3. Baseline Socio-economic Characterization of Watersheds

Anantha KH , Suhas P Wani and TK Sreedevi

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Patancheru 502 324, Andhra Pradesh, India

Abstract

Baseline characterization is important to measure project performance before making any changes to project processes. The paper provide insights into the baseline characterization of watersheds with special reference to socio-economic aspects to propose appropriate policy directions for enhancing productivity and sustainability in the semi-arid zone.

Keywords: Watersheds, characterization, socio-economic, stratified sampling, baseline.

Introduction

The arid and semi-arid tropics are generally characterized by rainfall variability, low productivity, natural resource degradation, climate variability and low development of infrastructure. Large investment made on irrigated agriculture and technological development had little impact on dry areas. Therefore, it is imperative to manage and conserve water and soil resources in order to enhance productivity and improve the well being of people (Wani et al. 2003a,). In this context, watershed development programs have become engines of development especially to reduce poverty, maintain food, fodder and fuel security with sustainable manner for huge population and seen as the lynchpin of rural development in dry regions (Wani et al. 2003b). Several noteworthy watershed programs have been carried out since inception that have yielded sterling results (see Wani et al. 2003b) while reviews and studies show that overall the performance have not kept pace with the expectations (Joshi et al. 2005; Joy et al. 2006). According to meta analysis of watershed development, only 35 per cent of watersheds have yielded favourable benefit-cost ratio while others have performed little by way of unbalanced development (Joshi et al. 2005). One of the major reasons for poor performance is that improper characterization of watersheds and poor project planning and implementation.

Baseline characterization is important to measure project performance before making any changes to project processes. If we do not have baseline data then

there is no way to evaluate whether a change is making a difference. It is used during the project to indicate progress towards the goal and objectives and after the project to measure the amount of change. It allows those involved in the project to understand the initial livelihood conditions of the people, and what needs to be done to reach the goal of improving the livelihoods of the poor. Thus, baseline characterization builds necessary foundation for the plan and obtains proper information for effective planning, implementation and monitoring.

Therefore, proper characterization of watersheds is a prerequisite for appropriate policy directions for enhancing productivity and sustainable development. Tools of geomatics (eg, satellite data, GIS and GPS) besides conventional ones (eg, field survey, topographical and cadastral maps) along with traditional multi-disciplinary methods (eg, PRA, soil and water analysis, socio-economic survey etc.,) provide insight into characterization of watersheds, project formulation and proper implementation of such development programs.

Strategy and Approaches

Broad Areas of Enquiry for the Socio-economic Characterization

The main purpose to characterize socio-economic systems in the watersheds is to identify existing and potential production constraints, and propose potential areas for targeting technology transfer for sustainable development. It requires huge information from a number of sources, published, unpublished and micro level field investigation. The following broad areas (indicators) may be essential to characterize socio-economic systems in the watershed (Appendix 1). Thus, careful identification of these indicators may provide an opportunity for better implementation and monitoring of watershed development programs.

Demographic Information

Demographic information has many purposes; it is used for research in the social sciences, creation of policy, and identification of potential socio-economic networks. The demographic information is a guide to and starting point for research about basic information on the areas of investigation. Demographic information consists of numeric data or statistics involving groups of people.

Demographic information includes household profile, village profile, livelihood options available to the people in the village, primary and secondary occupation

and literacy level among male and female etc. In addition, age, sex, education and marital status of the family members form a base for understanding demographic condition of the household.

Agriculture

Land Ownership

Land ownership builds a strong base for the utilization of resources for production purposes. It is a habitual conception that ownership of land is acceptable. Most societies are characterized by the convention of ownership. In the context of watershed, land ownership determines the participation of the community in watershed development activities to conserve, manage and use of natural resources that are crucial for overall development of the society.

Land Use Pattern

The land use pattern includes geographical area, forest area, non-agricultural use, barren and uncultivable land, permanent pasture and other grazing lands, land under miscellaneous trees and groves, culturable wasteland, permanent (other) fallow, current fallow, net area sown, area sown more than once, and gross cropped area (GCA). This information gives broad picture about the production structure of the society and thereby facilitates for better policy directions.

Area, Production and Yield of Crops

Information on area, production, and yield of all major and minor crops grown in the production system will be required to examine spatial and temporal changes in area under different crops and possible crop substitution. This information is useful to compare the baseline situation with improved technology due to project intervention. Important crops in the production system include cereals: rice, wheat, sorghum, pearl millet, maize, finger millet, and other millets. pulses**:** chickpea, pigeonpea, and other pulses. Other crops include oilseeds: groundnut, rapeseed and mustard, sesame, linseed, and other oilseeds; cash crops: sugarcane, cotton, jute, and tobacco; fruits and vegetables: onion, other vegetables, and fruits. The cropping system changes according to seasonal variability. Thus, care need to be taken to capture seasonal variability on the productivity and yield.

Crop Utilization and Commercialization

The information pertaining to crop utilization and commercialization need to be collected. The information required may include, crop utilization for different

domestic purposes and quantity sold in the market, which is a marketable surplus, provides value addition to household economy.

Input Use

The baseline information on input use across crops is a prerequisite for identifying potential strengths and weaknesses of the production system. The information needed for input use characterization includes: crop-wise labor use, crop-wise fertilizer use, crop-wise area under high-yielding varieties (HYVs), crop-wise pesticide use, crop-wise irrigated area, number of tractors, number of bullocks, and crop-wise cost of cultivation. Input change in watershed development areas may indicate the progress made in terms of effective cultivation practices and training and capacity building for farmers. Input change, for example, reduction in fertilizer utilization can also improve water quality and soil health.

Output and Input Prices

The aim of the watershed development program is to strengthen natural resource base to achieve sustainable development. The efficient management of available resources facilitates for improved cultivation and higher productivity. This can be linked with suitable pricing system. Farm harvest and retail prices of important crops and the prevailing input prices during the project implementation period is required to examine the cost, profitability, and competitiveness of different crops in the region so that performance of watershed development program can be assessed effectively. The farm harvest prices for all the important crops and input prices such as seed, fertilizers, pesticides, farm operations, labor wages, and electricity charges for irrigation would be required to assess the performance of the watershed development.

Irrigation

Irrigation is a major input for agriculture development. One of the major objectives of watershed development strategy is to conserve water resources. Thus, to characterize production system in the watershed, information regarding gross irrigated area, net irrigated area, irrigated area under different sources, crop-wise irrigated area, number of private tube wells, number of public tube wells, number of pumpsets, and irrigation potential are required. Irrigation enhances the productivity and production of crops and baseline production capacity helps to assess the performance levels of the project in a more effective manner. This suggests whether the watershed development strategy is making any changes in terms of its effectiveness.

Livestock

Livestock is an integral component of the conventional farming systems and plays a major role in the rural economy with high contribution to the gross domestic product (GDP). Since watershed development is expected to improve the feed and fodder situation and facilitate dairy development, special attention needs to be given on the livestock sector. Small ruminants like, sheep or goats are the best source of regular cash income for rural poor with less investment. The year round income can be assured from these sources. The selection of appropriate livestock species matters much in improving the productivity of livestock, which is an important consideration in the development of an integrated farming system. The crop-livestock system in semi-arid region enhances income flows of rural households by increasing outputs such as milk, meat, wool, etc., Therefore, a clear account of large and small ruminants will be essential. It is therefore, necessary to take note of changes in the composition of livestock breed and outputs, using pre and post watershed data, to be quantified from landed and landless people.

Economic Variables

One of the crucial aspects of watershed development is to improve rural livelihoods through increase in income. There are different avenues and sources of income-generating activities due to watershed development. The growth of income and expenditure and changing poverty status can be examined through information pertaining to work force, agricultural labourers, poverty indicators such as income and consumption pattern (disposable income on various activities and consumption expenditure). The important economic variables include: income across different social groups as well as landholding classes; household income and consumption pattern; and poverty status across social groups. The information regarding economic variables during pre and post watershed development facilitates to measure the impact of watershed development program on household economic condition.

Rural Infrastructure Facilities

Availability and access to infrastructure facilities is a backbone for rural development. Apart from availability, quality of infrastructure makes difference in people's standard of living. Therefore, characterizing socio-economic system involves gathering information about available infrastructure for better monitoring and evaluation of the project. The information includes: intensity of roads in rural areas, regulated markets, number of rural banks (nationalized, cooperative, regional rural banks), number of electrified villages, number of small-scale and medium industries, number of other processing mills, number of technology transfer agencies, number of staff engaged in technology transfer and other infrastructure facilities.

Infrastructure development is a major criterion to assess the development of the economy. Watershed development program provides opportunity to create number of infrastructure facilities to enhance the growth process. Thus, baseline data in the watershed area is essential to compare the infrastructure development and the feasibility of these structures for development process. For instance, availability of transport and markets are essential to boost the confidence of landed and landless households to undertake income generating activities to strengthen their economic condition. Thus, pre and post watershed data might be useful for quantifying the changes across watershed villages.

Economic Feasibility of Improved Technologies

Watersheds are learning and experimental sites. Hence, watersheds provide opportunity for the application of improved technology for better outcomes. However, understanding the economic feasibility of all improved management strategies and technologies are essential to know their costs and benefits under different scenarios. The information regarding capital cost, input cost and output cost are essential to understand the feasibility of improved technologies. For instance, capital cost includes component-wise cost of any soil and water management technology which has a long life; input cost include item-wise cost of all inputs required for crop production with existing (local) technology; item-wise cost of all inputs required for crop production with improved technology; and output cost consists of output produced and prices with existing (local) technology; output produced and prices with improved technology.

Procedure and Practices

Sampling Procedure

There are number of methods available to collect data for an enquiry. However, care should be taken to avoid error caused by multiple methods. Stratified Random Sampling procedure would be allowed to collect information. Stratified random sampling is the purest form of probability sampling. Each member of the population has an equal and known chance of being selected. When there are very large populations, it is often difficult or impossible to identify every member of the population, so the pool of available subjects becomes biased. The commonly used probability method is superior to random sampling because it reduces sampling error. A stratum is a subset of the population that shares at least one common characteristic. Random sampling is then used to select a sufficient number of subjects from each stratum. Stratified sampling is often used when one or more of the stratums in the population have a low incidence relative to the other stratums. Reliable information needs to be collected by applying below steps.

- Divide the whole study area (watershed) into two strata. Stratification is done on the basis of the intensity of the specific activity, which one intends to study. For example, if one plans to study agricultural intensification in a watershed, the two strata are: (i) upstream; and (ii) down stream. The upstream and downstream needs to be classified based on toposequence.
- Select appropriate number of villages (as per the convenient) from each of the strata and one additional village may also be selected as a control village. Equal number or percentage with minimum number of farmers (large, medium, small, and one control) from each village may be selected. The criteria of categorizing, farmers are: small farmer – less than 2 ha; medium farmer – 2.01 and 5 ha; and large farmer – more than 5.00 ha. Selection of farmers is made randomly from each size class.
- Survey timing is very important to obtain reliable information. Sufficient timing should be allotted to collect data. It should be done when farmers are relatively free to give sufficient time to enumerators for discussion. Data collection immediately after the harvest of the crop will give more reliable information about production and input use.

Selection of Households

In most cases, the number of households within the watershed will be too large to feasibly survey every household. In this case, one must pick a representative sample of households. Sampling means that only some of the households in the watershed area are picked for survey. The concept of 'representative' is important and means that the sample of households interviewed must reasonably represent the entire group. To accomplish this, a random sample needs to be chosen. In situations where there is a census of the entire targeted population, households can be randomly chosen by various means such as picking every fifth household or using a random numbers table. The ideal sample should cover 20-25 per cent of the households, depending on the sample size, without double counting of their landholding in the village. The minimum number of households per village should be fifty.

Method of Data Collection

Data collection means gathering information to address those critical evaluation areas that we have identified earlier. There are many methods available to gather information, and a wide variety of information sources. The most important issue related to data collection is selecting the most appropriate information or evidence to answer our questions. Several approaches are adopted to generate desired information from the respondents. These include:

a) community group interviews;
b) household survey (interview, questionnaire survey);
c) frequent visits to the study area and regular discussions with the respondents;
d) direct observations;
e) participatory rural appraisal methods;
f) rapid rural appraisal; and
g) case studies.

To plan data collection, one must think about the questions to be answered and the information sources available. Also, we must begin to think ahead about how the information could be organized, analyzed, interpreted and then reported to various audiences. The selection of a method for collecting information must balance several concerns including: resources available, credibility, analysis and reporting resources, and the skill of the evaluator. Thus, either of the approaches may be selected depending upon the objectives of the study. However, questionnaire is an appropriate and widely used instrument to collect data in social science research in addition to many participatory approaches. Therefore, care needs be taken while preparing the questionnaire (Box 1 for checklist). In addition, following points needs to be considered when planning a baseline survey:

- The baseline survey should be strongly linked with the critical aspects of the project's M&E plan.
- There is need to understand the current condition in which the baseline survey will be conducted. Eg, what season of the year is it? What political condition prevails? What is the current state of the economy? Will the baseline survey occur during, or follow on from, extraordinary events such as natural disasters, political upheavals or economic shocks?

Analyzing the Data

The first step in analyzing data (after collection of data) is to determine what method of data analysis we would be using. If most of the information collected contains numbers, then the data is quantitative data. If the information collected consists of words, then the data is qualitative data. With quantitative data the analysis does not begin until all data are collected. In contrast, most qualitative data analysis begins as data are collected. For example, when conducting group interviews, group discussions, the transcripts are analyzed as soon as possible in order to generate additional questions for follow-up interviews.

If most of the information collected contains numerical (quantitative) data, then descriptive statistics (mean, median, mode, standard deviation, etc) can be used

to characterize the data. If most of data collection was done using focus group interviews, open-ended questions, or case studies, then data will be in the form of qualitative data. Unlike being able to use a hand calculator or computer program to analyze numerical data, the qualitative data of words need to be analyzed initially by reading and sorting through the data. With qualitative data, how the data is ordered, categorized, and arranged is important because most qualitative data are words that must be interpreted for content. This process will include carefully reading the information, and then identifying, coding, and categorizing the main themes, topics, and or patterns in the information. Coding is simply attaching some alpha-numeric symbol to phrases, sentences, or strings of words that follow a similar theme or pattern. This process allows us to then place these phrases of similar themes into a category for further analysis.

Box 1: Checklist for Forming Questionnaire

- Is this question necessary? How will it be useful? What will it tell us?
- Will you need to ask several related questions on a subject to be able to answer your critical question?
- Do respondents have the necessary information to answer the question?
- Will the words in each question be universally understood by the target audience?
- Are abbreviations used? Will everyone in the sample understand what they mean?
- Is the question too vague? Does it get directly to the subject matter?
- Can the question be misunderstood? Does it contain unclear phrases?
- Have you assumed that the target audience has adequate knowledge to answer the question?
- Is the question too demanding? For example, does it ask too much on the part of the respondent in terms of calculations/estimation?
- Is the question biased in a particular direction, without accompanying questions to balance the emphasis?
- Are you asking two questions at one time?
- Is the question wording likely to be objectionable to the target audience in any way?
- Are the answer choices mutually exclusive?
- Is the question technically accurate?
- Is an appropriate referent provided? For example: per year, per acre, etc.

Recommendations for Practitioners

Following points are necessary for practitioners to undertake baseline survey in characterizing watersheds.

- Plan and conduct participatory rural appraisal (PRA) and focused group discussions (FGDs) with the watershed villagers including women, landless and marginal farmers.
- Team of multi-disciplinary experts should be involved in PRA & FGDs facilitated by a good facilitator.
- The results of PRAs and FGDs should be used to fine-tune the questionnaire to be used for detailed stratified household survey.
- Explain the importance and purpose of the household survey, which will help to plan watershed interventions needed for them to improve their livelihoods and assess the impact of watershed interventions.
- Pretest the questionnaire in the village and train all the enumerators by the expert and tell them the importance and expectation of high quality baseline data.
- Baseline survey should be launched in the first three months of project initiation and completed within first six months.
- Good baseline report of a watershed lays a strong foundation for the project and provides insights in various aspects of the watershed.
- It is often best to create a graph of the data that summarizes the frequency or percentage of what is being measured over time.

Conclusion

Socio-economic characterization of watershed involves several steps to follow. However, the baseline characterization provides great deal of ideas to better monitoring and evaluation of projects. The socio-economic characterization of watersheds generate results and helps to identify trends, commonalties and testimony that will help answer the critical questions that were part of an evaluation. If the evaluation is to be useful, the evaluator must interpret the information so that the stakeholders will understand the results and know how to use them for further action. The very purpose of characterization of watersheds is to study the potential change on economic, ecological and social system in a watershed. Information generated through baseline survey provides knowledge. Knowledge is achieved when people examine information, think about it, discuss it, compare it, and relate it to other sources of information. This is to increase our level of understanding so that we may take appropriate actions.

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Appendix 1: Information Needed for Socio-economic Characterization of Watersheds.

Characteristics	Purpose	Method
1. Demographic condition		
Household profile (age, sex, education, marital status, etc)	For understanding demographic condition	Data collection and analysis
Primary & secondary occupation	-do-	Data collection and analysis
Literacy (male and female)	-do-	Data collection and analysis
Livelihood options (farm and non-farm activities)	For watershed development plans	Data collection and analysis
2. Agriculture		
Cropping systems- *kharif, rabi,* summer	To introduce new cropping interventions and management to bridge yield gaps	Sampling/survey
Crop-wise Input use- seeds, fertilizers, organics, pesticides etc	- do -	Sampling/survey
Yields obtained	- do -	Sampling/survey
Trends in area	- do -	Historical records
Trends in crop production	- do -	Historical records
Trends in crop yield	- do -	Historical records
Land ownership	Land & water mgmt and crop planning	Sampling/survey
Land use pattern	- do -	Sampling/survey
Area, production & yield	- do -	Sampling/survey
Crop utilization and commercialization	- do -	Sampling/survey
Input use	- do -	Sampling/survey
Input and output prices	- do -	Sampling/survey
Irrigation	- do -	Sampling/survey
Characteristics	Purpose	Method

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3. Livestock		Sampling/survey
Availability of feed and fodder	For land use and livestock planning	Data collection and analysis
Livestock breed	- do -	Sampling/survey
Milk production	For economic feasibility	Sampling/survey
Meat production	- do -	Sampling/survey
Wool production	- do -	Sampling/survey
4. Economic variables		Sampling/survey
Employment (work force, and agricultural laborers)	For sources of income and availability of work	Data collection and analysis
Migration	-do-	Sampling/survey
Income across different landholdings	For land productivity and capacity	Data collection and analysis
Income and consumption	For poverty status	Data collection and analysis
Consumption expenditure	- do -	Sampling/survey
Expenditure on health, sanitation and drinking water	- do -	Sampling/survey
Disposable income on various activities (eg, cloths, food, shelter etc)	- do -	Sampling/survey
Poverty related indicators	- do -	Sampling/survey
Financial institutions (formal/informal)	For understanding the livelihood opportunities	Sampling/survey
5. Rural infrastructure facilities (roads, market, transport, etc)	For watershed development plans	Sampling/survey
6. Economic feasibility of improved technologies	- do -	Sampling/survey