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Methodology for Monitoring and Evaluation of Integrated Land and Water Development

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Abstract: In spite of an urgent need to consider land and water development in combination, fragmentation in education and training and existing institutional structures form important constraints. Intense past disappointments with water projects in many countries have now created a new readiness to persuade planners and decision makers to consider an integrated approach to land, water and other related resources in river basin development. The author proposes that with the massive investments in water development projects in developing countries, systematic monitoring and evaluation should become an integrated part of the management process. The information produced has to be timely, cost-effective, relevant and correct, and free from professional biases. Monitoring and evaluation have to comprise both planning, design and construction; operation and maintenance; agricultural production; and achievement of socio-economic objectives.

Introduction

While nearly all water resources development projects in developing countries are multipurpose in nature, the major purpose without any doubt has been generally to provide irrigation water to increase agricultural production. The two other important purposes often considered simultaneaously are hydroelectric generation and flood control.

Timely, reliable and well-managed water supply and its effective use is a most crucial requirement for the modern high-yielding agricultural production. This is clearly indicated by the fact that even though only 20% of the world's agricultural land is irrigated at present, they account for 40% of the global agricultural production (IDRC 1979). It is quite clear that without reliable water control, the world food problem cannot be resolved.

Since the main emphasis of water development projects in developing countries is to increase agricultural production, it is no longer adequate to consider water development in isolation. Increasing agricultural production requires simultaneous optimal use of resources like water, land, and energy, and availability of other inputs like good quality seeds, credit, and extension services. Furthermore, increasing overall agricultural production cannot be the exclusive goal: the issue of equity – who receive the benefits and by how much – should be a major consideration. Equally important is the consideration how the benefits are affecting the socio-economic conditions of the basin area: how the lifestyle and quality of life of people are changing.

Even though there is an urgent need to consider land and water development simultaneously, it is not happening at present. Fragmentation in education and training and

existing institutional structures in countries are two important constraints that need to be overcome if an integrated approach is to be adopted successfully and widely.

Lack of such an integrated approach has contributed to nearly half of the world's irrigated area being afflicted with some degree of salinity, alkalinity or waterlogging. It was estimated during the UN Water Conference that by 1990, out of 92 million ha of irrigated land in developing market economies of Africa, Asia and Latin America, 45 million ha would require improvement at an estimated cost of more than $ 22,000 million at 1975 prices (Biswas 1978). Futhermore, water resources development projects generally do not appear to have contributed to equity. An analysis of the experiences of the United States Agency for International Development (US AID) indicates that irrigation is "at best a reaffirmation of the existing social and economic distribution of assets, but more often, it will tend to exacerbate differences in both income and social prestige" (Steinberg 1983). Often estimates of cropping patterns and intensities, average yields, farm prices, employment and income generation, and availability of credit and inputs like pesticides, fertilizers and seeds, extension services and marketing facilities have turned out to be pious hopes rather than reality. In addition, environmental and health costs of irrigation projects have been substantial (Biswas 1982a, 1982b).

There is however a good possibility that some countries may be willing to adopt an integrated approach because of the intense disappointments with the results of certain irrigation projects undertaken during the past decades. For example, a review of the irrigated agriculture projects in the Sahel by the Club du Sahel and CILSS (1980) concluded that the area under modern irrigation doubled during the period 1960 to 1979, but "generally speaking, during the past few years, the development of new areas has barely surpassed the surface (area) of older ones which had to be abandoned". A major conclusion of a Workshop on "Aid to Irrigation", convened by the Development Assistance Committee of OECD (1983), was not only an expression of general dissatisfaction with the performance of large-scale irrigation projects in developing countries but also the radical suggestion that for some areas of Africa, "irrigation should not be generally promoted until existing schemes were shown to be productive and until well-tested technology and comprehensive plans have been prepared."

Such reasons for pessimism can, hopefully, now be used constructively to persuade planners and decision-makers to consider an integrated approach to land, water and other related resources to river basin development.

One of the main reasons for the past failure of water development projects to meet the approved objectives is due to the lack of adequate monitoring and evaluation, and the failure by the management to use monitoring and evaluation successfully as a management tool. It is not unusual to find that monitoring and evaluation are completely neglected.

Monitoring and Evaluation as Tools in the Water Development Process

In the context of the present discussion, monitoring is defined as continuous or periodic surveillance over the implementation of an activity (and its various components) to ensure

that input deliveries, work schedules, targetted outputs and other required actions are proceeding according to the plan. Since the purpose of monitoring is to achieve efficient and effective project performance, it is an integral part of the management information system and is an internal activity. Evaluation is defined as a process which attempts to determine as systematically and objectively as possible the relevance, effectiveness and impact of activities in the light of their objectives. It is a learning and action-oriented management tool and an organization process for improving activities still in progress and future planning, programming and decision-making.

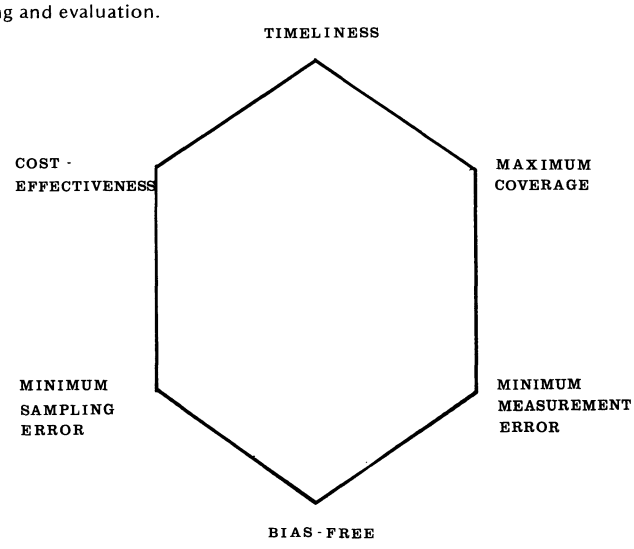
It is essential that monitoring and evaluation become an integral part of the management process to ensure future stream of benefits to occur at the appropriate time-scale to the right target group. It can be equally argued that for this purpose to be achieved, monitoring and evaluation projects have to meet some principal requirements (Fig 1):

i) timeliness;
ii) cost-effectiveness;
iii) maximum coverage;
iv) minimum measurement error;
v) minimum sampling error; and
vi) bias-free.

Information has to reach the dicision maker at the right time

Management decisions generally have a time dimension, and timeliness of certain decisions could be more important than others. Thus, monitoring and evaluation (M&E) information needs to reach decision makers on time so that the contents of the information sup-

Fig 1 Requirements for monitoring and evaluation.



plied serve as a fundamental basis on which rational decisions can be taken. In other words, M&E information needs to be converted into action as shown in Fig 2. Management success depends not only on the timeliness of the information but also quality, extent and form of the information channelled into the decision making process. Problem arises because even if required M&E information is available, it is often not channelled into the decision making process since it is either in a diffused or inappropriate form or could not be obtained and analysed within the time frame by which decisions have to be made (Biswas 1976).

If M&E information from the project does not reach the decision makers on time, it is possible that one or more of the following consequences, which are not mutually exclusive, may occur:

- wrong decision may be taken;
- decision taken may not be optimal in terms of agreed objectives;
- no decision may be taken when one is essential;
- decision taken may result in irreversible damages; or
- decision taken may unnecessarily increase the cost of the project and/or time required for completion.

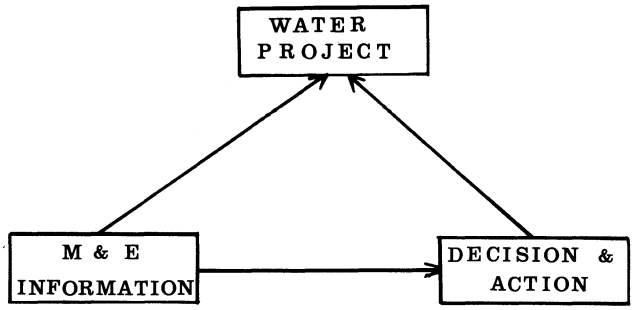
It is therefore essential that M & E information from the project should reach the people who need it on time and on a continuing basis.

The process has to be cost-effective

Since financial resources, expertise, man-power and equipments available in developing countries are invariably limited, there is always pressure for the M&E system to be effective. This may essentially mean sensible trade-offs between the depth and context of information, as well as between amount, relevance and accuracy.

Information collection, analysis and processing require time, money and expertise. Thus, as a general rule it should be remembered that the value of information collected should exceed the cost of obtaining that information.

Fig 2 Relationship between water project, monitoring and evaluation, and decisions.

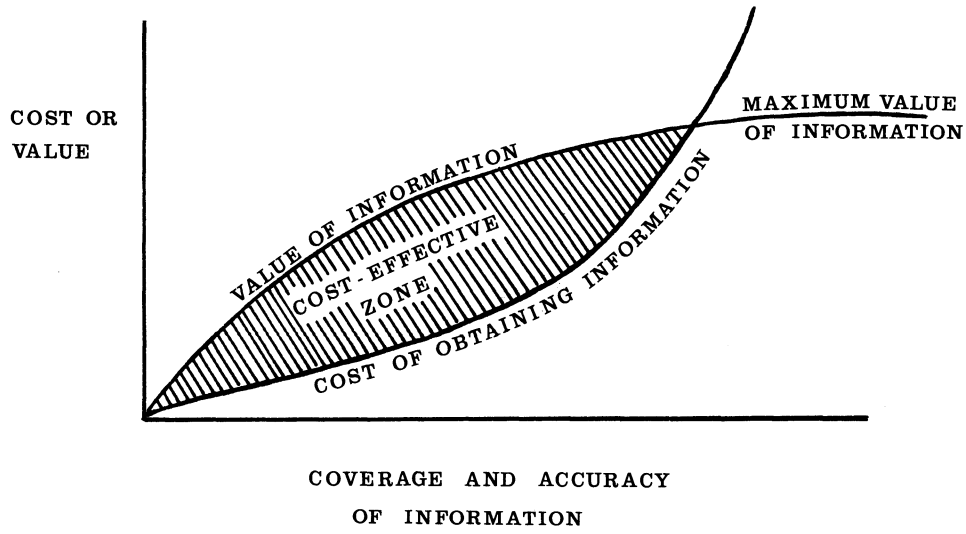


For most projects, from a decision making viewpoint and at any specific point in time, value of information generally increases with increasing extent and accuracy of information available. However, for most decisions, value of information generally reaches almost a plateau after a certain point, beyond which the value may increase only very, very marginally as shown in Fig 3. The cost of obtaining information, however, continues to increase with increasing coverage and accuracy. Thus, it can be argued that the shaded area in Fig 3 is the cost-effective zone, beyond which the cost of obtaining information will rapidly exceed its intrinsic value. Exactly where within the shaded area a decision has to be made will depend on the specific projects concerned, but the trade-off consideration will very often be a value judgement.

Minimum sampling error – Since it is generally neither possible nor desirable to monitor developments in the entire project universe, sample surveys are essential. M & E of irrigation projects will invariably cover not one issue but several, and it should be remembered that what may be considered a suitable sample size for one issue or discipline may be too large or too small for another. For example, for analyses of rainfall, one rain gauge per km^2 will be considered by hydrologists to be a very dense network, and not necessary unless for very specific purposes, but similar sample sizes would be totally unacceptable to statisticians or sociologists. Thus, based on ultimate use of the information to be collected and practical considerations, sample sizes have to be decided carefully.

Minimum measurement error – In contrast to anthropologists and sociologists who tend to prefer maximum coverage, engineers and physical scientists are more concerned with the accuracy of measurements and data collected. A good M & E system naturally should have small sampling error and minimum measurement error. In any event, there is always a trade-off between coverage, sampling, precision, and time needed for analysis. The final decision that has to be taken on all these aspects would have to be case specific.

Fig 3 Relationship between cost, coverage and accuracy of information.



For water development projects, measurement error is a real problem, especially when benefits occuring to small farmers and landless labourers are considered. They are often illiterate and thus may have considerable difficulty with explicit numerical quantifications. Accordingly, they may be somewhat vague or imprecise about changes, especially when they are of the order of less than 15–20%. The questionnaire designers should be aware of this problem and ensure that questions that cannot be answered are not asked. For many purposes it is adequate to get "more/less" responses.

One of the main measurement problems for socio-economic data of existing water development projects is the virtual lack of baseline information. Since the original status of socio-economic conditions in the river basin when development started is often unknown, it is difficult to make quantitative measurements of improvements of these conditions which can be attributed to the project. Thus, a base-line survey of socio-economic conditions of the basin area, before the development process is initiated, is absolutely essential for future evaluations.

The information should be free from professional biases

M & E of water development projects often suffer from biases, which stem from the general tendency to concentrate on some specific issues at the cost of other equally important issues. Biases commonly observed may be concerned with the following:

- major structures and canals but not watercourses;
- head of watercourse but not tail;
- water entering watercourses but not losses;
- irrigation but not drainage:
- roads along canals and watercourses but not fields where access may not be easy or comfortable;
- visible structures but not people;
- contact with rural elite but not farmers;
- large farmers but not small;
- farmers but not landless labourers;
- men but not women;
- senior project staff but not junior;
- users of services but not non-users;
- review during healthier, better-fed dry season when climate is pleasant but not during food-scarce, unhealthy and unpleasant wet season;
- emphasis on the visible but neglect of social relationships;
- extrapolation of trends over the entire project area on the basis of a glimpse at one specific point and/or period of time; and
- evaluation soon after completion but not ten years later when projects is fully developed and conditions have stabilized.

There is also a tendency in irrigation projects which are multifacetted, to introduce biases in terms of one's own discipline. Thus, M & E carried out by indisciplinary people often

tend to emphasize areas that are of primary interest to them. The problem emphasis of different disciplines in the area of irrigation, and the standard solutions proposed could be the ones suggested in Tab 1.

Tab 1 Problem emphasis and biases of different disciplines in the area of water development

Discipline	*Problem Emphasis*	*Solution*
Administrators	Poor co-ordination	New organization with administrator as co-ordinator
Agricultural Economists	Agricultural prices and marketing	Improve marketing and prices
	Lack of credit	Provide credit
	Risks of production	Reduce risks
Agriculture Extensionists	Farmers unaware of good agricultural and water management practices	More extension service to farmers
Biologists	Inundation impacts on flora and fauna	Reduce impacts by changing scale or location
Economists	Inefficient water use	Water pricing
	Low return on capital and underutilization of potential	More investment
Engineers, Agricultural	Poor land levelling	Level land
	Poor maintenance or lack of field channels	Improve situation
Engineers, Civil	Inadequate structural development	Construct more/better structures
	Poor operation and maintenance (O & M)	Provide more funds for O & M
Engineers, Drainage	Salinity and waterlogging	Construct comprehensive drainage system
Environmentalists	Too much damage to the environment and ecosystems	Stop construction or reduce scale of development
Lawyers	Central-Provincial relations or international implications	Resolve potential legal problems
Political Scientists	Inequitable distribution of agricultural production and water	Change power structure
Sociologists	Inequity and conflict over agricultural production and water distribution	People's participation and conflict resolution
	Rehabilitation of displaced people	Preparation and implementation of better plan for rehabilitation

It should be realized that in the real world an issue is an issue, and it only becomes technical, economic, or sociological depending on a person's discipline, experience and ways and means of approaching it. Thus, for M&E of water projects, it is preferable to use interdisciplinary individuals, who may specialize in one discipline but are flexible, observant, sensitive, eclectric and are capable of intermixing and questioning inventively. Since in reality, it may be difficult to find such interdisciplinary individuals, one may have to depend on who is available. This can be done by carefully selecting a multidisciplinary team, which can offset biases by juxtaposition of insights of various disciplines. However, it should be noted that the choice of a multidisciplinary team does not necessarily produce a real multidisciplinary approach and effort.

Four Levels to Monitor and Evaluate

Complexity of the problems

Water projects are complex to monitor and evaluate, since a large number of specific and specialized tasks have to be performed, both concurrently and sequentially, in a coordinated manner, by a variety of professionals, with decisions being made which may have direct impacts on the projects by local, regional, national and international institutions. In addition, all the project benefits and costs, both direct and indirect, are not confined to the project boundary: some of them could occur far from the area. Thus, it is not easy to define an area which could be said to contain all project impacts.

Time dimension of impacts is another complicating factor. Some impacts are immediate, and thus can be identified during the implementation phase or soon thereafter. Some other impacts, however, could be slow to develop, and thus may not be easy or even possible to monitor meaningfully in the early stages. For example, some unanticipated changes in ecosystem and the environment could easily take more than a decade of operation of the project, before they could even be identified and thus their monitoring could begin. Salinity development in irrigation projects, under certain circumstances, could take 15–20 years, but in others it could take only 2–3 years, depending on physical conditions, drainage provided and effectiveness of operation and maintenance procedures. Thus, water projects need continual M & E, even when the projects appear to be functioning most efficiently for several years. The time dimension also makes intercomparison of impacts of different irrigation projects a difficult task.

The different levels

From monitoring and evaluation viewpoints, water development projects can be logically arranged into following four interrelated levels:

i) planning, design and construction of physical facilities,
ii) operation and maintenance, especially of irrigation, drainage and hydropower generation facilities,

iii) agricultural production, and
iv) achievement of socio-economic objectives.

Of these four levels, probably the easiest one to handle in terms of monitoring and evaluation is the first one – planning, design and construction of physical activities. It is also a discrete phase, which is completed once the construction of physical facilities is over. In contrast, the other three levels require continual monitoring and evaluation during the project life to ensure that the system is operating at the desired efficiency, and that the objectives of the project are being continued to be met.

Planning, design and construction of physical facilities

This is one level of activity where some forms of monitoring and evaluation have always been a standard practice. It has been a common practice among engineers and surveyors to monitor:

i) progress of planning and design on schedule and within financial limits;
ii) use of equipments and construction materials;
iii) construction of structures according to previously designed plans;
iv) project costs do not exceed budget estimates; and
v) construction proceeding on schedule.

Thus, normally for the engineering and technical aspects, there would normally be a technical inspection and cost-accounting system already integrated within the project in some fashion. What may be necessary is to review the existing system or the system proposed to see if some further improvements can be made to make it more efficient.

There are areas, however, where monitoring is essential at this level, but are seldom done – except in an anecdotal fashion. Information on the following aspects is recommended.

Employment: Employment creation during the planning, design, construction and operation phases of water development projects is rarely considered to be an important criterion, and is seldom explicitly considered in most developing countries in order that the potential could be maximized. If the projects are designed to use labour-intensive methods from the beginning, the poor – especially large number of unskilled workers, including women – can benefit from them best (Biswas 1980). Employment of small subcontractors should be encouraged as much as possible to stimulate local business development.

It is necessary to monitor the wages being paid to men and women to ensure that women receive the same wages as men for identical amount of work. It is equally necessary to ensure that children are not employed in contravention of agreed international labour conventions.

Equipments: Classified by number and cost, by type, and whether manufactured nationally or imported.

Materials used: Classified by type of materials, by units used and cost, and wheter produced nationally or imported.

Farmers' participation in project planning: Very seldom do farmers participate or are consulted on project planning and design, including important issues like canal alignment, which is a very important consideration in terms of equity. Information should be collected on the extent of participation during this phase, type of people who participated, e.g. large or small farmers, landless labourers, etc., the process through which the participation took place, positive and negative aspects of the participation process and the extent of women's participation.

Participation of local authorities in project planning: Participation of local authorities in project planning, especially if they are elected, is essential for the long-term sustainability of any project. Was the project imposed on the local people by the central government or was it seen as essential by local authorities?

Operation and maintenance of water control facilities

Operation and maintenance (O & M) is one of the most underestimated aspects of water projects in developing countries. And yet, if the benefits from such projects are to occur on time and to the specific target groups, it is essential that O & M be carried out efficiently to ensure that water supply is reliable, electricity generating facilities are properly maintained, farmers in the tailend receive their regular quota of water, and drainage system is functioning properly so that salinity and waterlogging problems do not occur. A review of past water projects will indicate that most project agencies are generally not ready to undertake O&M work when the construction phase is completed. Until recently, O&M was accorded low priority, at least when judged by the actual performances, by both governments and international institutions or donor agencies. Thus, not surprisingly, funds available for O & M are mostly inadequate, and often maintenance efforts continue to be postponed, until a major crisis appears and it can no longer be postponed. During this period, the efficiency of the projects continues to decline, and during crisis situation, generally the problem faced is more complex to resolve technically and more funds have to be expended than had the maintenance works been carried out on a regular basis.

Another problem pertains to the attitude of the technical staff. Design and construction phases of water systems are considered to be glamorous, and thus not only do the best staff prefer to work in such areas, but also their superiors prefer to assign them to those tasks. O & M assignments are seldom considered to be desirable (Hotes 1983), and thus are often staffed by inexperienced and/or below-average calibre staff.

Primarily as a result of the above two factors, efficiency of irrigation systems a decade after construction is mostly very low: around 20–40%. This means that 60–80% of water abstracted from the rivers do not reach the agricultural fields (Biswas 1983). Similarly hydroelectric generation declines with time because of poor maintenance, and often the blame for this is attributed to the lack of rain or water in the reservoir.

Another major problem worth noting is the fact that poor though O & M is for irrigation, it is even worse for drainage. Poor drainage contributes to salinity and waterlogging development, but since such problems take some time to develop in most cases, the magnitude and extent of the problems are seldom realized until they become serious. This is especially true where M & E system does not exist or is not functioning properly.

Agricultural production

The fundamental objective of any irrigation project is to provide efficient water control in order to increase agricultural income. Efficient water control, referred to at the previous level, by itself is not the sufficient condition to maximize agricultural production, which simultaneously requires other essential inputs as seeds, fertilizers, pesticides, machineries, energy, as well as extension, credit and marketing facilities. It is equally important to ensure that irrigation water and the factors mentioned are available to the farmers in an integrated and timely basis. For M&E at this level, all the factors mentioned – with the exception of irrigation water which has already been considered in the previous level – need to be considered.

Information needs to be collected at critical times for each cropping season, which can then be used to provide better co-ordination between the different organizations responsible for the various inputs and services. At the end of the cropping season, an overall performance review of the season needs to be carried out. This review will be helpful in preparing an integrated, and more improved plan for the subsequent cropping season.

In many irrigation projects, M&E of agricultural production may require the maximum effort when compared with the other three levels mentioned in this section.

Achievement of socio-economic objectives

The fundamental objective of irrigation is to increase agricultural production, which will not only increase availability of food for people, but also directly contribute to increased income generation of both farmers and non-farmers. Increased productivity and rise in farm income could go a long way to achieve the socio-economic objectives to the project.

It is, therefore, absolutely essential to monitor the impacts of the project on the proposed beneficiaries. For example, it is quite possible that an irrigation project may enhance the employment and income potential of landless labourers on farms and in neighbouring towns due to intensified agricultural activities. Equally, it could replace overall employment potential by undue emphasis on mechanisation, which could make the life of landless labourers far worse than the pre-project level. Similarly, it may be possible that the income of small farmers and landless labourers increases significantly due to the project, thus making more equitable income distribution in the area. Alternately, the benefits could accrue primarily to the large farmers at the cost of small ones, and thus make income distribution even more skewed than ever before. Depending on specific irrigation projects, both alternatives have been observed in the past.

It is equally important to monitor the impact of increased income on some quality of life indicators. For example, is the increased income improving the quality of life of the people in the project area, e.g. better literacy rate, improved health services, provision of clean water and sanitation, etc., or is it being primarily used for conspicuous consumption, as has been observed in certain instances.

From a management viewpoint, it is essential that M&E be carried out continually so that decision-markers are aware of the developments in order that appropriate policies

may be formulated and implemented on time to reverse undesirable trends. To this end, both intended and unanticipated impacts should be monitored.

As mentioned earlier, time factor is very important for this type of evaluation since some of these results may not materialize within 9–12 years. Socio-economic monitoring need, not to be carried out as frequently as monitoring of operation and maintenance of water control facilities or agricultural production. Key variables could be monitored annually, and others could be surveyed once in 2–5 years.

Concluding Remarks

During the past three decades, water resources development projects in developing countries have received massive amount of financial support (OECD 1982). Irrigation is the largest subsector of the agricultural and rural development sector of the World Bank and the IDA lending (Hotes 1983). During the period March 1948, when the very first loan was made to a developing country for irrigation and power ($ 13.5 million for Chile), and June 1982, World Bank's agricultural lending has amounted to $ 26.7 billion, of which more than $ 10 billion was for 285 irrigation projects. The total project costs have been around 2.5 times the amount of the loans.

With such massive investments in water development projects in developing countries, it is essential that systematic monitoring and evaluation of the projects be carried out in order that:

i) timely corrective actions can be taken for maximising project impacts, and thus achieving the project objectives;
ii) goal achievements can be determined;
iii) lessons can be learnt for more effective project design and management;
iv) project assumptions can be verified; and
v) overall project impacts can be analysed.

Because of these considerations and massive investments in irrigation projects, monitoring and evaluation issues have assumed greater importance in recent years than ever before. Because of general scarcity of investment funds, it is essential that the funds available be used as efficiently as possible to maximise development efforts, which without continual monitoring and evaluation can clearly not be achieved.

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