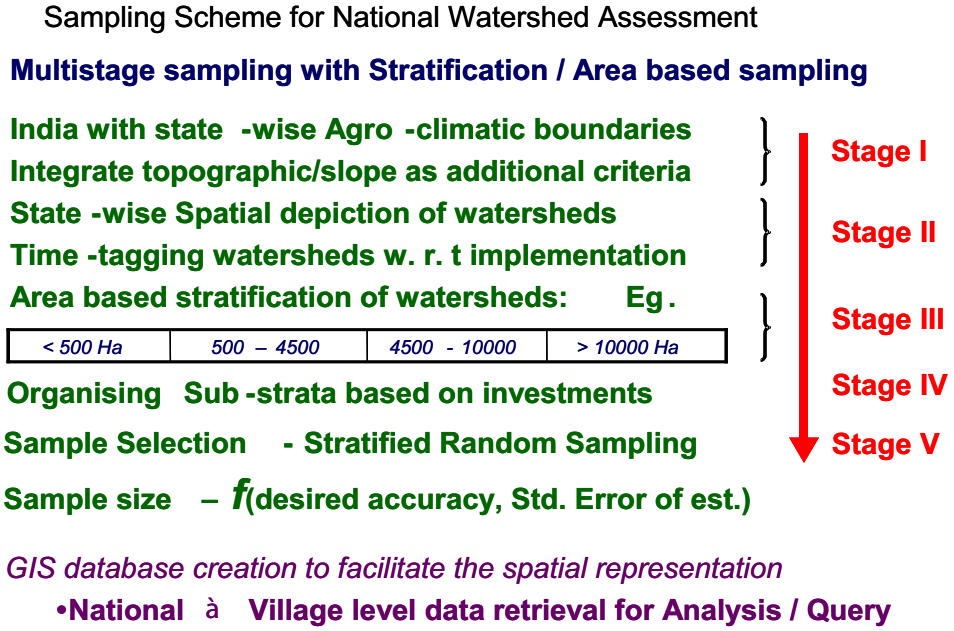
- It is a well-understood fact that watershed development impacts not only the people in the area but also the natural resources and climatic conditions of the area. Hence, it was necessary to experiment with agroclimatic zone-wise sampling across the country in the first stage itself.
- While considering the agroclimatic conditions it was also felt necessary to use broad level topographic conditions across the country which would give due importance to terrain conditions while treating watersheds. This would be an additional parameter, which would be used while sample selection was done.
- Since various government and non-governmental organizations (NGO) programs are implemented at the administrative unit level, ie, state, it was now felt necessary to take stock of the programs taken up in each state in the country.
- Since a number of programs commenced at different periods of time, it was agreed in the final presentations that a cut-off date of 1995, could be considered for all assessments. However, the group considered time frames like, 1980–95, 1995–2000 and 2000 onwards for segregated assessments. If the assessment had to bring about aspects related to better learning practices through a time series analysis, a time frame of about past 15–20 years of watershed development practices was preferred.
- In view of the above it was felt necessary to time-tag each of the watersheds taken up for assessment. The stratification criteria would include the time-tagged watersheds, as this becomes an important factor at the assessment/ analysis stage.
- It was felt necessary to take note of the size of the watersheds taken up for development in each state and hence would be used as the 'stratification criteria'. Due considerations would now be given to isolated small watersheds as compared to contiguous watersheds of larger sizes while sampling. The sizing criteria would be uniformly adopted across the country keeping the agroclimatic and terrain conditions in mind.
- While it was noted that there were many government sponsored programs, bilateral and NGO–based programs for watershed development, due consideration needed to be given for equitable representation of all types of programs while drawing samples for assessment.
- The entire above-mentioned details would be captured in the form of Geospatial databases under GIS environment as it would help in spatial depiction of the watersheds and the sampling scheme.
- It was noted that to a large extent the assessments would be done based on the secondary data (project reports, data, project assessment reports, etc) made available from the executed projects. However, depending on the project requirements, satellite remote sensing data could also be used

for baseline, project impact and sustainability characteristics with respect to natural resources. Also, there would be a need to undertake fieldwork on a selective basis for collecting primary data on the project implementation – both on the social and natural resources aspects. This needs to be done, again on a sample basis within a given watershed, by keeping in view the ridge, middle and valley portions accompanied with sample distribution with respect to small, marginal, big and landless farmers/families.

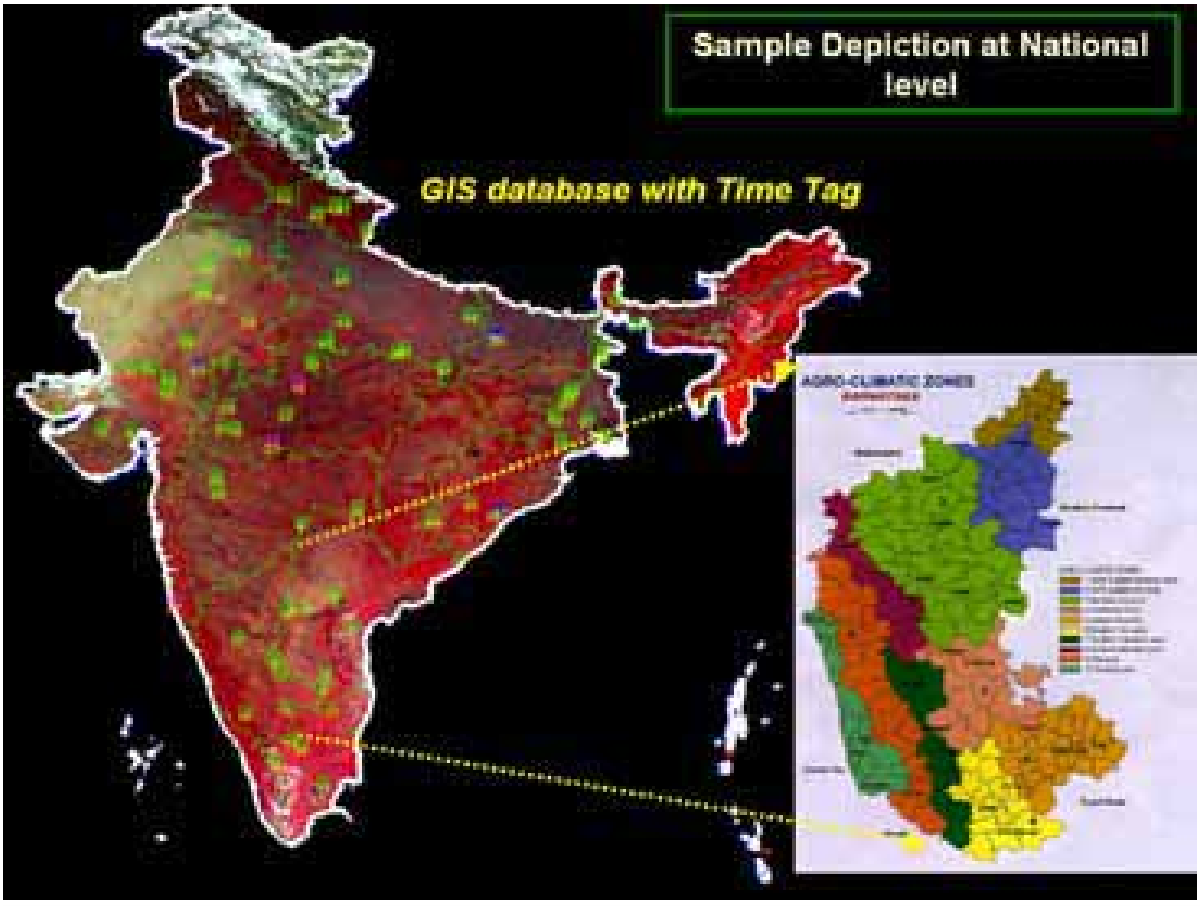
- One of the important factors also to be considered for sampling strategy was to segregate watersheds for assessment with respect to the investments done. To explain, further stratification of watersheds within area-based strata with respect to the investments made, as this factor has a direct bearing on the watershed performance and also depends on the modalities of funds utilization.
- It was also noted that this kind of an approach facilitates, creating database elements and providing necessary reports at national/state/district level.

The above details were brought out by the group, keeping in view the various analysis that could be carried out in addition to different types of inferences that could be drawn based on the assessment. The entire sampling needed to be hierarchically organized in the spatial domain from the beginning of the project by keeping in view the possibilities of ultimately hosting a website/portal for information dissemination to the needy. The database standards and design would be evolved in such a way that one could do a spatial data mining and obtain relevant information at desired level, ie, national/state/district/*taluk*/village or at village clusters.

A brief depiction as presented by the group during the technical sessions is as follows.



Spatial Depiction of Selected Samples in a National Framework



Additional Points

- 7 Agencies & 4 Ministries
  - Agri., Rural Dev, Env. & For, Water resources, Plg com... ...
  - Bilateral projects, NGO–based projects
  - IWDP, DPAP, NWDPRA, MOEn, NAEP, DFID etc.
- Cut off time period for sampling:
  - 1980 – 1995 } *Periodicity of sampling....., sustainability*
  - 1995 – 2000 } *Start, End and Sustainability (3 point data)*
  - post 2000 → *To consider only completed projects*
  - Dependency on TOR
- Sampling strategy to independently handle above data sets
- Baseline & post project (2 / 5 yrs) database by samples / RS
- Secondary sample data compilation / analysis
  - *Data availability ? → Alternative sampling point for data*
- Sampling for Socio-economic aspects at field level – sample watershed
  - Household, Community, Demography, (Census data, NSS),
  - watershed interventions, secondary data / reports

Purposive sampling?!; Cost considerations; Timeframe !!!

Group II: Impact Indicators

Amita Shah, Suhas Paranjape and DK Marothia

The group tried to identify important indicators for capturing impact of watershed development in a post-project scenario. Recognizing the problems in assessing some of the critical indicators, especially in the absence of baseline data, the group decided to first list out important indicators, and subsequently draw a sub-set within the initial list, which could be treated as a critical minimum set. The initial list of indicators focused on three broad categories, viz, biophysical, socioeconomic and processes as well as institutional.

(Due to lack of time needed to discuss the methodology/data collection instrument to be used for each of the indicator listed here, it may be useful to refer to the following menu for selecting right kind of methods that are feasible within a time frame – of one year).

What was noted against each indicator was the feasibility of capturing the impact through Sample Survey of micro watersheds as well as of households – SS;

Case Study of purposefully selected micro-watersheds - CS;

Focus Discussion Groups - FDGs; and Remote Sensing data – RS.

Available Menu for Selecting Methodologies for Impact Assessment:

1. ICRISAT - Various Papers Compiled in the book 'Methods for Assessing Impact of Natural Resources Management Research'
2. Indo-German Project - Watershed Impact Assessment Manual
3. GIDR - Chapters 1 and 2 in the 'Study on Benchmark Survey for Watershed Projects'
4. SOPPECOM - Participatory methods for resource mapping and impact assessment
5. WASSAN - Process Indicators

1. Bio-physical Indicators

- Soil

  Soil erosion (CS, RS)

  Soil Water Holding Capacity (CS, RS)

  Soil Health as wider concept

- Water

  Availability of surface and groundwater and its utilization (SS, CS)

  Recharge – normal and contributed by watershed activity (CS)

  Nature of hydrograph (floods, base and seasonal flows) (CS)

  Water balance and components as wider integrating concept (CS)

  Water quality indicators (SS, CS)
- Biomass

  Biomass Cover (SS, RS)

  Biodiversity (SS, CS)

  Variation according to rainfall (drought – good and bad years)

2. Socioeconomic Indicators (Indicators in this category can be assessed by combinations of SS and CS, FDGs)

- Changes in yield (adjusted for rainfall and other climatic conditions), cropping pattern, cropping intensity, land use pattern, increase in gross irrigated area (adjusted for rainfall).
- Changes in the portfolio of livelihood activities and sources of income (change in income should be imputed from changes in physical indicators, isolating the impact of changes in prices)

  - Agriculture
  - Horticulture
  - Fodder production
  - Livestock
  - Fisheries
  - Pastoralists
  - Artisans
- Increase in on- and off-farm employment due to project interventions (segregating on-site employment benefits of non-recurring type), and changes in intensity as well as nature of migration.
- Fulfillment of basic needs

  - Food and Nutrition
  - Fodder
  - Drinking water
- Equity Across (this is an overarching indicator, applicable for other socioeconomic indicators noted above).

- Landless and their situation
- Women and their situation
- Relative distance between classes/groups

3. Institutions and processes (These indicators can be captured mainly through CS and FDGs)

- Organizations internal to the watershed – watershed committees, associations, user groups, SHGs
- These institutions should be seen against the following indicators existence
  - composition
  - functions
  - division of responsibilities
  - continuance
  - sustainability
- Institutional arrangements for conflicts, contestations, negotiations and resolution
- Interface and mapping of prior social institutions for NRM and watershed organizations and institutions
- Interface and mapping of natural resources and property and access rights and their change
- SHGs, credit functions, revolving funds, kinds of activities
- Organizational hierarchies and interrelations - interfaces
  - PRIs
  - Government Agencies (village, district, state and central levels, departments)
  - Financial institutions
  - Donor Agencies
  - CBOs and NGOs
- Cost sharing and contribution
- Watershed Development Fund
- Convergence
- Multidisciplinary processes
- Exit strategies and post-project roles of agencies

4. Critical Minimum Indicators (a proposed sub-set)

- Increase in availability of fodder, drinking water and fuel wood/NTFP (in forest regions)
- Stability in yield or crop survival under prolonged dry spell
- Coverage and composition of watershed treatment (with special emphasis on common property land resources)
- 10% increase in crop yield under normal rainfall situation as compared to pre-project period or control villages.
- Decrease in sedimentation at the monitoring point
- Increase in groundwater table in the proximity of water harvesting structures
- Women's involvement in decision making, benefit sharing and future management
- Actual actions undertaken for repair and maintenance
- Benefits to landless going beyond the onsite employment

The group discussion highlighted the following issues for consideration while finalizing the list of indicators along with methodologies to be adopted keeping feasibility criteria in mind.

1. The group could not come to a consensus. The idea was to clarify what were the issues and gain a common understanding, rather than develop the indicators.
2. One of the major issues was that of income, especially assessed in monetary terms. However it was also acknowledged that a) it was difficult to get direct assessments of monetary income and b) both monetary and non-monetary items were important.
3. Another related issue was that of livelihood. An interesting discussion followed on how households fulfill their needs. It was suggested that it is better to convert all produce/collections/gains in kind as much as possible and to assess incomes/gains from imputed values with explicit assumptions. Finally a number of livelihood patterns were identified.

Likewise, two levels of 'indicators' were earmarked. One pertained to estimating actual flows in a more 'neutral' manner and the second level attempted to be more 'normative'. For example how groundwater recharge had changed environment would be a neutral indicator. But if a weight was assigned say of 1, 2 and 3 respectively for a 3, 7 and 10% increase in recharge in hard rock areas and 7, 15 and 20% recharge in alluvial regions as a measure of efficiency of watershed treatment, that would be a normative indicator. There was a need to emphasize on both and there cannot be a normative one without an underlying neutral one.

Group III: Institutions and Policies

TK Sreedevi

Definition

- Policies are at different levels, national, state or others
- Institutions are defined as rules and can be formal or informal
- Organizations are structural, ie, ICRISAT, IEG, NABARD, etc
- Delivery Mechanism is generally discussed as implementing agency

Elements of Policy

- The Group discussed that the elements of policy and its impact need to be understood differently at various levels, directly or by implication.
- The Group discussed policies at national level such as drought mitigation, soil and water conservation, employment guarantee and poverty reduction, etc, and those at state level such as Watershed Mission of Maharashtra, Water Mission of AP, etc.
- It also discussed the policies operating within an overarching legal framework.
- Institutions or rules were framed for enhancing the efficiency of operationalizing the policies. For example, institutions for participation, cost sharing, knowledge sharing, sustainability, etc.
- There was a discussion on examining policies that work at cross purposes also such as water policy, environment and forest policy, agriculture and land use, power tariff, etc.

Technical Session III

SP Wani chaired the session. He initiated the discussion with an invitation for comments and reactions to the presentations and the discussions of the first day. Some of the key points raised are summarized on the following subjects:

- Inclusiveness - which raises the issue of regional clustering, institutional share, and commitment to the proposed work
- Participation - which relates to the involvement of other stakeholders like non-conventional organizations that offer financial assistance to farmers
- Access - which deals with how this assessment work can utilize outputs of earlier assessments

The workshop for the day was geared towards getting more inputs for developing the over-all framework of the comprehensive assessment. There were three groups namely:

1.0 Conceptual Framework

- Defined the boundary of the assessment
- Argued to clarify semantic debates on the meaning, scope and differences of review, evaluation, and assessment

2.0 Developing Indicators

- Stated that indicators to be used as yardsticks to make inferences on changes
- Presented the major topics where relevant indicators should be made namely; socioeconomic, biophysical and institutional processes
- Posed the issue of how indicators should be assessed. In this regard, SP Wani mentioned the ICRISAT publication 'Method for Assessing Economic and Environmental Impacts; Natural Resource Management in Agriculture' as an excellent reference.
- Suggested the inclusion of indicators to determine social exclusion (provides a better understanding of equity issues)

3.0 Sampling and Method

- Suggested sampling strategies that employ the element of multi-stage technique and area based (sufficient consideration of the peculiarities of the watershed areas)

Some concluding remarks made were on:

- The significance of this nodal assessment which is expected to break new grounds for planning watershed programs
- The global implication of the output of this assessment; its utility to improving the implementation of watershed projects not only in India but also in South and Southeast Asia as well as initiatives in the offing in Africa.

Concluding Session

Recommendations

Chair : DK Marothia

Rapporteur : KP Raverkar

The session was chaired by DK Marothia. During this session all the three group discussions centered on sketching the Road Map for a Comprehensive Assessment of Watershed Program in India.

1. Impact Assessment
2. Policies and Institutions
3. Approaches, best practices and case studies

K Palanisami presented the outcomes of the group discussion on 'Impact Assessment'.

Following are the outcomes of the group discussions on 'Impact Analysis'. The methods used for impact assessment of watershed development programs discussed were: i) How to undertake different tasks? (ii) Approaches and Methods and (iii) Organizations to be included.

(i) How to undertake the tasks

***Selection of agroclimatic zones for the study*:** The study area may be selected so as to cover states, major agroclimatic conditions, districts and micro watersheds.

Review of existing reports: Involves collection of information regarding the impact assessment and relevant data to take up the impact. Meta analysis will also help in making relevant inferences. Benchmark information may also be collected in terms of various biophysical, socioeconomic and institutional aspects.

Deeper inquiry/study: This may be taken up to identify the gaps in the existing methods of impact assessment and data requirement. This will mainly include additional data collection, case studies and sample surveys.

Analysis of different watershed development programs in terms of objectives, funding, institutional arrangements and operational procedures, eg, DPAP, IWDP, NABARD, MoA and NGOs – program wise.

Select a case of watershed each representing different programs as well as implemented by different project implementing agencies (PIAs). For example, Department of Agriculture, Engineering, DPAP and NGOs.

(ii) Approaches and methods

Attributes of watersheds/multi components: To perform impact assessment, there is a need to identify the different components of watershed development and its differential functions. This will help to assess the impacts in a holistic manner.

Approaches for impact assessment of watersheds include the following:

- Combination of pre- and post and with- and without.
- Benchmark information will be collected and compared with after-intervention.
- Control villages will be selected and compared with watershed intervention.
- Comparison of before and after and with and without and the impact due to watershed intervention.

Indicators: To assess the impacts indicators may be developed under four broad categories (i) biophysical, (ii) socioeconomic, (iii) institutional and (iv) financial. The biophysical indicators may include soil erosion, soil health, groundwater recharge, groundwater availability, water balance, biomass cover, biodiversity, water quality, etc. The socioeconomic indicators include cropping pattern, land holding and land use pattern, productivity of crops, income, employment, migration, awareness of technology, knowledge base, food security, equity, peoples participation, gender equity, etc. The institutional indicators may indicate existence of watershed institutions (Watershed Association, Watershed Committee, User Groups, Self-Help Groups), support from the PIAs, presence of formal or informal organizations other than watershed institutions, mechanisms for cost-benefit sharing and conflict resolution, property rights, mechanism for convergence of watershed programs with other rural development programs, proper exit protocols, and presence of other financial institutions. The financial indicators may include NPV, BCR and IRR.

Tools to be used: Different tools like GIS, remote sensing, sample survey and case studies may be followed. In addition, to perform qualitative assessment, techniques like Rapid Rural Appraisal, focus group meetings, key informants discussions may be followed.

(iii) Organizations to be involved

To perform various tasks of impact assessment of watershed programs in the country different organizations such as Sate Agricultural Universities, Research institutions at different levels like ICRISAT, ICAR, ICSSR, NGOS, and consultancy firms will be involved. The role of different institutions in impact assessment will be defined properly.

Approaches and Methods

The studies on Impact Evaluation of Watershed Programs for Comprehensive Assessment could be approached through:

- State-wise agroclimatic zones sampling.

Attribution of watershed: The operationalization of watershed in any particular area whether by one/multi agencies shall be considered, to evaluate the impact of program in the area. This could be achieved through getting information from key informants and/or rapid assessment.

Policies and Institutions

Facilitators: Kanchan Chopra and TK Sreedevi

The outcome of the group discussion on 'Policies and Institutions' was presented by **TK Sreedevi**. The salient points of presentation were:

- For effective Comprehensive Assessment of Watershed Programs in India policies at different levels such as national, state and others; institutions/ rules (formal/informal); structures and functions of organizations (ICRISAT, IEG, NABARD, etc); and delivery mechanism which vary with implementing agency/ies, need to be considered.
- The study of elements of policies at varying levels and their direct implications on watershed programs is very important.
- At national level the policies on drought, soil and water conservation, employment generation, poverty, wasteland development, agriculture, water, rainfed agriculture, joint forestry management, etc, and at state level watershed mission, water mission, etc, would have a direct or by implication impact on watershed programs in India.
- Overarching legal framework, eg, private property rights (groundwater), *Panchayati Raj* Institutions (PRIs) may result in financial and/or administrative conflicts and *vis-à-vis* influence the watershed program.

The below mentioned are some of the important aspects, which dictate success of watershed programs:

- Participation
- Equity
- Sustainability
- Knowledge sharing
- Learning process

The multiplicity of line departments and different rules, also influence the watershed programs. Certain policies – eg, water policy, environment and forest

policy, land use policy, power tariff policy, etc, work at cross purposes and thus also need to be considered for a comprehensive assessment of watershed programs in India.

Approaches, best-bet practices and case studies

The outcome of the group discussion 'Approaches, best practices and case studies' was put forth by PG Diwakar. Speaking concisely he stressed on six major points, which are needed for a comprehensive assessment of watersheds in India:

- Stratified approach for sampling, based on agroclimatic conditions to be followed.
- Process oriented case(s) for understanding the beneficial method of organizing processes; engines for positive and negative direction to be taken up.
- Processes in watershed development, eg, project formulation, impact, training, activities for landless, modalities of implementation, etc, which was to be compared and evaluated.
- Cost factor (ceiling) – wages, labor problem, etc.
- Sizing of watersheds (sub-basin level), cluster wise (500 ha), impact size and contiguity to be studied.
- Impact activity in private land *vis-à-vis* community land to be considered.

Organizational structure

For carrying out a comprehensive analysis of watershed programs in India effectively, a pyramidal organization at national, regional and state level model was suggested. Following the presentations **SP Wani** requested the members to undertake the exercise of listing organizations' willingness to undertake Comprehensive Assessment activities based on their strength. To undertake the Comprehensive Assessment three broad groups, viz, impact assessment, policies and institutions and approaches and case studies were decided. Representatives voluntarily listed their willingness to contribute in the comprehensive assessment. The details are presently in the table below.

Participating Agencies /Organizations in the CA

Impact	Policies Institutions	Approach/case studies	Remarks
NCAP	NCAP		
Junagarh Agri. Univ.		Junagarh Agri. Univ.	
TNAU	TNAU	TNAU	
WALMI, Bhopal	WALMI, Bhopal	WALMI, Bhopal	
	IGAU, Raipur	IGAU, Raipur	
	NABARD	NABARD	
ISEC, Bangalore	ISEC, Bangalore	ISEC, Bangalore	
	WASSAN	WASSAN	
		FES, Rajasthan	
CRIDA	CRIDA	CRIDA	
IEG, Delhi	IEG, Delhi	IEG, Delhi	
ISRO			DB Organization
ICRISAT	ICRISAT	ICRISAT	
IWMI	IWMI		
		GBPUA&T, Pant Nagar	
WOTR		WOTR	
BAIF		BAIF	
Pragna, Hyderabad		Pragna, Hyderabad	
	Rajiv Gandhi mission for watershed development, Madhya Pradesh		
CSWCRTI, Dehradun		CSWCRTI, Dehradun	
GIDR, Ahmedabad	GIDR, Ahmedabad	GIDR, Ahmedabad	
CAZRI, Jodhpur		CAZRI, Jodhpur	

Glimpses of the Workshop

Inaugural session in progress.

Wani explaining objectives of the workshop.

Groups actively involved in discussions.

Participants of Comprehensive Assessment Inception Workshop

Annexure I

Program

Tuesday 6 June 2006

0900–1000	Registration	
Session I	**Inaugural Session**	
	Chair **: Radha Singh**	
	Rapporteur **: Rosanna P Mula**	
1000–1005	Welcome	Prabhat Kumar
1005–1035	Workshop Objectives and Project Outline	SP Wani
1035–1045	Messages from Rural Development and Agriculture Ministries	
1055–1115	Keynote Address	Radha Singh
1115–1145	*Group Photograph and Tea/Coffee*	
Session II	**Technical Session I**	
	Chair **: David Radcliffe**	
	Rapporteur **: P Pathak**	
1145–1245	Presentations	
•	Methods for Impact Assessment of Watershed Programmes: K Palanisami Impact Assessment of Watershed Development	
•	Some Methodological Issues	Amita Shah
•	Watershed Impact Assessment	Harbir Singh
•	Drivers for Enhancing Impact and Sustainability of Watershed Management Programs	SP Wani, TK Sreedevi and PK Joshi
•	A Comprehensive Assessment of Watershed Programs in India	SP Wani and Team
•	Post Project Sustainability under Watershed Programs	NK Sanghi
•	Strategies for Comprehensive Assessment	KV Raju
1245–1315	Discussion	
1315–1400	*Lunch*	

Session III	**Technical Session II**	
	Chair **: Kanchan Chopra**	
	Rapporteur **: Rosana P Mula**	
1400–1600	Strategies for Comprehensive Assessment	
	Discussants:	
	KV Raju	
	SP Wani	
1600–1615	*Tea/Coffee*	
1615–1800	Road Map for the CA	
	[Parallel Discussion in 3 Groups on Projects, Data, Regions,	
	Lead Persons, Methods, Partners, Strategy, Timeline, etc.]	
1930	*Workshop Dinner*	
Wednesday 7 June 2006		
0900–1000	First Day's Summary Reports from 3 Groups	
1000-–1030	Discussion	
1030–1045	*Tea/Coffee*	
1045–1300	Group Discussions *(Contd..)*	
1300–1345	*Lunch*	
Session IV	**Technical Session III**	
	Chair **: SP Wani**	
1345–1500	Presentations of Outcomes of the Group Discussions	
Session V	**Concluding Session**	
	Chair **: DK Marothia**	
	Rapporteur **: KP Raverkar**	
1500–1600	Presentations by Rappoteurs	
	Technical Session I	TK Sreedevi
	Technical Session II	Rosana P Mula
	Technical Session III	KP Raverkar
	Chair's Remarks	
	Vote of Thanks	
1600	*Tea/Coffee*	

Annexure II

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Annexure-III

A Comprehensive Assessment of Watershed Programs in India

June 2005–May 2007

Full Proposal Submitted to
The Chair, National Watershed Committee
Government of India, New Delhi

The International Crops Research Institute for the Semi-Arid Tropics
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I. SUMMARY

The Task Force on Hunger of the Millennium Project recommended increasing the agricultural productivity of food-insecure farmers through improvement of soil health, expansion of small-scale water management systems, improvement and accessibility of quality seeds, diversification of farm enterprises and establishment of an effective extension service (Sanchez et al. 2005). Rainfed agriculture in India occupies an important place in the development initiatives as, 66% of 142 m ha arable land is rainfed, and productivity is low (≈ 1 t ha^{-1}) although potential is quite high (Wani et al. 2004). The Government of India (GOI) has undertaken strategic investments through watershed approach for development of rainfed areas in the country for sustainable management of natural resources in the region. A second Green Revolution in India is urgently needed to achieve sustainable food security in rainfed areas. Integrated watershed management programs have shown the potential of doubling the productivity of rainfed areas while sustaining the natural resource base (Wani et al. 2003). However, the success of watershed programs are limited and there is a need to assess the impact of watershed programs in the country and bring in necessary changes in approach, institutions, guidelines and implementation in order to enhance the effectiveness of these programs for reducing the poverty in the country. To date a comprehensive assessment of watershed programs in India is lacking.

Watershed programs in India have not generated the desired impact though there are a number of bright spots where substantial impacts are recorded. Impact of watershed programs could be enhanced through a comprehensive assessment of these initiatives by synthesizing the lessons and learnings from the successful projects as well as from less successful ones. The overall project goal is to enhance the livelihoods of rural poor and conserve the natural resources through efficient and sustainable management of watersheds development in India. Hence, a multi-level assessment will focus on identifying and quantifying impacts of watershed programs in India. Some of the most critical dimensions to be looked into are – the drivers of success, ways/means to prevent bottlenecks/ constraints enabling policies and institutions for potential impacts of watershed programs in the country.

The identification and synthesis of biophysical and socioeconomic constraints will enrich future options for improving watershed programs in the country through more inclusive technological interventions mainly - convergence, institutional arrangements, funding and implementing guidelines.

The proposed approach to undertake this complex and exhaustive study will be a combination of macro and micro-level studies. It will also include detailed analysis of secondary data from the published literature as well as primary data

collection through detailed case studies. The project will attempt to deliver a *State of the Art Knowledge Report* detailing a comprehensive account on the spatial and temporal progress of watershed development in the country. This report will synthesize existing manuals/studies on integrated watershed management and provide answers to some key questions about watershed programs and their impact in India. Another important output of the project will be a Databank for Watershed Development Programs in India. The Comprehensive Assessment Program emphasizes on delivering key messages to a number of stakeholders.

II. BACKGROUND

India is home for 221 million out of 852 million hungry people in the world and has to take urgent steps to meet the millennium development goal of halving the number of hungry people by 2015. Eighty per cent of the hungry people are in rural areas, 50% are small landholders, 22% are landless and 8 % are pastoralists and forest dwellers (Sanchez et al. 2005). Further, the task force on hunger of the Millennium Project recommended increasing the agricultural productivity of food-insecure farmers through improving soil health, improved and expanded small-scale water management, improved access to better seeds, diversified farm enterprises, and establishing the effective extension services (Sanchez et al. 2005). Rainfed agriculture in India occupies an important place in the development initiatives as, 69% of 142 m ha arable land is rain-fed, and productivity is low (1 t ha-1) although potential is quite high (Wani et al. 2004). In India, rainfed agriculture generates nearly half of the total value of agricultural output (Kerr, 1996). Moreover, the largest share of resource poor rural communities is hosted in rainfed regions. From a water for food perspective as well as poverty, hunger, and equity perspective, a hotspot emerges, namely the drought prone arid, semi-arid and dry sub-humid areas in India, where rapid population growth, resource poor rural communities, hosted in landscapes subject to serious human induced land degradation coincide.

These regions, generally defined as 'drylands' which cover vast areas in the country, are of particular concern in terms of their environmental vulnerability, due to the high incidence of human induced land degradation, or desertification, the importance of which was manifested through the creation of the UN Convention on Desertification (UNEP, 1999). These are regions where rainfed agriculture dominates. The Government of India (GOI) has undertaken strategic investments through watershed approach for development of rainfed areas in the country for sustainable management of natural resources in the region. Different ministries implement watershed programs in India by adopting varying guidelines. Not only these programs varied for implementing guidelines and implementing ministries but they also varied in the approaches, objectives

as well as financial allocations to undertake watershed development activities in the region.

India is in unique position as the country has reached self-sufficiency for food through the Green Revolution. However, the ever-increasing population and number of poor people in the country demands second Green Revolution in India is urgently needed to achieve sustainable food security and it has to be now Grey to Green Revolution through development of rainfed agriculture. Moreover, the integrated watershed management programs have shown the potential of doubling the productivity of rainfed areas while sustaining the natural resource base (Wani et al. 2003). However, the successes of watershed programs are limited and there is need to assess the impact of watershed programs in the country and bring in necessary changes in approach, institutions, guidelines and implementation in order to enhance the effectiveness of these programs for reducing the poverty in the country. The watershed programs in the country have evolved over the period and further improvements are needed to enhance the effectiveness of such initiatives.

Changes in Watershed Approaches

A close look through the watershed programs in India from the beginning reveals that the approach has evolved over time from compartmental towards integrated and holistic approach for managing the natural resources. The issues of enhancing productivity, sustainability, gender mainstreaming, capacity building, and equity concerns have become important. The journey through the watershed approach evolved in India is depicted in the Figure 1. In the beginning, watershed programs went through the structure-driven approach for soil conservation and rainwater harvesting, aiming at only some productivity enhancements. Soil conservation programs became synonymous with contour bunding and water conservation with check-dams. This was a compartmental and top-down contractual approach. This led to less transparency and inequitable benefits among the community members. The rich who could invest in a bore-well have harnessed the benefits of the augmented water sources. On the other hand, small and poor landholders comprising of about 80% of the community could not get any tangible and equitable benefit from the conservation measures. Small landholders always looked at these interventions as employment opportunities during the project period and people's participation was not adequate. Also, most of the projects lacked technical backstopping.

Watershed programs were initiated more than four decades ago, however, the activities have become more vigorous since 1990s. The watershed programs covered different agro-ecological regions of the country and their nature and scope were continuously modified. There are few studies conducted to assess the impacts of watershed programs (Chopra et al. 1990, Kerr et al. 2000, Kerr

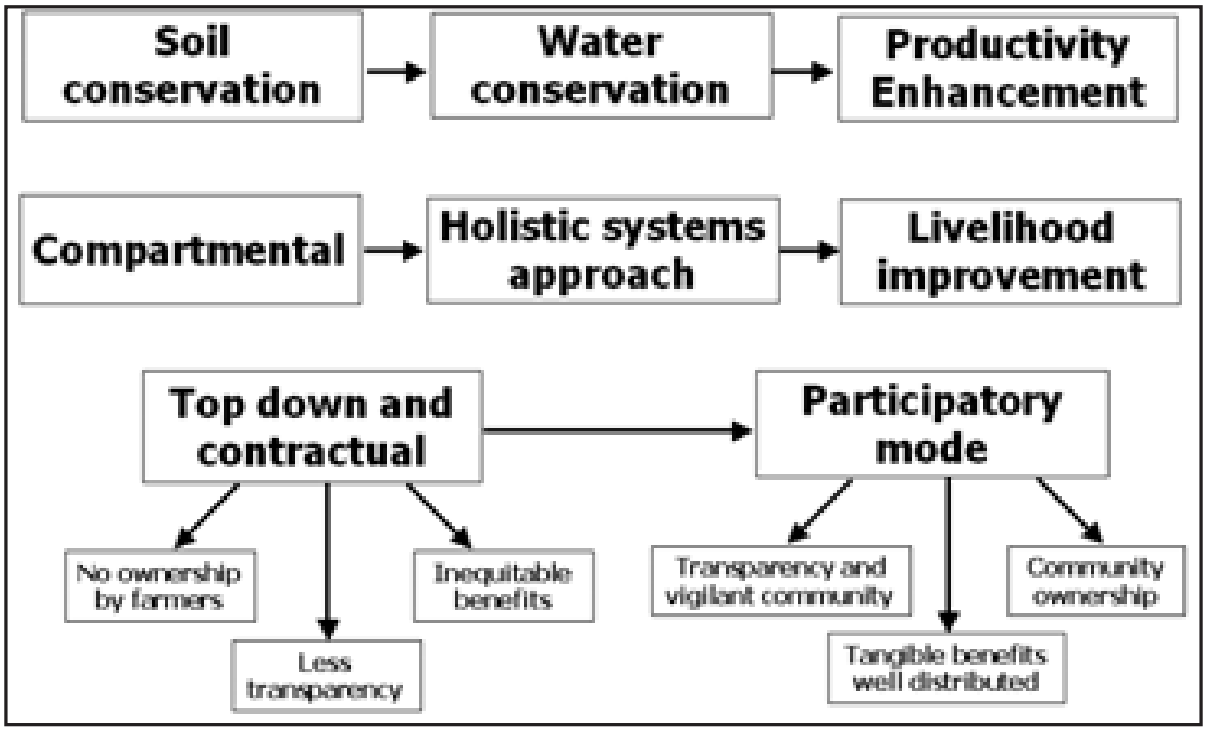

Figure 1. Journey through watershed approach in India.

2002 and Joshi et al. 2004), however comprehensive assessment of watershed programs is lacking.

The watershed development program is now planned, implemented, monitored and maintained by the watershed communities. To bring about uniformity in programs being implemented by various agencies, the WARASA-Jan Sahbhagita Guidelines have been brought out in conformity with the "Common Approach/ Principles for Watershed Development" agreed upon by the Ministries of Agriculture and Rural Development.

The National Watershed Development Project for Rain-fed Areas (NWDPRA) has been considerably restructured during the IX Five Year Plan with greater decentralization and community participation, higher degree of flexibility in choice of technology and suitable institutional arrangements for ensuring long-term sustainability. An area of 2.76 m ha has been treated with an expenditure of 9108 million rupees during IX Five Year Plan period.

To involve village communities in the implementation of watershed projects under all the area development programs namely, Integrated Wastelands Development Programme (IWDP), Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP), the Guidelines for Watershed Development were adopted in 1995, and subsequently revised in 2001. These guidelines emphasized the role of community participatory approach and gender equity. To further simplify procedures and involve the Panchayat Raj Institutions (PRIs) more meaningfully in planning, implementation and

management of economic development activities in rural areas, these new guidelines called Hariyali guidelines were issued in April 2003. These new guidelines have envisaged the very critical role of the *panchayat Raj* institutions in implementation of watershed development programs. However, a lot of concern about Hariyali guidelines is being raised and needs to be addressed.

Arya and Samra (2001) have analyzed and evaluated the performance of watershed management in 27 villages having 2070 families of Haryana *Shivaliks* during the past 20 years in the area on natural resource management. Beneficiary participation increased as the project progressed chronologically from planning to implementation and maintenance stages. It was also noticed that women carried out most of the increased agricultural, dairying and fodder collection tasks, whereas men often controlled the income generated. Projects were not able to fully eliminate the gender inequalities. The fundamental need is to evaluate a project's potential impact on, and expected benefits to, both men and women separately.

Joshi et al. (2005) have assessed the performance of watershed programs by employing meta-analysis. Based on an exhaustive review of 311 case studies on watershed programs in India, their study attempted to document efficiency, equity and sustainability benefits. It was noted that the mean benefit-cost ratio of watershed program in the country was quite modest at 2.14. The internal rate of return was 22%, which is comparable with many rural developmental programs. The watershed programs generated enormous employment opportunities, augmented irrigated area and cropping intensity and conserved soil and water resources. Performance of watershed program was best in rainfall ranging between 700-1000 mm, jointly implemented by state and central governments, targeted in low and medium income regions, and had effective people's participation. The study concluded that the watershed program is silently rejuvenating and revolutionizing the rainfed areas. It was noted that lack of appropriate institutional support is impeding the tapping of potential benefits associated with these programs.

There is a change now and models are developed giving priority to the empowerment of the community and the stakeholders so that we are operating not as a supply-driven project but as a demand-driven project (Joshi et al. 2004). Earlier experiences from the various watershed projects have indicated that a straightjacket approach did not yield desired results and mix up of individual and community-based interventions are essential. Multi-disciplinary teams are involved to provide the technical expertise to solve the problems at community level. The benefits are transparent and distributed well among the community members including women resulting in higher participation. In this approach, it is ensured that good participation is there and watershed is considered as an entry point for improving the livelihoods of the peoples.

A new model for efficient management of natural resources in the Semi Arid Tropics has emerged from the lessons learnt from the long-term watershed-based research conducted by ICRISAT in partnership with national agricultural research systems (NARS) (Wani et al. 2002, Wani et al. 2003). The concept of consortium and convergence are integral parts of the new integrated watershed management model (Figure 2). The model is a holistic systems approach and it demands collective efforts of all the stakeholders to address the complex problems in watersheds. The new consortium model envisages watershed management as an entry point for improving livelihoods through adoption of holistic approach by converging NRM related activities.

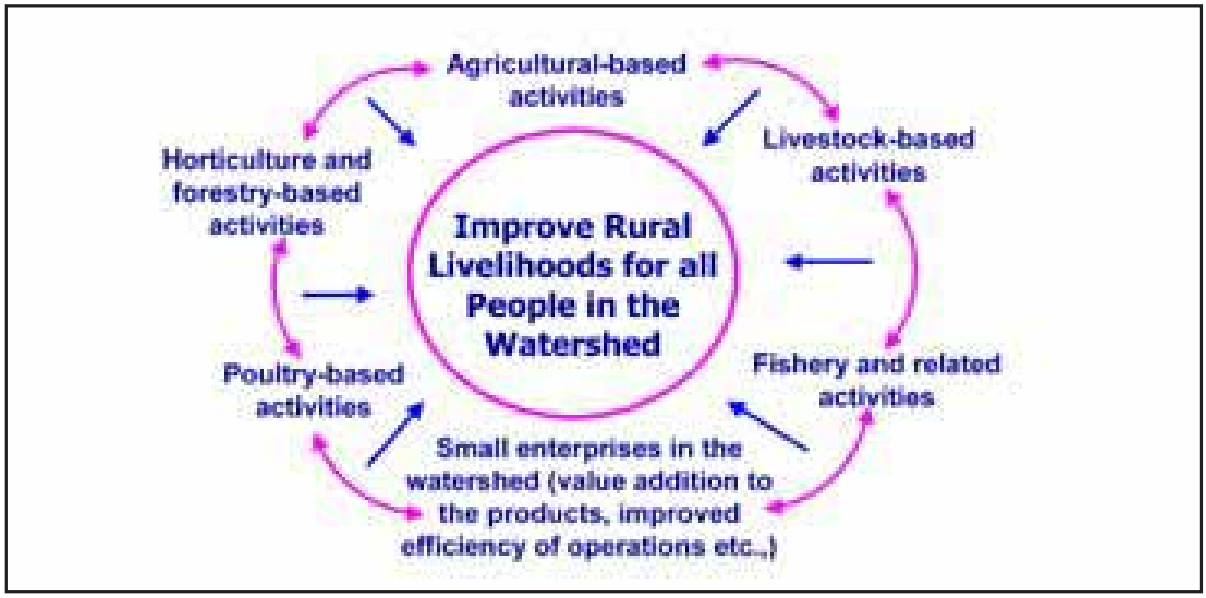

Figure 2. Convergence strategy in consortium model for watershed development (Wani et al. 2002)

At the Adarsha Watershed, Kothapally, Andhra Pradesh, it was observed that along with the highest system productivity the benefit-cost ratio of the improved cropping systems of maize/pigeonpea was more (1:2.47) compared to the farmers' traditional cotton-based systems. At Lalatora, Madhya Pradesh the economic analysis of the on-farm trials showed that intervention of combined application of boron and sulphur gave maximum benefit with 1:1.8 benefit-cost ratio as compared to control with traditional practices (1:1.3) and gave almost 49% higher benefits to the farmers (Patil et al. 2003). The integrated fertility management resulted in enhanced rainwater as well as irrigation water use efficiency. The watershed concept has moved from more conservation of resources to efficient use of conserved water and other natural resources. There is a long way to go for developing sustainable NRM options for improving livelihoods in rainfed areas.

III. PROJECT PURPOSE

The overall project goal is to enhance the livelihoods of rural poor and conserve natural resources through efficient and sustainable management of watersheds development in India. Watershed programs are considered as a key to agricultural growth and development in rainfed areas of India. Watershed programs in India have not yielded the desired impact in general, however, there are a number of bright spots where substantial impacts are recorded. Impact of watershed programs could be enhanced through comprehensive assessment of these initiatives by synthesizing the lessons and learnings from the successful projects as well as not so successful ones. By identifying the drivers of success and identifying appropriate enabling policies and institutions along with technological interventions and funding mechanisms based on critical evaluation of the watershed programs in India the benefits of watershed programs could be scaled out (Wani et al. 2004).

The specific objectives are:

- To critically assess the impact of various watershed development programs in India
- To identify the drivers of success from the bright spots in terms of targeted objectives, enabling policies and institutions contributing towards achieving greater impact
- To develop suitable institutional and technical recommendations, policy guidelines and suitable database for sustainable and efficient management of the watershed programs

Approach and Activities

A multi-level assessment will focus on identifying and quantifying impacts of watershed programs in India along with the drivers of success, hindering bottlenecks/constraints, enabling policy and institutions for potential impacts of watershed programs in the country. The synthesis and identification of biophysical and socioeconomic constraints will be enriched by identification of potential and future options for improving impact of watershed programs in the country through more inclusive technological interventions through convergence, policy options, institutional arrangements and funding and implementing guidelines.

The proposed approach to undertake this complex and exhaustive study will be combination of macro and micro-level studies. It will also include detailed analysis of secondary data from the published literature as well as primary data collection through detailed case studies. The study would employ a consortium approach to undertake specific studies by the specialized institutions for

specific issues for e.g. policies and institutions, environmental services, agricultural productivity, social issues, collective actions, gender equity, etc. New science tools such as GIS and remote sensing methods along with well-tested conventional analytical tools by undertaking representative case studies will be employed.

The study attempts to employ various methods to assess the impacts of watershed development in Agriculture. It also attempts to identify the drivers of success in the bright watershed programs and innovations for enhancing community participation, there by developing suitable recommendation and policy guidelines. The speed breakers that resulted in failure of particular watersheds will also be studied to draw the lessons from the mistakes committed. The approach is as follows:

1. Review of published and departmental reports
2. Detailed case studies from major programs covering different agroecoregions
3. Synthesis of results, study impact and pathways of impact
4. Culling out the impact indicators, suitable technical, institutional policy and social options for achieving impact
5. Compilation and development of reports, policy briefs and recommendations for achieving greater impact of watershed programs
6. Identify gaps: knowledge, technologies, governance, policies, funds, etc.

Knowledge Review

Review literature and departmental reports for assessing impact of watershed programs. The specific data and information covering the following aspects will be collected.

- Area coverage and Benefit-Cost ratio
- Increased productivity
- Increased cropping area and intensity
- Increased irrigation and groundwater availability
- Conservation of Natural Resources
- Guidelines and institutional mechanisms
- Development of social, technical, human and physical capital
- Gender and equity issues
- Quantitative and qualitative impact indicators
- Exit strategies

Case Studies

The detailed case studies covering different agroecoregions in the rainfed areas, different watershed development programs, different implementing agencies, bright spots as well as not so successful watersheds will be covered. The widely consultative and the approach will be participatory involving different stakeholders and analytical in nature for drawing broad policy guidelines.

Criteria for Selecting Case Studies

The watershed programs will be grouped based on objectives, agroecoregions, implementation guidelines or approach, source of funding and implementing agency, etc. Stratified and random sampling technique will be used for identifying case studies. All available secondary data will be collected and analyzed for selection of detailed case studies involving all stakeholders.

Techniques to be Used

- Workshops and discussion meetings will be held to finalize the objectives of this study, methods to be adopted, approaches to be used and criteria to be followed for selecting detailed case studies.
- Meta analysis, which is also known as the '*analysis of analyses*' techniques will be used to collate the research findings from the selected detailed case studies, and distil them for drawing broad conclusions.
- Detailed case studies at micro level.
- Participatory Rural Appraisals, Rapid Rural Appraisals.
- Focused Group Meetings, interactions with implementing agencies, program executives, policy makers and public representatives will be organized.
- Impact indicators/parameters used by various watershed development programs and qualitative data will be compiled.
- Missing data links in the published information will be identified and the analysis of the impact indicators and parameters will be done.
- Workshops to discuss findings prior to final outputs preparation in the form of final reports and policy briefs for reaching large number of audience nationally and internationally

Information on detailed case studies to be collected (based on the available data sets)

- Guidelines and institutional arrangements including exit strategies
- Community participation
- Gender and equity

- Convergence of different actors-linkages with market, private entrepreneurs, funding agencies, etc.
- Benefit-cost ratios
- Technical interventions
- Crop productivity and cropping intensity
- Expansion of irrigated area and increase in sources of irrigation
- Reduction in flooding and soil loss
- Changes in soil and water quality
- Improved water availability, increased land cover / vegetative cover
- Increased incomes and prosperity
- Social capital development by way of developing new institutions
- Human Resource Development
- Improved access to information and Ecosystem Services provided

The drivers of success as well as hindering bottlenecks will be identified. Innovations and best-bet practices will be identified and compiled. Critical analysis of the benefit-cost ratios and internal rate of returns from the various case studies will be carried out. Drivers, particularly for improved participation, addressing equity and gender issues will be identified. The policies and institutions responsible for the impacts will be identified. A detailed analysis will be made to understand the policies and governance mechanisms that were responsible for the gaps for the desired impacts. Critical assessment of the gaps in the impact will be made with respect to lack of technical inputs and inappropriate approaches.

IV. OUTPUTS (Deliverables)

The project will deliver:

1. *A State of the Art Knowledge Report*. A comprehensive report on spatial and temporal progress of watershed development in the country based on agroecological zones, states, covering:
    - Extent and source of funding for watershed development programs.
    - Assessment of the impacts of watershed development programs in the country.
        - Area coverage and Benefit-Cost ratio
        - Increased productivity
        - Crop productivity and cropping intensity
        - Expansion of irrigated area and increase in sources of irrigation

- Reduction in flooding and soil loss
- Changes in soil and water quality
- Improved water availability, increased land cover / vegetative cover
- Increased incomes and prosperity
- Social capital development by way of developing new institutions
- Human Resource Development
- Conservation of Natural Resources
- Development of social, technical, human and physical capital
- Gender and equity issues
- Quantitative and qualitative impact indicators

• Guidelines and institutional mechanisms including exit strategies

2. Manual on Integrated watershed management covering various aspects of
   • Best technological interventions and their impact
   • Qualitative and quantitative impact monitoring indicators
   • Facilitating policies and institutional mechanisms
   • Drivers for bright spot watersheds including drivers for enhancing community participation, gender and equity perspectives
3. *Synthesis*. The knowledge gained from a variety of studies will be synthesized to provide answers to some key questions about watershed programs and their impact in India: whether key watershed program interventions in rainfed areas can deliver food, livelihood, and environmental security now and in the future; what those key interventions are; and where more understanding is required.
   • Qualitative and quantitative impact monitoring indicators
   • Facilitating policies and institutional mechanisms
   • Drivers for bright spot watersheds including drivers for enhancing community participation, gender and equity perspectives

Another important output of the project will be the Databank for Watershed Development Programs in India. Lessons learnt from the earlier watershed development programs and broad recommendations for enhancing impacts of watershed programs will be documented.

4. *Communication and Outreach*. The Comprehensive Assessment Program places much effort in delivering key messages to a number of stakeholders. The research findings from this comprehensive assessment will be communicated through working papers, policy briefs, and workshops at national level based on the outputs of reviews, specific micro-level case studies undertaken through the comprehensive assessment, and synthesis.

A CD-ROM will be prepared based on the major findings and useful datasets from this study.

Time frame: The proposed time frame for comprehensive study is two years however, the outputs will be spread over the period grouping them in to short term deliverables and long-term deliverables. For each quarter of six-months milestones to reach proposed outputs are indicated below:

V. MILESTONES

I Quarter

- Planning workshop held with important consortium partners to discuss and finalize methods and approaches to identify case studies and indicators for monitoring.
- Detailed work plans prepared with the concerned partners and work initiated for state of the art knowledge review, micro-level case studies, analysis of policy guidelines.

II Quarter

- Draft report on state-of-the-art knowledge covering programs, guidelines, and policies.
- Primary field data and secondary data for the selected programs completed,
- Annual Report of the work progress submitted.

III Quarter

- Mid-term review and planning meeting of the project team members
- Draft of watershed manuals prepared
- Analysis and synthesis of all data competed

IV Quarter

- Three regional workshops to disseminate the project results held. Summary proceedings prepared.
- National Workshop to discuss the project findings held and workshop inputs synthesized for finalizing the reports.

Final Reports on

- Watershed Manual covering best technological options and impact monitoring indicators
- Report on impact of watershed programs, drivers of success, enabling policies and institutions

- CDs covering reports prepared.
- A synthesis report for the planners and policy makers.

Core Project Team (Project Lea der, SP Wani, Team Members: P Pathak, Piara Singh, Rosana P Mula, TK Sreedevi and Prabhat Kumar) and Consortium Partners

VI IMPLEMENTATION ARRANGEMENTS

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is one of the 15 international centers of the Consultative Group on International Agricultural Research (CGIAR) co-sponsored by the FAO and the World Bank. ICRISAT's apolitical and independent nature enables to act as bridge, broker, and catalyst between various national, regional, and international organizations working for upliftment of millions of poor people to achieve the food security while maintaining the environmental quality.

ICRISAT will provide excellent coordination and leadership in implementing this project. It will continue to be responsible for the overall technical and financial management of the study including providing technical backstopping. A multi-disciplinary team of scientists from ICRISAT will provide technical support in the consortium mode in cooperation with Department of Agriculture and Cooperation, Government of India for managing natural resources sustainably. The project will be managed and supervised by Project Coordinator, ICRISAT and implemented by adopting consortium approach.

The project will be implemented over two years. ICRISAT will submit annual progress reports to the Chair, National Watershed Committee, Government of India. ICRISAT will procure goods and services and recruit short-term specialists in accordance with ICRISAT guidelines for procurement and guidelines on the use of consultants as appropriate, or through other arrangements. Within three months of completion, ICRISAT will submit a comprehensive project completion report.

Duration: 2 years

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Annexure IV

PowerPoint Presentations

METHODS FOR IMPACT ASSESSMENT OF WATERSHED PROGRAMMES

K.PALANISAMI

TAMIL NADU AGRICULTURAL UNIVERSITY

COIMBATORE

Watershed Development Activities

- Planning
- Formulation of CBOs
- Entry Point Activities (excluded in Haryali guidelines)
- Watershed Treatments
- Exposure visits
- Training

Watershed Management in India

Two third of cropped area is rainfed

Rainfed agriculture

- Low productivity
- Degraded natural resources
- Widespread poverty

Watershed development from SWC to rural development thro institution building

Different ministries viz MoA, MoRD, MoEF and NGOs, INGOs

Objectives

- promotion of economic development of village community
- employment generation and
- restoration of ecological balance

Watershed treatment activities

- Soil and moisture conservation
- Drainage line treatment measures
- Water resources development
- Horticulture plantation
- Afforestation

Watershed Development Activities

- Planning
- Formulation of CBOs
- Entry Point Activities (excluded in Haryali guidelines)
- Watershed Treatments
- Exposure visits
- Training

Methodological challenges

Nature of watershed technologies and its impact on different sectors poses challenges. More specifically, major challenges include

what impacts to assess

where to look for these impacts

choice of methodologies

selecting appropriate indicators to assess the impacts

choice of discount rate and life of the project

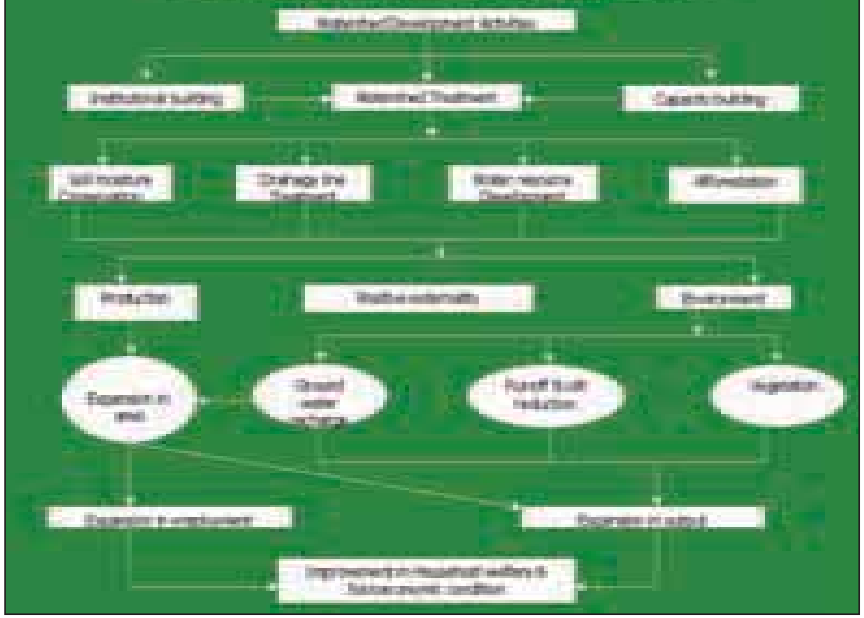
incorporating risk in assessing benefits

integrating indicators and assessing overall impact of the project

Funding pattern for WSD

1999 Guidelines	2001 Guidelines	2003 Haryali Guidelines
Cost norm : Rs.4000/ha	Cost norm : Rs.6000/ha	Cost norm : Rs.6000/ha
Watershed treatment : 80%	Watershed treatment : 80%	Watershed treatment: 83%
Community mobilisation and EPA : 5 %	Community mobilisation and EPA : 5 %	Community mobilisation and training : 5 %
Training : 5 %	Training : 5 %	
Administration : 10%	Administration : 10%	Administration : 12%

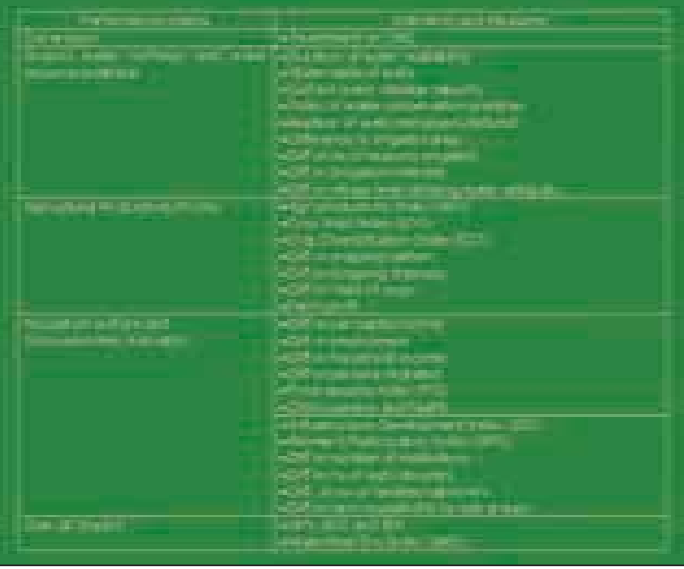
Framework for Watershed Impact Assessment



Why watershed impact assessment?

- Does the program achieve the intended goal?
- Can the changes or outcomes be explained by the program, or are they the result of some other factors occurring simultaneously?
- Do program impacts vary across different groups of intended beneficiaries, regions, different programmes and over time?
- Are there any unintended effects of the program, either positive or negative?
- How effective is the program in comparison with the resources it costs?
- Feedback for future programmes

Indicators for watershed IA



Approach for impact assessment of watersheds

- Quantitative and Qualitative
- Combination of before and after and with and without

  Benchmark information be collected and compared with after intervention.

  Control villages be selected and compared with watershed intervention.

  Comparison of before and after and with and without and find out the impact due to watershed intervention.

Methodologies : What is needed ?

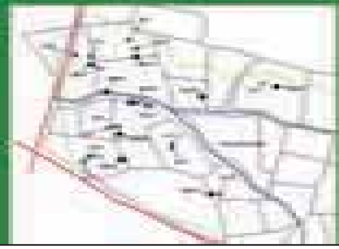
1. Watershed Performance Index (WPI)
2. Redefining the benefits in IWD
3. Decomposing natural and artificial recharge

Developing indicators for IA in watershed development

- Soil conservation
- Groundwater recharge Water resources development
- Agricultural production
- Socio-economic conditions
- Overall impact

Pumping test of Karanampettai Study Area

Well No.	Date of Pumping Test	Depth of Well (m)	Discharge (lpm)	Pumping Hours	Transmissivity (m²/d)	Specific yield
KP-4	13/04/2004	25.80	300	2	22.18	0.09548
KP-5	27/12/2004	21	250	8	27.52	0.02262
KP-6	20/12/2004	21.65	250	2	19.26	0.10846
KP-7	20/12/2004	21	250	2	18.75	0.07825
KP-3	28/12/2004	16.5	200	2	16.26	0.07128
KP-9	28/12/2004	18	250	2	17.52	0.08256
KP-10	03/12/2004	18.6	300	3	20.14	0.08123



1. Watershed Performance Index (WPI)

Situations where more number of watersheds to be assessed and compared

Eg.

$NPV = a_0 + b_1 NPOND + b_2 NCD + b_3 CP + b_4 SOIL + b_5 NWELLS + b_6 LOCATION + U_i$

Where,

NPV	= Net Present Value in Rs.
NPOND	= Number of percolation ponds in the watershed
NCD	= Number of check dams in the watershed
CP	= Cropping pattern
SOIL	= Soil type
NWELLS	= Number of wells in the watershed
LOCATION	= Location of micro watershed in the subwatershed

Recharge pattern in observation wells - Karanampettai

Distance from the pond (m)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Date and Days from start of pond filling		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
01/10/2004	0 day	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	5 days	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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29/10/2004	29 days	1.76	1.75	2.40	2.06	1.78	0.91	2.11
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

2. Redefining the benefits in WSD

- Based on the zone of influence
- Incorporating risk in quantifying the benefits (rainfall)

Water balance in Karanampettai recharge structure

Particulars	April to June 2005	July to September 2005	October to December 2005	Total
Rainfall	242.2mm	92.4mm	355.92mm	690.42mm
Inflow/Runoff volume	5,353 m³ (1.6%)*	3,518 m³ (2.7%)*	13,762 m³ (2.8%)*	22,633m³ (2.3%)*
Out flow volume	-	-	3,210m³	3,210 m³
Volume stored	5,353 m³	3,518 m³	10,552 m³	19,422m³
Evaporation volume	743m³ (14%)*	580m³ (17%)*	892 m3 (8%)*	2215m³ (11%)
Percolation/ infiltration volume	4,604 m³ (86%)*	2937 m³ (83%)*	9,660 m3 (92%)*	17,201 m³ (89%)*

Note: * - Percent to the stored volume; *- Percent to the rainfall volume

Expected Quantity of Rainfall (mm) for a given probability of exceedence based on Gamma distribution

Season	Probability of exceedance (%)				
	10	30	50	70	90
SWM	290	221	180	145	102
NEM	520	384	304	237	159
Summer	215	170	142	118	88
Year	891	742	649	564	456

Mean rainfall (mm): SWM= 188.97 ; NEM= 325.80; Summer=147.80; Year=663.7

Recharge details of Karanampettai Artificial Recharge Structure

Catchment Area	1.4026 km²
Rainfall in Recharge Period	691.42 mm
Volume percolated by Structure	17200 m³
Depth Equivalent	12.2 mm (1.8% of Rainfall)
Natural Recharge as estimated by the Project	41.47 mm (5%=6.8/43.9%) @ 6% of Rainfall
Natural Recharge estimates by CGWB (4-8% of Rainfall)	27.65 mm
Increase in Recharge due to structures in relation to project estimates (artificial/natural)	29.75 %

3. Decomposing natural and artificial recharge

- How to decompose the groundwater recharge due to artificial recharge

Impact Assessment of Watershed Development: Some Methodological Issues

Amita Shah
Gujarat Institute of Development Research,
Gota, Ahmedabad

Inception Workshop on Comprehensive Assessment
Of Watershed Programmes in India
June 6-7, 2006
NAAS, New Delhi

Organised by
ICRISAT

Implementation of WDPs: Inherent Constraints

- Striking a Balance Between Conservation & Utilisation of NR (Multiplicity of Objectives)
- Scientific Measures Cut Across Boundaries: Fields, Villages, Stakeholders Interest
- Trade-Off Among Resources, Stakeholders
- Resultant Impact is Often Slow and or Non-Substantial
- Interactive Process Involving Interface Between Physical & Social Engineering

WSD
- An Approach Rather Than A Project
- A Continuous Process Through Eco-Incentive & Subsidies

Achievements: A Broad Overview

- YIELD GAINS though, LIMITED & SELECTIVE (ON IRRIGATION PLOTS)
- GROUND WATER RECHARGE though, LOW WATER-USE EFFICIENCY
- REDUCED SOIL EROSION
- EMPLOYMENT GENERATION though, NON-RECURRING
- FORMATION OF SHGs
- ENVIRONMENTAL AWARENESS

Three Aspects of Impact Assessment

- Bio-Physical (Scientific Measurements on Limited Sites; GIS-Based)
- Socio-Economic (Survey based. Collecting Quantitative data. Using with-without or before-after comparison or combining the two)
- Institutional (often peripheral, using indicators of functional aspects rather than assessing robustness of institutions)

Mainly Focusing on Outputs (rather than Processes and Outcomes)

Major Strands of Approaches

1. Survey-Based (Official Programmes)
2. Participatory (NGO sponsored in selected cases)
3. GIS-Based
4. Combination of the Three (SOPPECOM, WASSAN, ForWaRD)

Limitations of the Existing Body of Knowledge

- Studies often adopt narrow, poorly defined and disparate notions of what constitutes "proper" rural development, largely within a "project" or programme framework
- Controls and benchmark data are largely missing
- Studies are short-term, whereas real impacts are visible only much later, especially in sequential drought years;
- Bio-physical changes do not get linked to their socio-economic impacts (i.e. it is assumed that these changes will lead to certain socio-economic benefits), or vice-versa changes in socio-economic parameters are assumed to be driven by improvements in bio-physical parameters, which are not monitored;
- Macro-level assessments miss out on the downstream effects;
- Absence of participatory monitoring approaches and increasing reliance on high-tech (but limited) monitoring such as through remote sensing, and a general lack of understanding of the importance of rigorous monitoring amongst implementers; and
- A Simplistic focus on aggregate, discounted economic returns masks inequity and non-translucidity of impacts
- An excessive focus on assessing or valuing outcomes leads to limited understanding of the socio-ecological processes through which investments get implemented, technologies are adopted and modified, conflicts are negotiated, and social norms are developed

Inconclusive Evidence: Methodological Limitations

(a) Selecting a proper control in an analysis using with-without comparison;
(b) absence of adequate base line information on vital parameters like access to irrigation, fertiliser use, seed variety, soil type and topography etc;
(c) lack of adjustment for rainfall related uncertainties;
(d) capturing only one-time employment gains including change in migration;
(e) cursory approach for assessing changes in physical parameters like soil moisture, ground water table, survival of plantation etc;
(f) problem of segregating the impact;
(g) Objectivity.

Post-Facto Studies

(i) Rapid Assessment

(Focusing on Physical Verification of Treatments, Geo-Hydrological Conditions, Presence of Institutions)

(ii) Detailed Assessment

(Combining various approaches especially in contiguous areas covered under WDP-treatments) preferably where Base-line Data are Available

Practical Problems Faced on Benchmark and Post-Facto Studies

Benchmark:

(i) Delineation of Micro Watersheds not clear
(ii) Data on Rainfall not available
(iii) Multiple Interventions
(iv) Absence of Institutional Arrangements for Installing Monitory gadgets
(v) Accessing Maps

Post-Facto:

(i) Choice of Time for Single Visit Survey
(ii) Problem of Segregating the Impact
(iii) Difficult to find Records of WDC SHGs etc.
(iv) Biased by Secretary/ Chairperson of WDCs
(v) Stock Taking Vs. Evaluation Mode

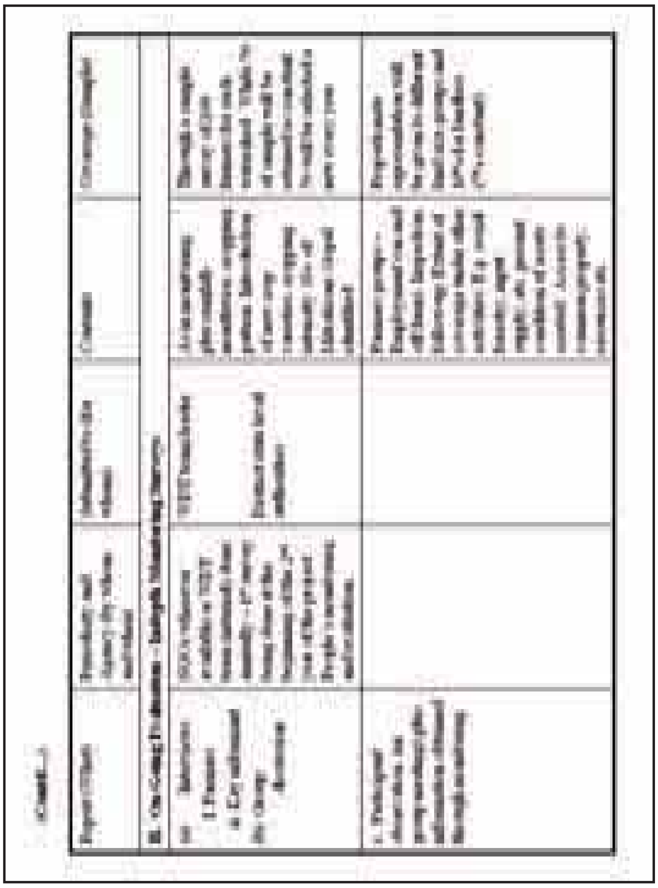
Need for Co-ordinated Efforts

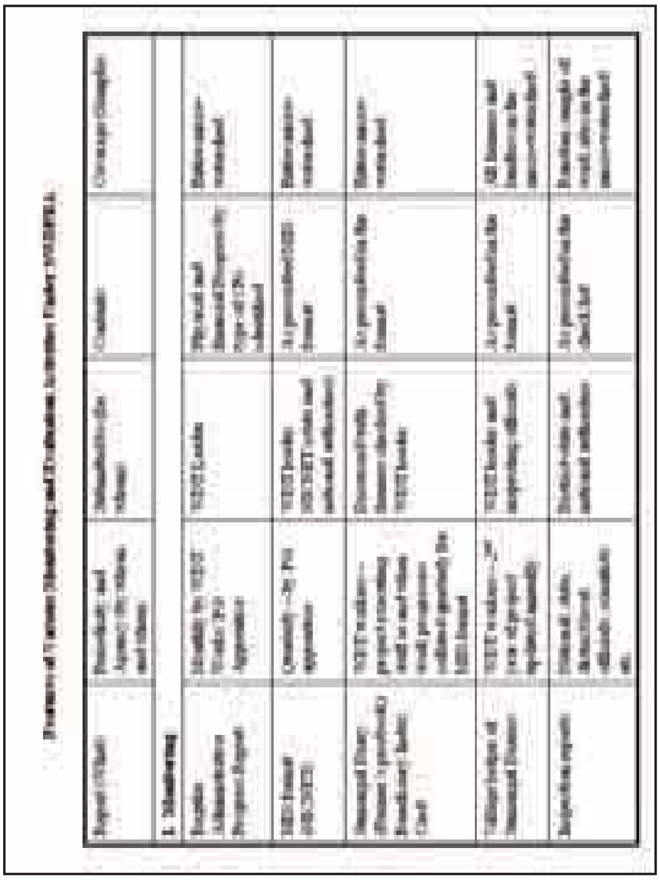
Tentative List of M & E Indicators

	Item	Indicator	Frequency	Method
1	Employment	Total Per unit of activity Employment/Rs. 1000 spent Migration	[illegible]	[illegible]
2	[illegible]			
a	[illegible]	[illegible]		[illegible]
b	[illegible]	[illegible]		-do-
c	[illegible]			
d	[illegible]			
3	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible] -do-
5	Productivity	[illegible]	[illegible]	-do-
6	Income	[illegible]	[illegible]	-do-
7	[illegible]	[illegible]	[illegible]	-do-

(Contd...)

	Item	Indicator	Frequency	Method of data collection
8	Impact on Women	Employment Wage rate [illegible] Other activities	[illegible]	[illegible]
9	People's Participation	[illegible] [illegible] [illegible] Management of common property resources	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]





Watershed impact assessment

6-7 June 2006
NASC, New Delhi, India

Facilitators of Impact

- Collective action/ Group action
- Property rights
- Private benefits vs. social benefits
- Capacity building
- Information access
- Institutional linkages
- Governance issues

Impact Assessment

- Why impact assessment?
- What are the impact indicators?
- What are the methods?
- What data set is needed?
- How to do impact assessment?

Why Impact Assessment?

- Watershed development involves commitment of huge financial outlays
- Donors seek evidence on impact as a basis for future financial support
- Helps in decision making process
- Basis for more efficient resource allocation

Impact Indicators

- Farm level
- Regional level
- National level

Farm Level Indicators

- **Efficiency**
  - **Profit**
  - **Cost reduction**
- **Crop productivity**
- **Irrigated area**
- **Cropping intensity**
- **Employment**
- **Household food security**
- **Risk management**
- **Natural resource conservation**
  - **Reduction in desertification and soil loss**
  - **Changes in soil and water quality**

Regional Level Indicators

- Agricultural production
- Food security
- Employment issues
- Gender and equity issues
- Poverty
- Inter-sectoral linkages
- Sustainability of natural resources
- Social capital development

National Level Indicators

- Production
- Prices
- Employment
- Poverty
- Spill-over effects
- Sustainability of natural resources

Methods

- Benefit-cost analysis
- Econometric approach
  - Changes in marginal productivity
  - Decomposition of neutral and non-neutral changes
- Economic surplus approach
- Meta analysis

Data Set

- Depend on the method used for impact
- Time of impact assessment
  - Ex ante assessment
  - Ex post assessment
  - Concurrent evaluation
- Efficiency indicator
  - Stream of costs and benefits
    - Before and after technology
    - With and without technology

Endocrinology of Yak Reproduction

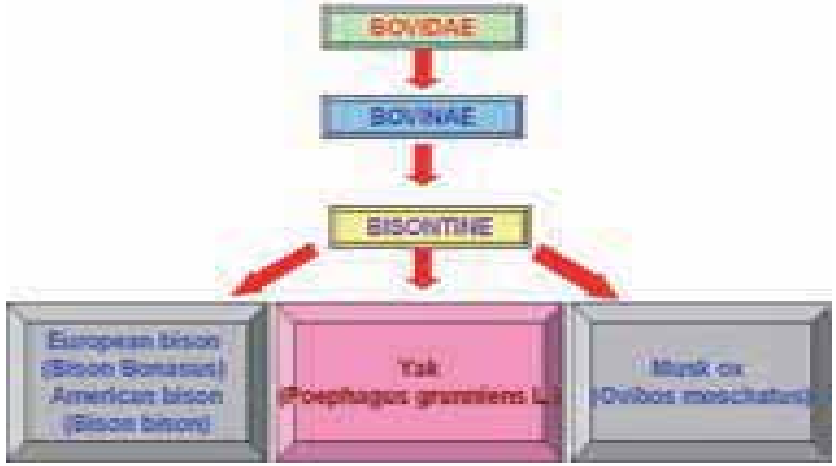
Mihir Sarkar

National Research Centre on Yak

Indian Council of Agricultural Research

Dirang 790 101,

Arunachal Pradesh



The generic name 'Poephagus' means grass eater and grunniens accounts for its grunt.

- Total world's yak population - 15 millions
- More than 85 percent of the population in China (12 Million) and Mongolia (0.55 million).
- Natural habitat 3000-6000m. above msl.

India

Arunachal Pradesh

Sikkim, J&K, HP & Uttaranchal

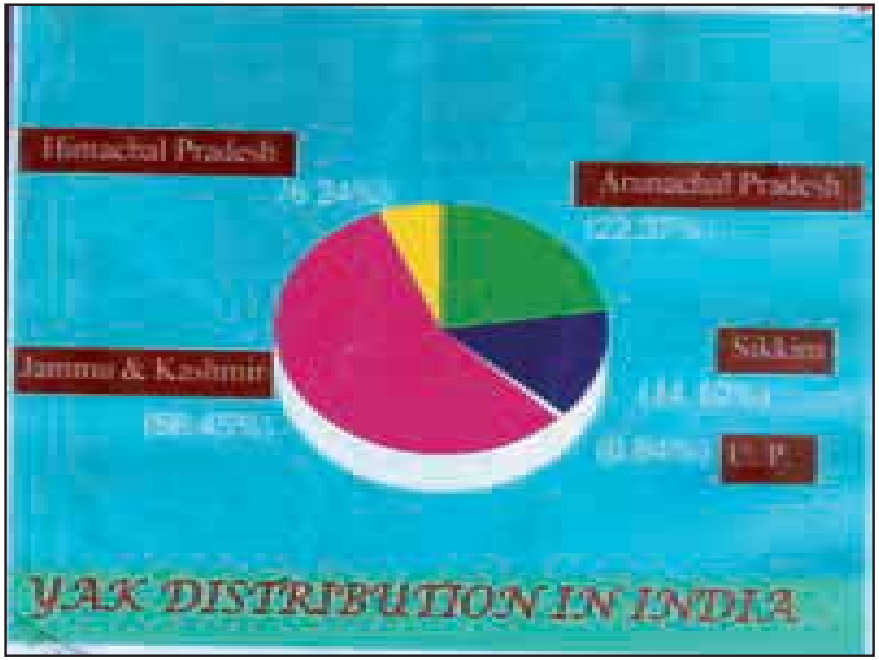
1977

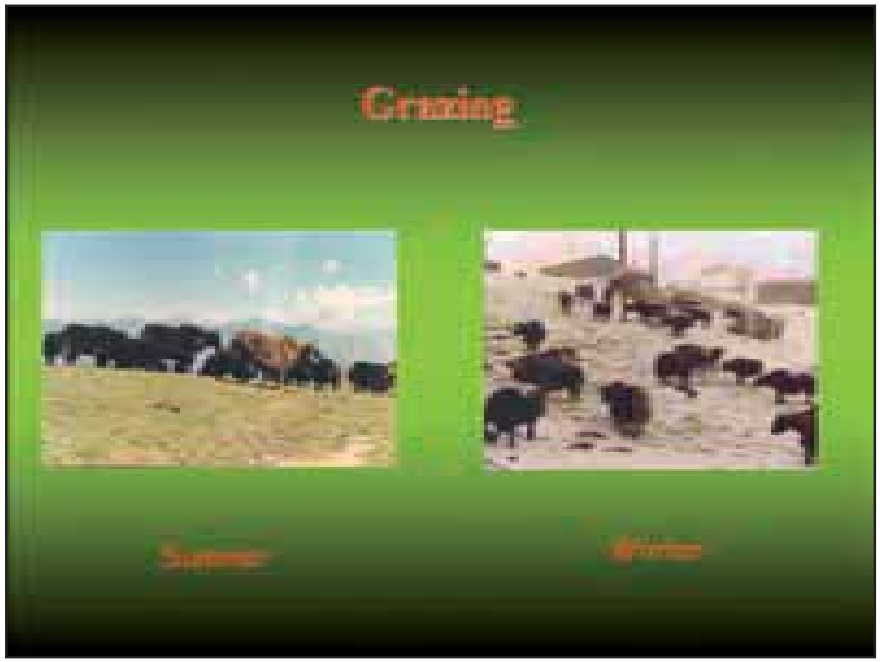
Census

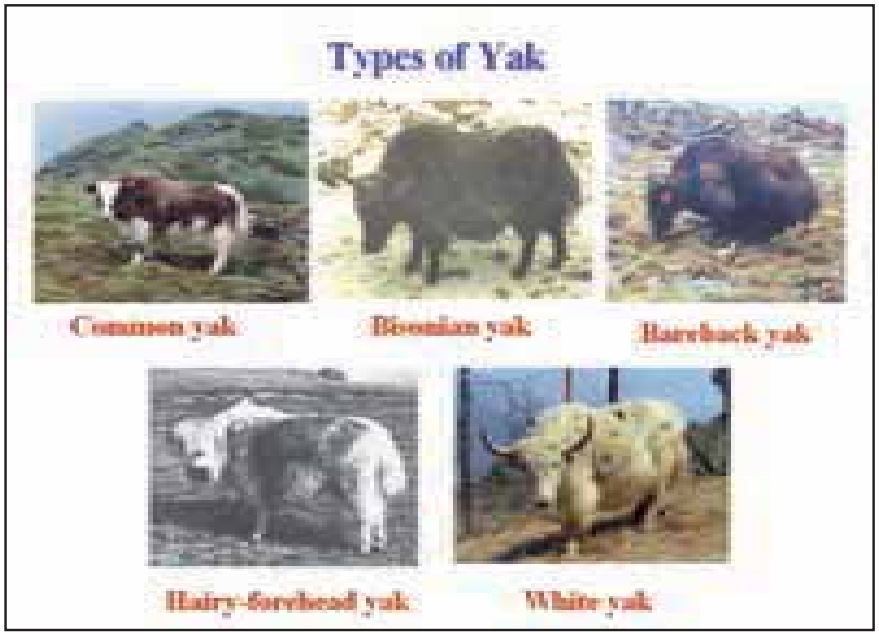
132,000

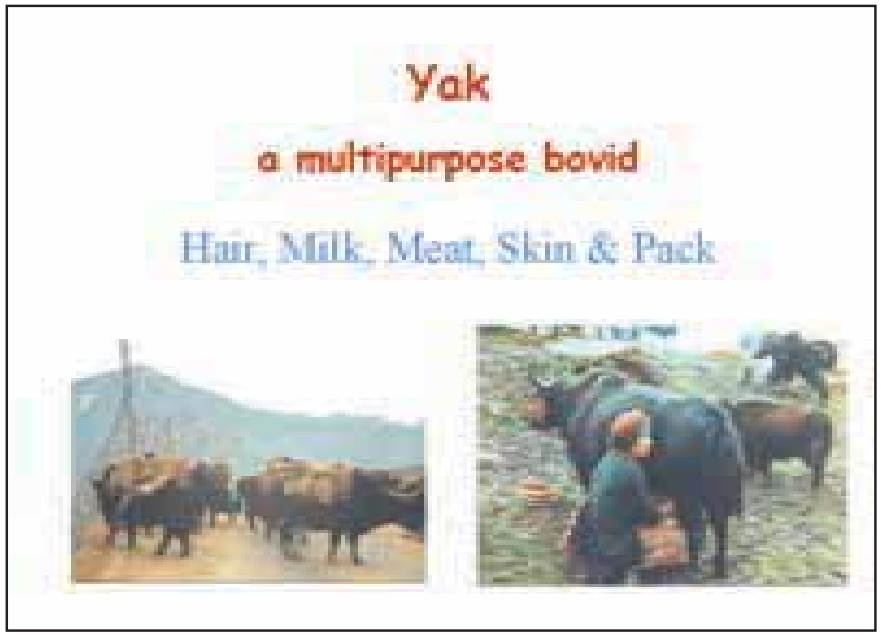
Present

70,000


Himachal Pradesh
Arunachal Pradesh
Sikkim
Jammu & Kashmir
U. P.
YAK DISTRIBUTION IN INDIA


Grazing


Types of Yak
Common yak
Bosonian yak
Barrback yak
Hairy-forehead yak
White yak


Yak
a multipurpose bovid
Hair, Milk, Meat, Skin & Pack

SOCIO- ECONOMIC IMPORTANCE

- Yak milk and meat are the main source of protein requirement
- Milk products like churpi , butter, ghee, toffee and salted tea
- Hat, tent, rope, blanket, sweater
- Purse, bag, shoes
- Own consumption
- Religious offering
- Earning other livelihood such as rice, maize, salt etc

REPRODUCTIVE PROBLEMS

- Late maturity (attain puberty at the age of 3.5-4years)
- Poor estrus expressivity (Weak heat symptoms)
- Seasonality of estrus (Breeding season from July to November)
- Long calving interval (2 calvings in 3 years)

Limits fertility and makes difficult for income generation.

- Drastic decline in yak population
- Cause of concern as they largely caters the need of highlanders.
- Threatened species (IUCN,2003)
- Conservation of yak genetic resources has got worldwide attention.

Objectives

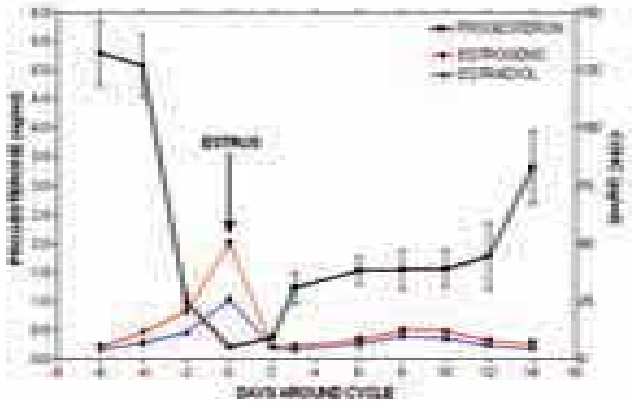
1. Validation of simple, direct and sensitive radio and enzyme immunoassays for steroid and protein hormones in yak plasma
2. Application of hormone assays for studying physiology of reproduction in yaks
3. Application of endocrine biotechniques for augmenting fertility in yaks
4. Standardization of artificial insemination process in yak

Validation of immunoassays

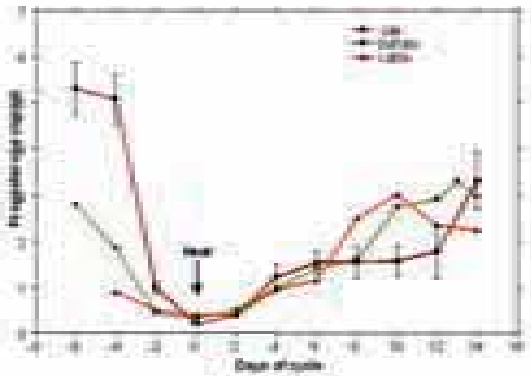
	Hormone	Technique	Reference
1.	Progesterone	RIA	Zoological Science,2005: 22(10): 11571162
2.	Melatonin	RIA	Animal Reproduction Science,2005: 90(1-2): 149-162
3.	Total Estrogens	EIA	Theriogenology, 2006: 65: 721-730
4.	Estradiol-17β	EIA	Theriogenology,2006: 65: 721-730
5.	LH	EIA	Animal Reproduction Science,2005 88(3-4): 353-362.
6.	Oxytocin	EIA	Theriogenology ,2006: 65: 496-516
7.	Prolactin	EIA	Animal Reproduction Science,2005: 90(1-2): 149-162
8.	GH	EIA	Paper presented in the 4th International congress on yak, September 19-26,2004, Chengdu, P.R. China

HORMONAL CONCENTRATIONS DURING ESTROUS CYCLE

Plasma progesterone, total estrogen, estradiol-17β, profile during estrous cycle in yak.



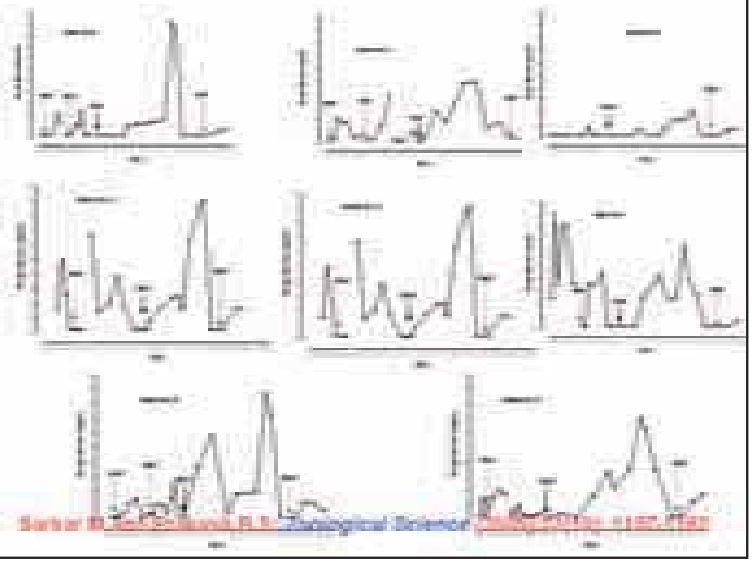
Comparison of plasma progesterone profiles during estrous cycle in Yaks, Cattle and Murrah buffaloes



Cattle: Mondal and Prakash (2009)

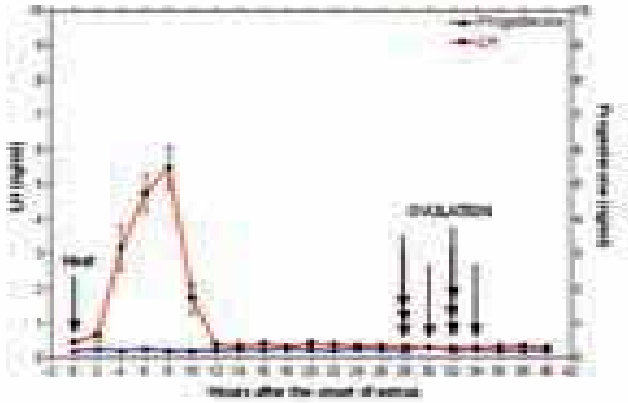
Buffalo: Patle et al. (2009)

Plasma progesterone as a marker for the determination of cyclicity in yak



Timing of LH surge and ovulation during spontaneous estrus in yaks

Changes in plasma LH and progesterone profile in yaks after the onset of spontaneous estrus



Sarkar M and Prakash B S: Animal Reproduction Science 2005; 86(3-4): 353-362

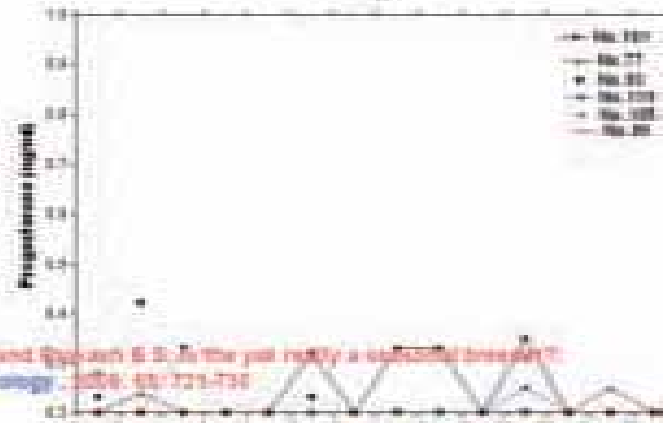
Plasma LH Peak characteristics and timing of ovulation in yaks exhibiting spontaneous estrus.

Parameters	Mean±SEM	Range
1.LH peak concentration (ng/ml)	10.11±0.35	8.75 – 11.51
2. Duration of LH peak (h)	3.25±0.75	2 – 6
3. Time from: Onset of estrus to onset of LH peak (h)	4.5±0.82	2 – 6
Onset of estrus to ovulation (h)	30.5±0.82	28 - 34
After end of LH peak to ovulation (h)	23.25±1.97	18 – 26

Sarkar M and Prakash B S: Animal Reproduction Science, 2005; 86(3-4): 353-362

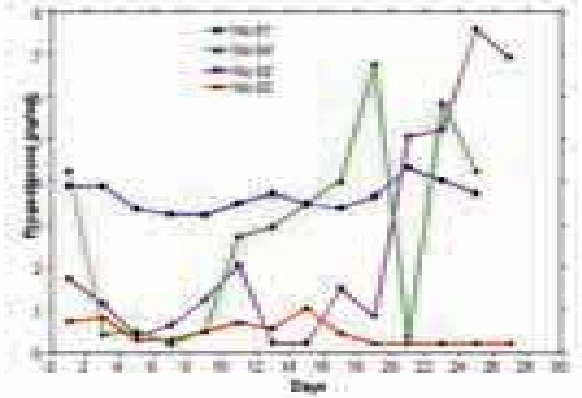
Is the yak really a seasonal breeder?

Plasma progesterone profile during non-breeding season yak



Sarkar M and Prakash B S: Is the yak really a seasonal breeder? Theriogenology 2006; 65: 721-735

Plasma progesterone profile during non-breeding season in yak



Sarkar M and Prakash B S: Is the yak really a seasonal breeder? Theriogenology , 2006; 65: 721-730

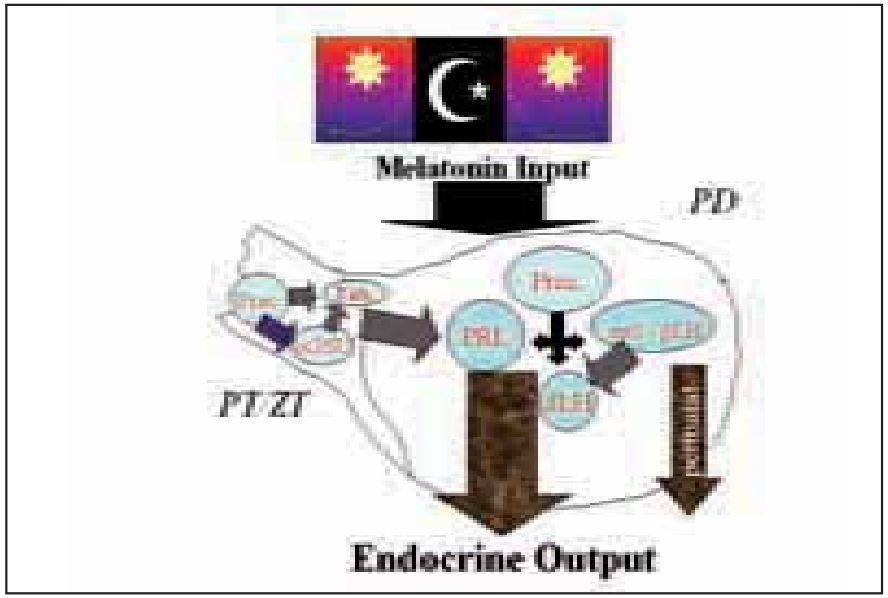
Conclusion

With improved nutritional support some yaks can be brought under cycling regimen even during the non-breeding period of the year

Circadian rhythmicity of melatonin and prolactin during breeding and non-breeding seasons

Melatonin and Reproduction

- Pineal gland acts as neuroendocrine transducer.
- Photic information is translated into endocrine output— Melatonin.
- Melatonin mediate changes in HPG axis and play a pivotal role in control of reproduction in seasonal breeders like sheep & Goat (Lincoln, 1978), horse (Hart *et al*, 1983).



Prolactin and Reproduction

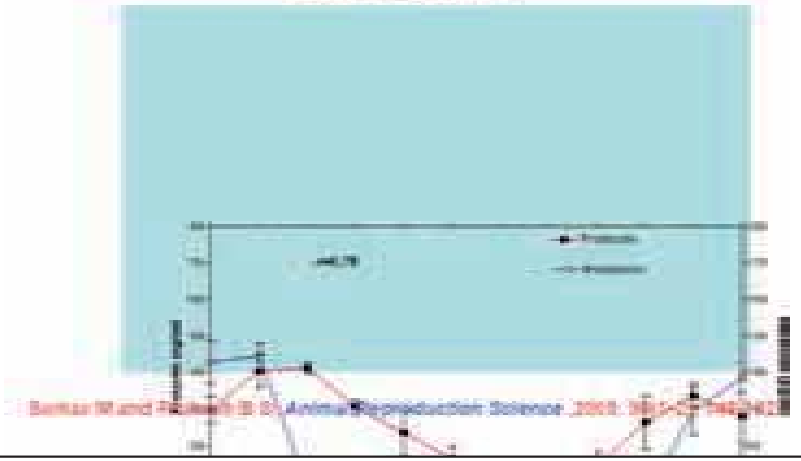
- Prolactin has been implicated in reproduction due to its alleged interference in:

a) Ovarian steroidogenesis mainly estrogen production through inhibition of FSH-induced aromatase activity
b) Suppression of behavioral estrus
c) Ovulation and gonadotropin release from the adenohypophysis (Tindal, 1974; Kang and Schuma, 1974)

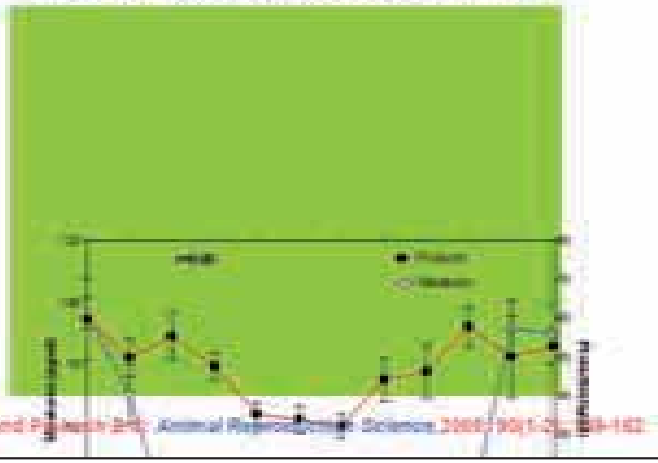
*Buffaloes suffer from silent heat problems during summer months, which arise from spurt of prolactin release due to severe heat stress. (Arya and Mohan, 1987)

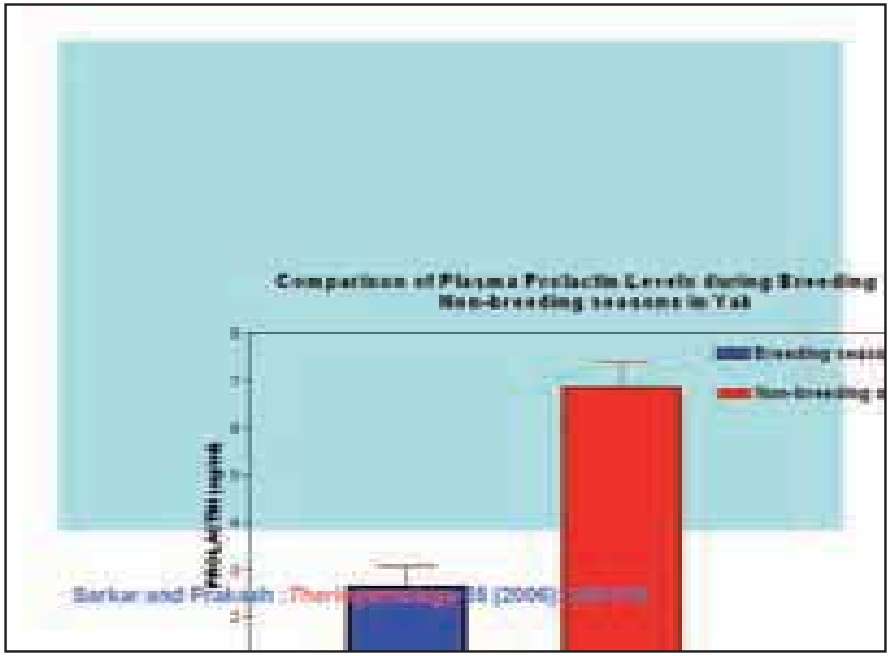
*Blocking the high prolactin levels increase the estrogen levels and animals show behavioral symptoms of estrus (Roy and Prakash,2005).

Comparison of circadian changes in plasma melatonin and prolactin profile (mean ± SE) in yak during breeding month



Comparison of circadian changes in plasma melatonin and prolactin profile (mean± SE) in yak during non-breeding season





Conclusions

1. Melatonin and PRL secretion followed a circadian pattern of secretion.
2. Melatonin and PRL secretion may be closely interrelated.
3. Higher PRL secretion during the non-breeding season could be due to nutritional and environmental stress and might be a factor contributing to lack of cyclicity.

Ovulation Synchronization in Yaks

- Silent or non-detected estrus is one of the major problems in yak reproduction.
- Proper heat detection is essential for potential artificial insemination practices
- To improve reproductive efficiency in yaks some estrus synchronization protocols utilizing PGF 2α treatment and others have been tried (Shao, 1996; Magash, 1997).
- The effectiveness of these protocols is however, dependent upon the precision of estrus detection and the time of ovulation after the synchronization.

* Behavioural estrus signs expressed after synchronized estrus are much weaker (Sarkar et al.2001).

*Recently a new estrus synchronization protocol (Ovsynch) has been developed which has been reported to considerably narrow down the ovulation time window

*Has the potential to achieve the maximum conception rate with set time AI in cattle and buffaloes (Pursley et al.1995; Paul and Prakash , 2005).

Events during Induced Estrus (GnRH-$PGF_{2\alpha}$ -GnRH)

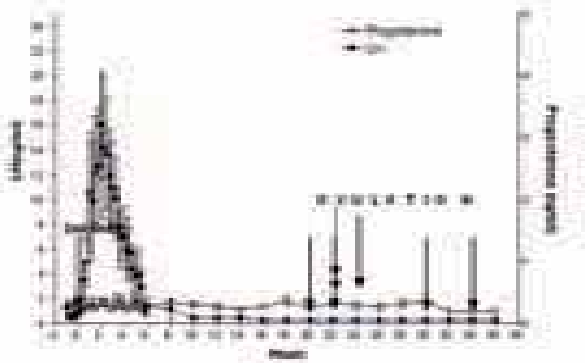
Estrus Behavior

•Estrus symptoms expressed: swollen vulva and mucus discharge on rectal palpation, excitement and chasing by bull.

•Intensity of these estrus signs was weaker than those observed after spontaneous estrus.

•Bellowing was not observed in any yaks.

Changes in LH and progesterone profile after the administration of 2nd GnRH in yaks treated with Ovsynch



Sarkar M and Prakash B S. Theriogenology. 2005; 63(8): 2494–2501

Plasma LH Peak characteristics and timing of ovulation in yaks subjected to Ovsynch protocol for estrus synchronization

Parameters	Mean±SEM	Range
1. LH peak concentration (ng/ml)	22.8±5.1	10.2- 40
2. Duration of LH peak (h)	4.69±0.36	2.75 – 5.75
3. Time of: Onset of LH peak after 2nd GnRH injection (h)	2.06±0.16	1.5 – 2.75
Ovulation after PGF 2α injection (h)	72.8± 1.95	68 - 82
Ovulation after 2nd GnRH injection (h)	24.8±1.95	20 - 34
Ovulation after end of LH peak (h)	18.96±1.91	14 – 29

Sarkar M and Prakash B S. Theriogenology 2005; 63(3): 3494-3501

CONCLUSIONS

1. Ovulation following Ovsynch protocol is well synchronized in yaks on account of successful regression of corpus luteum in most of the animals followed by highly synchronized LH response to the second GnRH administration

2.Successful application of this protocol for ovulation synchronization in yaks could make the potential application of fixed time AI very successful in this species.

Induction of estrus and synchronization of ovulation in anestrus yaks

*Recently an estrus synchronization protocol Heatsynch in cattle has been developed [Lopes et al.2006] which makes use of a combination of GnRH + PGF2α + Estradiol cyponate (ECP) injection.

Advantages of heatsynch:

1.Reduced hormone costs.

2. More efficient use of expensive semen and higher conception rate in animals since they are allowed to express estrus

3.Somewhat easier scheduling and implementation, since all injections and A.I. are at 24 hour interval in cows.

Heatsynch protocol for timed AI

Estrus Behavior

*All the nine animals responded to treatment.

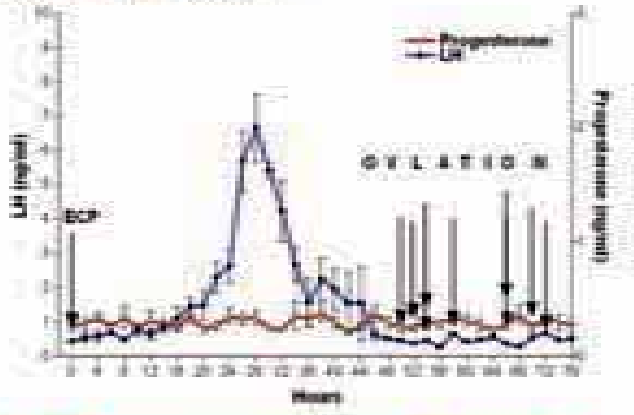
* Estrus symptoms expressed 39.8 ± 1.08h after ECP treatment.

Estrus symptoms expressed:

- Frequent urination
- Swollen vulva and uterine tone and mucus discharge on rectal palpation
- Excitement
- Chasing by bull
- Tail raising and bellowing

Intensity of these estrus signs were stronger and even more prominent than those observed after spontaneous estrus.

Changes in the plasma LH and progesterone profile (Mean±SE) after the administration of ECP injection in yaks (n=9) treated with heatsynch



Sarkar et al.: Livestock Production Science,2006 (Accepted)

Plasma LH surge characteristics and timing of estrus and ovulation in yaks subjected to Heatsynch protocol for induction of estrus and synchronization of ovulation

Parameters	Animals	Mean ± SEM	Range
LH peak concentration (ng/ml)	9	7.7±2.6	3.16-28.0
Duration of LH surge (h)	9	22±2.6	12-28
Time of:			
Onset of LH peak after ECP injection (h)	9	29.67±1.2	26-34
Onset of estrus after ECP injection (h)	9	39.8 ± 1.08	35-32
Ovulation after PGF2α injection (h)	9	84.22±3.4	74-96
Ovulation after ECP injection (h)	9	60.22±2.8	50-72
Ovulation after end of LH surge (h)	9	31.3±2.5	24-36

CONCLUSIONS

1. Heatsynch protocol can be successfully utilized for induction of estrus in anestrus yaks in order to cut short the long postpartum interval.

2. Ovulation following heatsynch protocol is well synchronized and the application of fixed time AI in this species can be successful.

Training of yak bulls, semen collection, extension, cryopreservation and artificial insemination

- Inbreeding due to improper herd size

- A total of five yak bulls trained for semen collection following AV technique

- Vaginal discharge was collected from estrus yak cows and applied it in the back region of non-estrus yak cows which were used as dummy.

- The inner temperature of the AV was maintained 50°C.

- Semen bank comprising of 1000 frozen yak straw have been produced

- A total of 10 estrus animals comprising 9 yaks and 1 local cow were inseminated using frozen yak semen straws.

- Pregnancy rate (50%) was determined on the basis of non-returning to estrus.

- Frozen yak straw is being distributed among the concerned departments of yak inhabiting states free of cost.

Das and Sarkar: Paper presented in the 4th International Congress on yak, September 19-26,2004 Chengdu, P.R.China

Conservation of yak genetic resources through embryo transfer technology

- Super ovulation was induced in 9 yak cows with FSH-P (Folltropin-V, Bioniche, Canada)

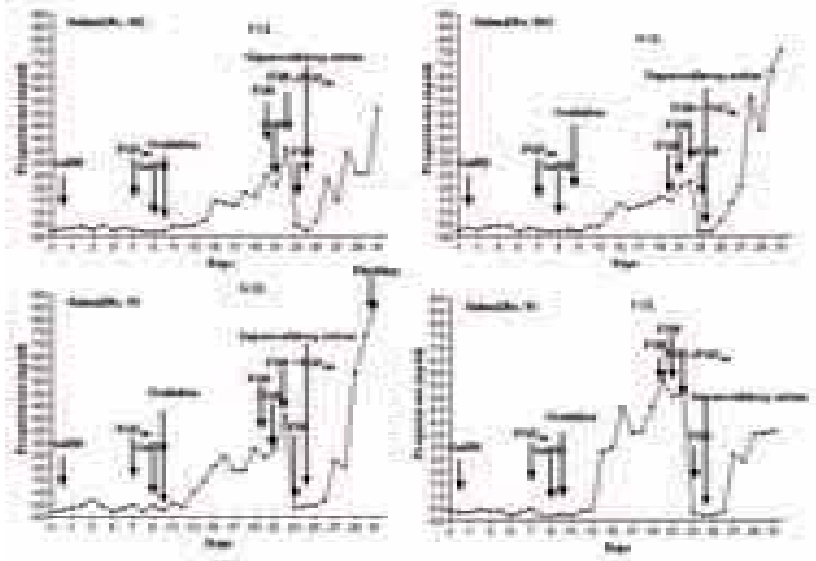
REGIMEN

DAYS	MORNING	EVENING
[illegible]	25mg FSH-P	25mg FSH-P
11TH	25mg FSH-P	25mg FSH-P
12TH	25mg FSH-P	

Numbers of palpable corpora lutea and recovered embryos for the individual yaks

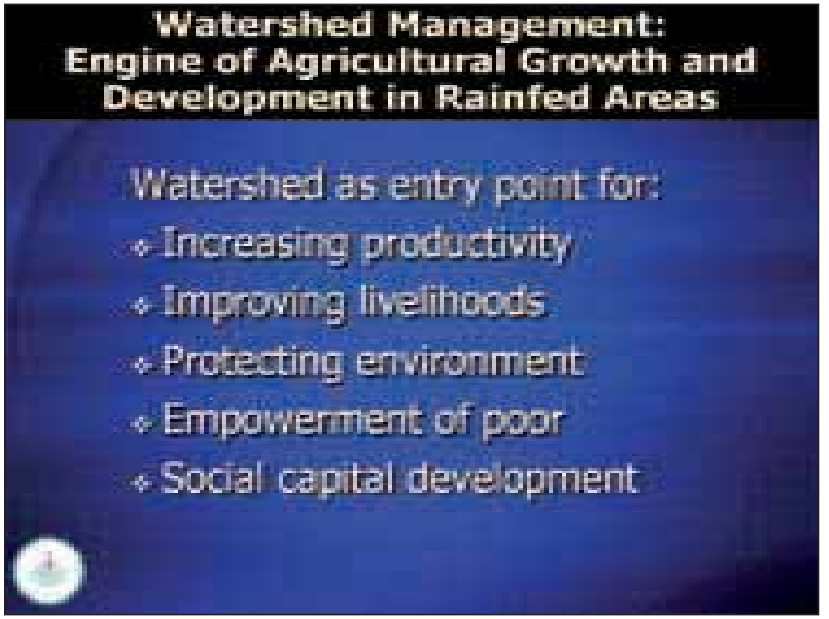
Animal No.	No. of palpable corpora lutea	No. of embryos recovered
102	3	1
95	3	1
6	1	0
90	5	2
89	5	2
87	0	0
33	0	0
59	6	3
104	4	2

Sarkar et al.(2006): Zoological science (In press)

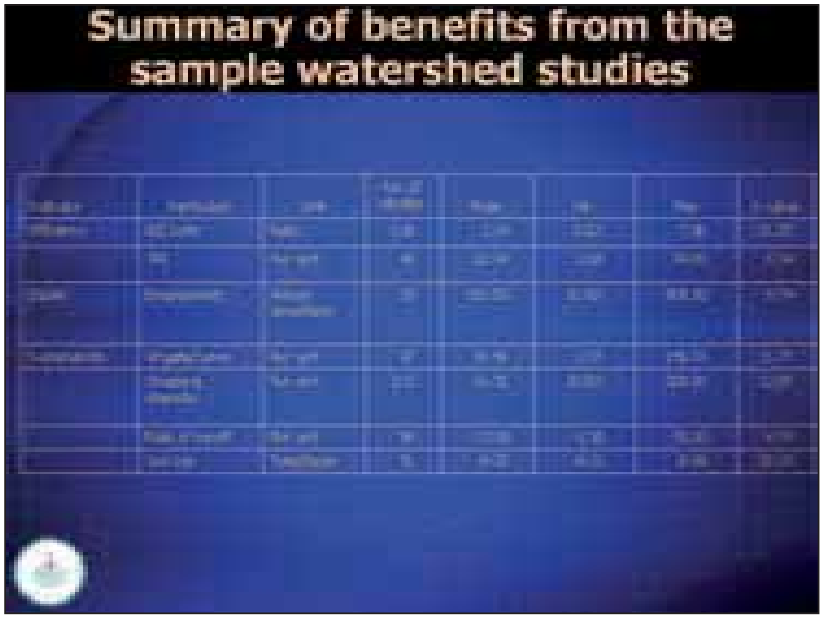


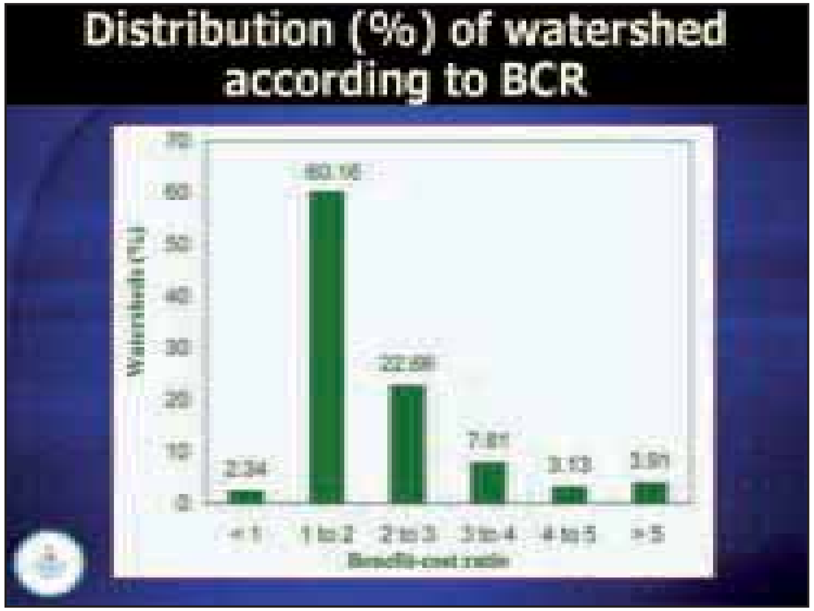
There are no full stops in human endeavor

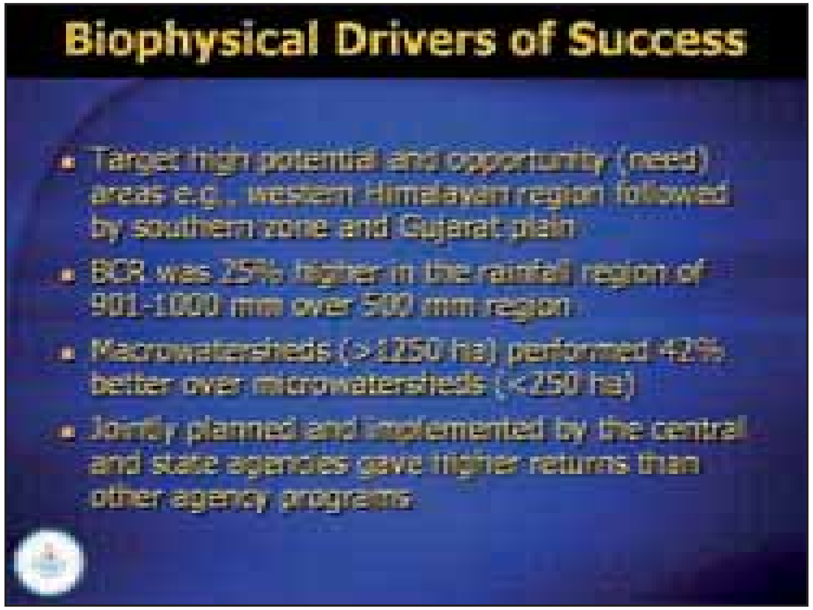

Drivers for Enhancing Impact and Sustainability of Watershed Management Programs

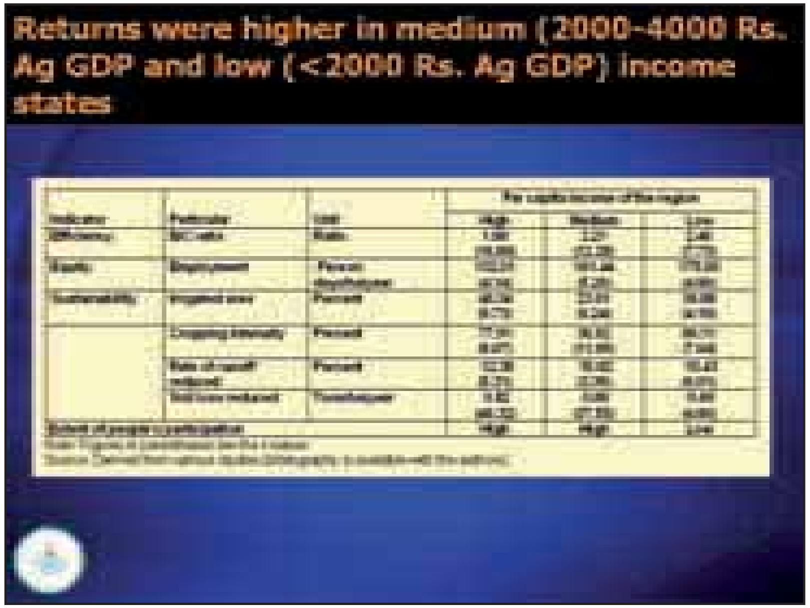

Watershed Management:
Engine of Agricultural Growth and Development in Rainfed Areas
Watershed as entry point for:
Increasing productivity
Improving livelihoods
Protecting environment
Empowerment of poor
Social capital development


Impacts
Increased productivity
Improved water level


Summary of benefits from the sample watershed studies


Distribution (%) of watershed according to BCR
Watersheds (%)
60.06
22.68
7.81
2.34
3.13
3.91
<1
1 to 2
2 to 3
3 to 4
4 to 5
>5
Benefit-cost ratio


Biophysical Drivers of Success
Target high potential and opportunity (need) areas e.g., western Himalayan region followed by southern zone and Gujarat plain
BCR was 25% higher in the rainfall region of 901-1000 mm over 500 mm region
Macrowatersheds (>1250 ha) performed 42% better over microwatersheds (<250 ha)
Jointly planned and implemented by the central and state agencies gave higher returns than other agency programs


Returns were higher in medium (2000-4000 Rs. Ag GDP and low (<2000 Rs. Ag GDP) income states


People's Participation is Critical
Indicator
Particular
Unit
People's participation
High
Medium
Low
Efficiency
B/C ratio
Ratio
IRR
Percent
Equity
Employment
Sustainability
Irrigated area
Percent
Cropping intensity
Percent
Rate of runoff reduced
Percent
Soil loss reduced

Adarsha Watershed, Kothapally, India: A Brightspot

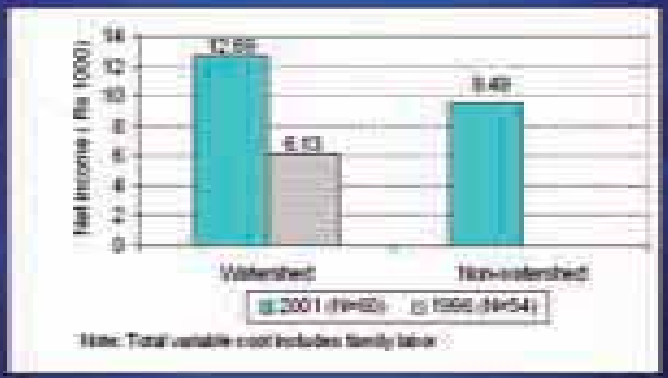
Adarsha Watershed, Kothapally, India: A Brightspot

- Increased productivity

Crop	[illegible]	[illegible]					
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	-	[illegible]	[illegible]	-	-	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]

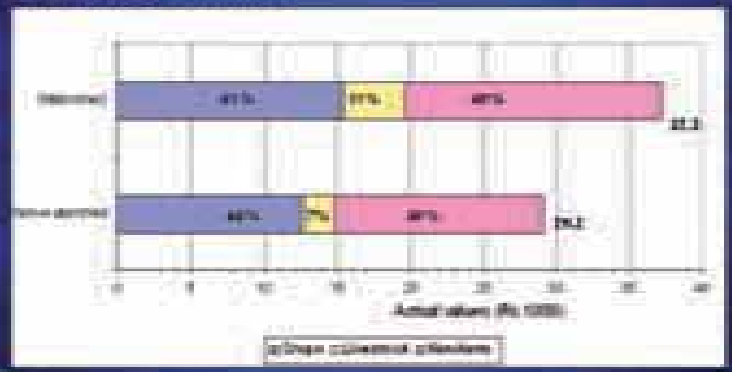
Adarsha Watershed, Kothapally, India: A Brightspot [Contd...]

- Increased incomes



Adarsha Watershed, Kothapally, India: A Brightspot [Contd...]

- Increased incomes



Drivers of Success in Adarsha Watershed

Innovations for enhancing community participation

- Demand driven — water scarcity, low crop yields, higher rainfed lands
- Tangible economic benefits to individuals through integrated approach
- Knowledge-based entry point
- Equal partnership, trust and shared vision among the consortium partners

Drivers of Success in Adarsha Watershed (Contd...)

Innovations for enhancing community participation

- Good local leadership
- Pre-disposition to work collectively for community development
- Transparency and social vigilance in the financial dealings
- Equity thru low-cost structures
- Empowerment – enhanced accessibility of new technologies and knowledge sharing developed local capacity

A New Powerguda thru Community Empowerment and New Technology

Study Approach

- Social Analysis
- Institutional Analysis
- Environmental Analysis

Drivers of Success in Powerguda

- Social cohesion
- Government support
- Community empowerment
- Leveraging savings
- Rural technologies
- Complimentary investment

Conclusions

- Rainfed agriculture's enormous potential could be unlocked
- Watershed management could become engine of agricultural growth and development in rainfed areas
- Important drivers of success are:
  - Target high potential and more opportunity areas
  - Need-based and demand-driven programs
  - Peoples participation is critical and could be triggered through:
    - Tangible economic benefits
    - Building trust, equal partnership and shared vision
    - Equity
    - Empowerment
- Transparency and social vigilance
- Good leadership and consortium for technical support
- Suitable technologies for different agroecologies are needed

Post project sustainability under watershed development programme

Continues to be a challenge particularly in the mainstream watershed programme

Contents

Part - I

Status of sustainability under mainstream watershed development programme

Interventions having HIGH sustainability

1. Organization of women SHGs
2. Construction of earthen / stone bunds in private land (as per Indigenous Technical Knowledge – ITK)
3. Construction of individual oriented water harvesting structures in private land (as per ITK)

Interventions having HIGH sustainability – contd.

4. Plantation of horticulture under irrigated condition in private land
5. Supply of livestock through revolving fund
6. Development of non-land based livelihoods through revolving fund
7. Management of revolving fund through SHGs

Interventions having LOW to MEDIUM sustainability

1. Organization of men SHGs, user groups, watershed committee - LOW
2. Construction of gully control structures in common / private land - MEDIUM
3. Plantation of trees in common land - LOW
4. Construction of community oriented water harvesting structures - MEDIUM
5. Management of common fund by WC - LOW

Interventions which are generally missing in the mainstream programme

1. Federation of SHGs at village / cluster level
2. Development of community managed resource centre at village / cluster level
3. Development of book-writers for organization of SHGs

Missing interventions – contd.

4. Productivity enhancement of land-based livelihoods (agriculture, horticulture, livestock, etc.)
5. Development of para-workers for supporting the above livelihoods (on payment of service charge)

Part - II

Methodology for assessing the sustainability of interventions

Cluster of parameters for assessing sustainability of each intervention

Water harvesting structure (WHS) - Parameters

- Adoption of demand driven in planning with particular reference to initiation of proposal; choice of technological options as well as local of structures, etc
- Payment of contribution in advance by actual users associated with the structure

WHS – Parameters (contd.)

- Proper functioning of WHS particularly during second years onward (due to better quality of design and construction)
- Due consideration to resource poor families while allocating users right over the water resource
- Formulation of proper modality for repair and maintenance of structures (by users themselves)

WHS – Parameters (contd.)

- Adoption of social regulation against overexploitation of water resources
- Due emphasis on a wide range of WHS based on indigenous as well as exogenous technical knowledge
- Due emphasis in meeting multiple needs of the community i.e. irrigation for crops, drinking water for human being as well as for livestock, etc.

Soil and moisture conservation measures – Parameters

- Adoption of demand driven in planning with particular reference to initiation of proposal; choice of technological options as well as local of structures, etc
- Adoption of indigenous technological options for conservation of soil and moisture

Soil and moisture conservation measures – Parameters (contd.)

- Payment of advance contribution by actual owners of the land
- Preferential attention towards development of assignment patta land allotted to resource poor families or other land owned by them
- Flexibility in ridge to valley approach while carrying out implementation of conservation measures

Soil and moisture conservation measures – Parameters (contd.)

- Proper functioning of conservation measures due to better quality of construction and adequate provision for safe disposal of runoff
- Timely repair and maintenance by concerned farmers
- Replication of successful measures by leftover farmers in the project area or new farmers in adjoining villages at their own cost

Agriculture productivity – Parameters

- Adoption of successful technologies by the same farmers during second years (at their own cost or through revolving fund to mature SHGs)
- Diffusion of successful technologies during subsequent years to other farmers (at their own cost or through revolving fund to mature SHGs

Agriculture productivity – Parameters *(contd.)*

- Working with SHGs for carrying out financial transaction but involving CIG (livestock) for carrying out other transactions i.e. related to technology, marketing, etc.
- Focus on organic farming practices for management of fertility as well as pests

Agriculture productivity – Parameters *(contd.)*

- Supply of preferred varieties / hybrids through seed village concept managed by the CBO
- Organization of a limited number of demonstrations/ trials during initial year (at project cost) on new and relevant technologies

Cluster of parameters for assessing the quality of project management phases

Preparation of action plan:

- Adoption of demand driven approach in planning.
- Facilitation of group action and conflict resolution for community oriented works.
- Investment on a wide range of technological options.
- Application of PRA tools.

Implementation of programme:

- Genuine contribution by actual users for developmental works.
- Implementation of works by people themselves.
- Flexibility in modification of plan during implementation phase.

Implementation of programme (contd.)

- Modality for repair of community oriented structures.
- Monitoring of participatory processes besides physical and financial progress.
- Social auditing and transparency.
- Operation of bank account of developmental fund by people themselves

Part - III

Framework for parameter based assessment of sustainability of interventions

Phases of project management

Implementation phase

SL No	Parameters and measurement criteria	Ranking for sustainability under watershed programme		
		Code (*)	Range of marks	Actual score
1	2	3	4	5
1.	Genuine contribution by actual users for development works • Contribution could not be collected from the community for construction of proposed works inspite of intensive efforts by WDT	R	0-3	

Implementation phase *(contd.)*

SL No	Parameters and measurement criteria	Ranking for sustainability under watershed programme		
		Code (*)	Range of marks	Actual score
1	2	3	4	5
1.	Genuine contribution by actual users for development works • Required contribution was collected but it was done through deduction out of wages of labourers or from the amount to be paid to suppliers of material / equipments	Y	4-7	

Community based organizations (CBOs)

Implementation phase *(contd.)*

Sl. No.	Parameters and measurement criteria	Ranking for sustainability under watershed programme		
		Code (*)	Range of marks	Actual score
1	2	3	4	5
1.	Genuine contribution by actual users for development works - Concerned users have paid contribution either in advance or during implementation of works in cases where actual beneficiaries were working as one of the labour	G	8-10	

Sustainability of Self Help Groups

Sl. No.	Parameters and their measurement criteria	Ranking for sustainability under watershed programme		
		Code (*)	Range of marks	Actual score
1	2	3	4	5
1.	Proper functioning of groups for performing its roles and responsibilities			
	1A. _____	R	0-3	
	1B. _____	Y	4-7	
	1C. _____	G	8-10	

Strategies for CA

[redacted]

Main Question

The overarching question for the assessment is "How the watershed programs can be made more effective and managed to

- increase agricultural productivity
- help to enhance incomes and reduce poverty
- Social capital
- to protect soil, water and other natural resources
- Enabling sustainable development
- Risk reduction
- Alternatives to enhance livelihoods

Approach

- Convergence and consortium
- Macro- and micro-level impacts
- Meso-level or sub-basin level studies
- Detailed analysis of secondary data
- Detailed case studies
- Use new science tools
- Policy implications @ macro & micro level
- Unintended benefits & costs
- Time-period of assessment
- Stratification

Key Features

- Review of literature
  - [redacted]
- [redacted]

- Case Studies
  - Covers different
    - Agroecoregions
    - Watershed development programs
    - Implementing agencies
    - Bright spots successful stories
    - Unsuccessful stories
  - Approach
    - Consultative
    - Participatory involving different stakeholders
    - Analytical
  - Draw policy guidelines

CA to Identify

- Impact indicators
- Innovations
- Best practices
- Drivers of success
  - Improved users participation
  - Equity
  - Gender role
- Impact pathways
- Institutional, policy, and social options
- Gaps: knowledge, technology, policies, funds etc. methodologies
- Identify baseline data gaps
- Upstream and down stream benefits and loss
- Shared vision of community and inclusion in project planning
- Unintended consequences (both positive and negative)

CA Outputs

- 1. State-of-the-art knowledge review
  - Extent & source of funding
  - Assessment of impacts
  - Guidelines
  - Institutional mechanisms
  - Exit strategies

- 2. Manuals on IWM
  - Best technological interventions & their impact
  - Qualitative & quantitative impact monitoring indicators
  - Facilitating policies & institutional mechanisms
  - Drivers for bright spots
  - Drivers for enhancing community participation, gender, and equity aspects

- 3. Synthesis report
  - Monitoring indicators
  - Policies and institutions
  - Drivers for success
  - Information base, updating, & online networking
  - Monitoring and learning mechanisms

- 4. Communications and outreach
  - Mechanisms to deliver key message to all stakeholders
  - Working papers, policy briefs
  - Workshops
  - Short videos on success stories
  - Micro-level studies
  - Datasets in CD
  - All in CDs

Time frame

- 2 years
  - Four quarters of 6 months each

Sampling

- Agroecoregionwise
- Programme specific
- Donor-funded
- State-fund specific
- NGO implemented
- Govt agency implemented
- CBO implemented

WORKING ARRANGEMENTS

STATE	ORG INSTITUTE	SITES	SOCIAL	ECONOMICAL	ENVIRONMENTAL	FINANCIAL
AP						
MP						
UP						
TN						

groups

- Sampling methodology
- Indicators of outcomes and processes
- Framework for baseline data, time frame

About ICRISAT®

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a nonprofit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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