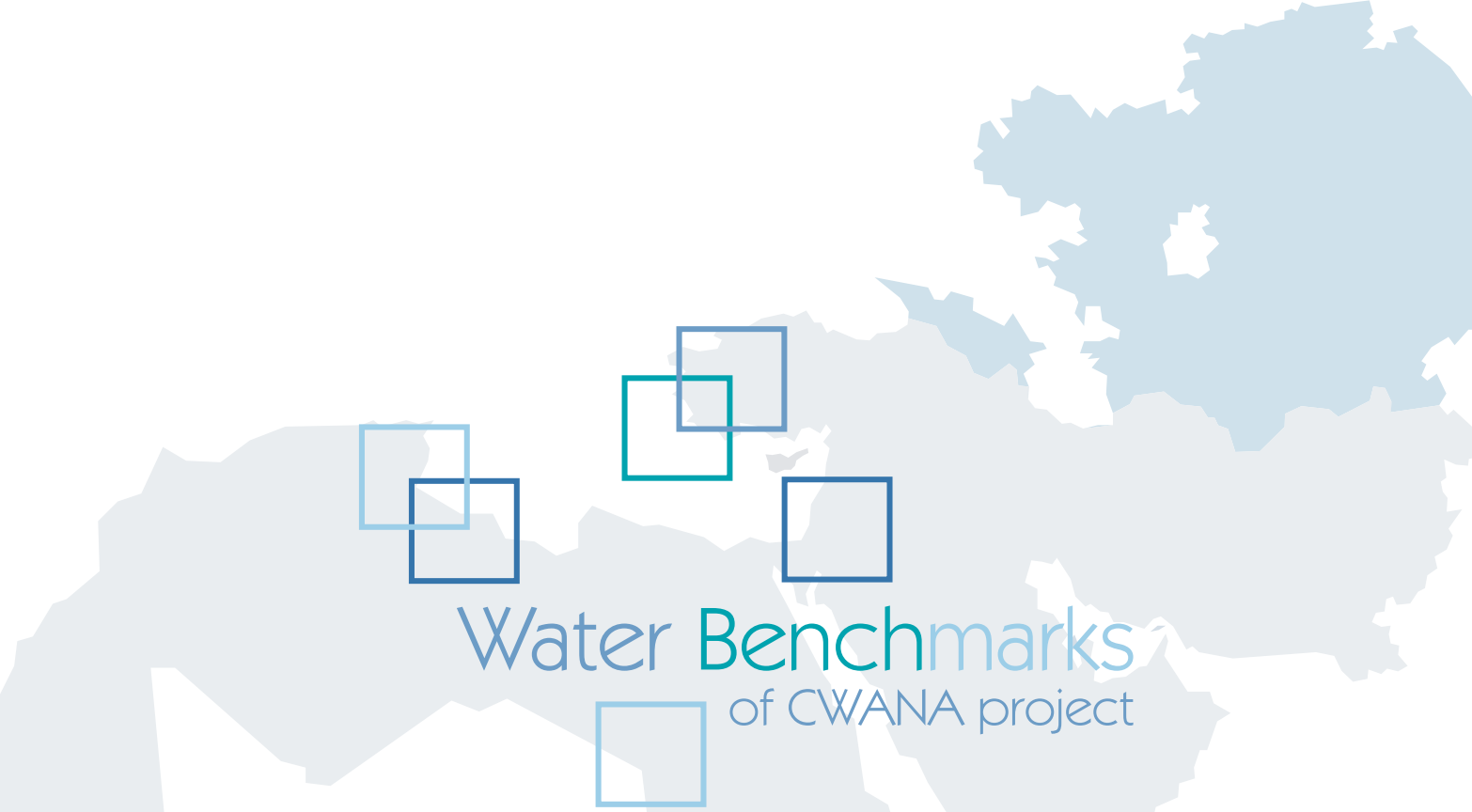

Water Benchmarks
of CWANA project

4

Monitoring and Evaluation Plan

Mohammad Samir El-Habbab

ICARDA

International Center for Agricultural Research in the Dry Areas

About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 15 centers supported by the CGIAR. ICARDA's mission is to improve the welfare of poor people through research and training in dry areas of the developing world, by increasing the production, productivity and nutritional quality of food, while preserving and enhancing the natural resource base.

ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and the Central and West Asia and North Africa (CWANA) region for the improvement of bread and durum wheats, chickpea, pasture and forage legumes, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national, regional and international agricultural research and development systems.

The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural Centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD) are cosponsors of the CGIAR. The World Bank provides the CGIAR with a System Office in Washington, DC. A Science Council, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

MONITORING AND EVALUATION PLAN

FOR

COMMUNITY-BASED OPTIMIZATION OF THE MANAGEMENT OF SCARCE WATER RESOURCES IN AGRICULTURE IN WEST ASIA AND NORTH AFRICA

Mohammad Samir El-Habbab

International Center for Agricultural Research in the Dry Areas

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Contents

1. Research Projects: Monitoring and Evaluation Characteristics

1.1 The Comprehensive Project

The comprehensive project consists of three main projects: the *Badia* Benchmark Project in Jordan, which includes two satellite projects in Saudi Arabia and Libya, the Rainfed Benchmark Project in Morocco, which includes three satellite projects in Tunisia, Algeria and Syria, and Irrigated Benchmark Project in Egypt, which includes two satellite projects in Sudan and Iraq.

1.1.1 Purpose of the Monitoring and Evaluation System in the Project

The Monitoring and Evaluation (M&E) system of the project is to be maintained and strengthened to support:

- The regular and systematic recording and reporting of progress against planned project targets for accountability to donors, implementing partners, beneficiaries and other key stakeholders. This will involve monitoring effectiveness and efficiency of project implementation. This would, on the one hand, contribute to a more effective and efficient program and on the other hand account for project implementation against planning.
- Increased understanding of the relation between project strategies and project impacts on the target group and the environment; as well as of issues related to sustainability so as to regularly review and in monitoring and evaluation in order to empower them in managing their development process.

1.1.2 Objectives and Outputs of the Main Project

The main long-term development goal of the project is to achieve sustainable and profitable agricultural production in the dry areas of WANA based upon the efficient and sustainable management of the scarce water resources provided from rainfall, groundwater and surface sources under on-farm conditions.

To reach this goal the project will develop and test, *with community participation*, water management options that increase water productivity, optimize water use and which are economically viable, socially acceptable and environmentally sound.

The research will be concentrated in three benchmark sites, one in Morocco for rainfed agriculture, one in Jordan for drier environments (*Badia*) and one in Egypt for irrigated environments. Each of these benchmark sites will be linked to several NARS satellite sites in the WANA countries. These satellite NARS sites were designated, to ensure maximum effectiveness of the project activities.

Four main outputs will be reached from the project:

- Strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems adopted by farming communities for improved and sustainable water productivity in the rainfed areas of WANA
- Suitable water harvesting techniques to capture and efficiently utilize rainwater runoff in more productive and sustainable agricultural systems integrated and adopted, by people in the WANA drier environments.
- Techniques and systems that optimize water productivity in irrigated systems, including water management, alternative crops, use of different water sources and policy and institutional options.
- Enhanced capabilities of national programs and the integration of researchers, extensionists, farmers and decision-makers in a regional program for sustainable management of water resources in WANA.

1.2 M&E in Agricultural Research

There are a number of features specific to agricultural research that influence the way it

is monitored and evaluated. These include agricultural research processes, agricultural research organizations, types of M&E, evaluation criteria, and techniques for measurement and attribution to National Research Systems (NARS). Agricultural research managers who are aware of these features can be much more effective in designing and implementing an M&E system. Agricultural research is a creative, often uncertain activity, where only a small proportion of the research ever produces results that find practical application.

Many research activities should be abandoned in mid-course, or their goals should be fundamentally revised. Monitoring of agricultural research should be designed as it is in the private sector - to support researchers and managers in a continual learning process, constantly refining research goals and processes.

Production systems and technological problems vary widely from place to place, so agricultural research needs be location-specific and may be decentralized. It may also take 10 to 15 years between implementation and impact, making it difficult to produce credible assessments of results when research is still underway or only recently completed.

Most agricultural research in developing countries is carried out by public-sector organizations that do not sell research outputs but provide them free to extension programs and farmers. The budgets of public organizations are seldom linked to their performance. In these cases, M&E is generally conducted to meet routine accountability requirements and has little application in management decision making. In contrast, where agricultural research is carried out by private firms or farmer-supported commodity research organizations, M&E tends to be better integrated with management decision making.

Much of the M&E that is now done in developing-country agricultural research was initiated by external donors to meet their accountability requirements. Donor organizations have also supported numerous studies to demonstrate the economic impact of agricultural research.

However, few national organizations have the capacity to carry out their own impact studies. In areas such as personnel planning and management, most national research organizations have systems for performance assessment, often based on civil-service regulations. Some larger research organizations have planning or other units dedicated to M&E. A few organizations are beginning to manage their research in projects, and to this end, they are setting up project databases and budgeting systems. In most organizations, however, research monitoring for internal use tends to be informal.

There are many possible standards, or criteria, for evaluating a research activity; some, for example, include professional standards of research quality, economic efficiency, and the accomplishment of goals. The most commonly used evaluation criteria in agricultural research are professional standards (especially related to technical feasibility), which are evaluated through peer review in project selection and through internal reviews. In external reviews, attempts are sometimes made to assess management procedures against professional norms and to assess users' (extension or farmers') satisfaction with research results. Some organizations are attempting to introduce farmers' criteria through farm-level evaluations and external reviews, but most impact studies use economic efficiency as the standard for evaluation. In contrast to the situation in industrial research and development, profitability is seldom used as a criterion in agricultural research.

In M&E of agricultural research, inputs are generally measured in terms of their financial cost. Publications or technologies (such as varieties) are sometimes used as indicators of

research output. More frequently, farm-level adoption levels or changes in yields, prices, or other variables are estimated and attributed to research efforts.

It is seldom easy to measure and attribute changes to specific research outputs. For example, measuring trends in yields or incomes is difficult where year-to-year variability is high. And once a trend is established, it is even more difficult to determine the contribution of agricultural research vis-à-vis other influences, such as extension and credit programs, price changes, or the weather.

Economic evaluation techniques have been developed to estimate the benefits of agricultural research and their distribution among different social groups. Data for these studies may be gathered through on-farm trials or surveys. Key variables are often assumed or obtained from experts, and macroeconomic impact is derived from farm-level results. Few assessments of social impact (such as nutritional status or employment rates) or environmental impact have been done.

1.3 Defining the M&E System and its Goals

In general, M&E is a continuum of observation, information gathering, analysis, documentation, supervision, and assessment. More specifically, monitoring is the observing or checking of activities and their context, inputs, processes, and results. It also involves the communication of these results to the appropriate level of management and the storage of this information for future evaluations.

Conventional Progress Monitoring has several goals:

- To ensure that inputs, activities, and outputs (results) proceed according to plan
- To provide a record of inputs, activities, and outputs
- To warn of deviations from objectives or goals
- To assist managers in making decisions

Process Monitoring, on the other hand, is a management tool designed to help "top-down" organizations become more participatory and demand-responsive. Process Monitoring is often confused with Conventional Progress Monitoring. Conventional progress monitoring focuses on physical, financial and logistic aspects of projects, while Process Monitoring deals with critical processes, which are directly related to the project's objectives. For example, progress monitoring looks at the number of training sessions held, or the percentage of work completed on a water supply scheme; while Process Monitoring evaluates the quality of training or the level of community involvement in identification, design, site selection, and supervision of construction. An ideal M&E system, which will be used here, contains elements from both progress and process monitoring (Hosain et al 1999).

Process Monitoring helps projects to:

- Become more innovative, flexible, adaptive and responsive
- Develop a sense of accountability in project staff towards the beneficiaries
- and towards their own development needs
- Facilitate changes within the project, local institutions and government agencies
- Solve problems through better identification, analysis and communication of causes and appropriate solutions
- Improve planning and monitoring skills
- Improve effectiveness and sustainability
- Provide continuity of information and knowledge in situations where high staff turnover affects institutional memory and project implementation
- Empower communities by linking the efficiency and appropriateness of the project to community needs and demands

Box 1. Example of the Differences between Conventional Progress Monitoring and Process Monitoring

A community organization from a project area complained about delays in project implementation. A conventional M&E system might have reported the delay, and the Project would have responded by instructing project staff to speed up implementation. Process Monitoring, however, examined the entire process with the community and project staff and identified the causes for delays. The main reasons for delays could be, for example, late disbursement of funds by the project, and logistical constraints resulting in infrequent contact between project field staff and communities.

Evaluation places greater emphasis on judgment and appraisal, assessing the worth, merit, value, or quality of research. It can occur before (ex-ante), during (ongoing), or after (ex-post) a research project has been completed. It is concerned largely with aspects of relevance, effectiveness, efficiency and impact.

1.4 Process Monitoring

Some of the main differences between conventional progress monitoring and Process Monitoring are described in Table 1.1. To improve coordination, communication and implementation, it is important that the Process Monitoring Unit is located within or closely linked to the Project's M&E Unit.

1.4.1 Step Approach to Implementing Process Monitoring:

Process Monitoring is carried out during all stages in the project cycle. When problems arise, Process Monitoring investigates to find causes, and then reports on its findings and offers recommendations to project management. Changes in implementation strategy, rules or procedures are then made to improve project implementation. Figure 2 shows the five steps for implementing the Process Motoring Approach, which starts with: establishing process monitoring, then situation review and selection of process, then observation, then reflections on findings, and then taking actions.

I. Establishing Process Monitoring Unit

The first step in establishing a Process Monitoring Unit is to recruit suitable staff. An ideal staff profile is gender balanced, with different professional backgrounds. Staff should be experienced in community development and M&E. It is useful for Process Monitoring to be both "internal" to the project, but with "external" linkages and independent reporting channels.

It is important that Process Monitoring staff develop good working relations with staff from other project units. Once the Process Monitoring Unit has been established, the Unit must establish channels and procedures for information flow to and from the Unit. Methods of communicating information, such as meetings, field notes, progress reports, work review discussions, and working group meetings should be used. In addition to formal information exchange, Process Monitoring staff can learn from informal discussions with project staff. The value of informal discussions in a friendly environment can not be overestimated. It is important that Process Monitoring information is recorded and shared with key stakeholders, including communities. Process Monitoring findings should be shared with project staff through presentation at working group meetings, project planning meetings, or in project progress reports.

II. Situation Review & Selecting Key Project Processes and Indicators

There are two ways in which key processes can be selected, first, they should be closely linked to project objectives and the project

Table 1.1. Comparison of process monitoring and conventional progress monitoring

Process Monitoring	Conventional Progress Monitoring
Concerned with key processes for project success	Primarily concerned with physical inputs and outputs
Measures results against project objectives	Measures results against project targets
Flexible and adaptive	Relatively inflexible
Looks at broader socioeconomic context in which the project operates, and which affects project outcome.	Focuses on project activities/outcomes
Continuous testing of key processes	Indicators are usually identified up front and remain relatively static.
Selection of activities and processes to be monitored is iterative, i.e., evolves during process of investigation	Monitoring of pre-selected indicators/activities
Measures both quantitative and qualitative indicators, but main focus is on qualitative indicators	Measures both quantitative and qualitative indi-tors, but main focus is on quantitative indicators
A two-way process where information flows back and forth between field staff and management	A one-way process where information flows in one direction, from field to management.
People (community) interactive	Paper-oriented (use of standard formats)
Identifies reasons for problems	Tends to focus on effects of problems
Post-active review and follow up	No post action review
Includes effectiveness of communication between stakeholders and different levels as a key indicator	Takes communication between stakeholders for granted
Is self-evaluating and correcting	Is not usually self-evaluating and correcting

Source: Hosain et al. 1999

cycle. Secondly, processes not previously identified for monitoring, but in which the project experiences problems and/or bottlenecks may be added to the key processes identified earlier. The selection of processes should take place in consultation with project management, staff, consultants and beneficiaries. This will help to ensure ownership of Process Monitoring activities by key stakeholders.

III. Observing Key Processes

Who observes, what methods are used and the best methodology should be identified and agreed in advance? It is important that Process Monitoring staff receive appropriate training before they begin work, since there is an in-built bias in most people, which prevents them from seeing certain things and predisposes them to see others. Moreover, collection and analysis of qualitative information also requires relevant skills and experience. The methods that can be used concerning community processes are: transect walks, participatory needs assessment, participatory discussions and participatory resource mapping.

IV. Reflecting on/Analyzing Findings

When observation is completed, it is time to assess the information collected. Process Monitoring staff has to answer questions like: What turned out differently than expected? Which part of the strategy to gain insights into

Figure 1. The process monitoring in the project cycle.

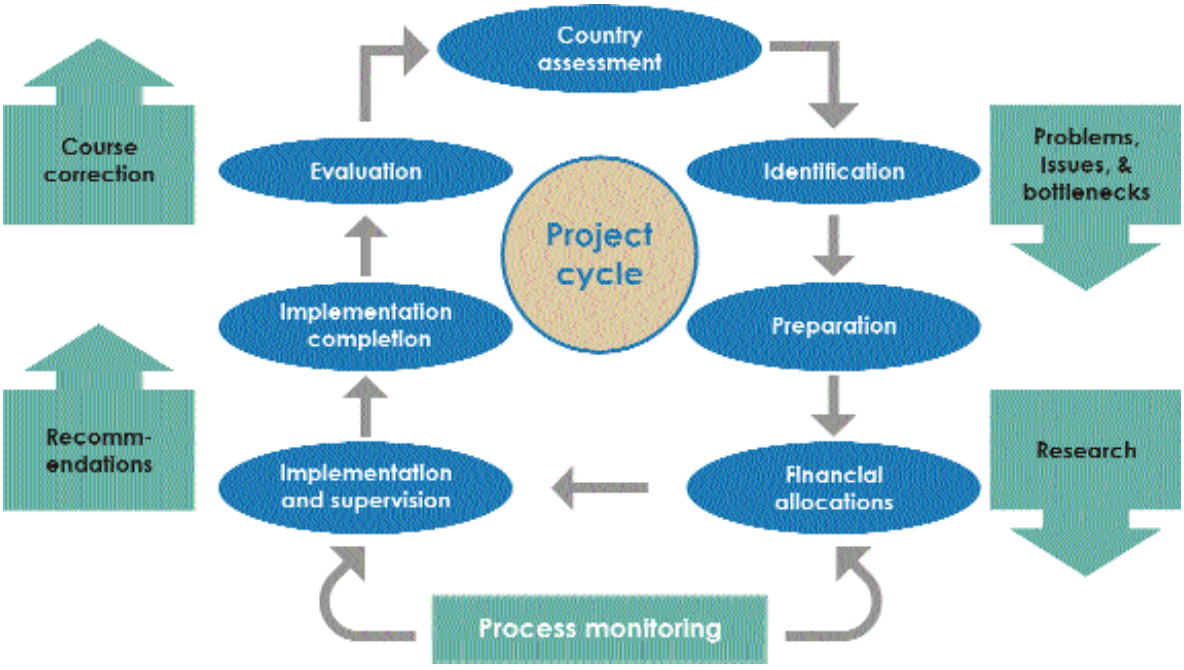


Figure 2. Steps for implementing the process monitoring approach.

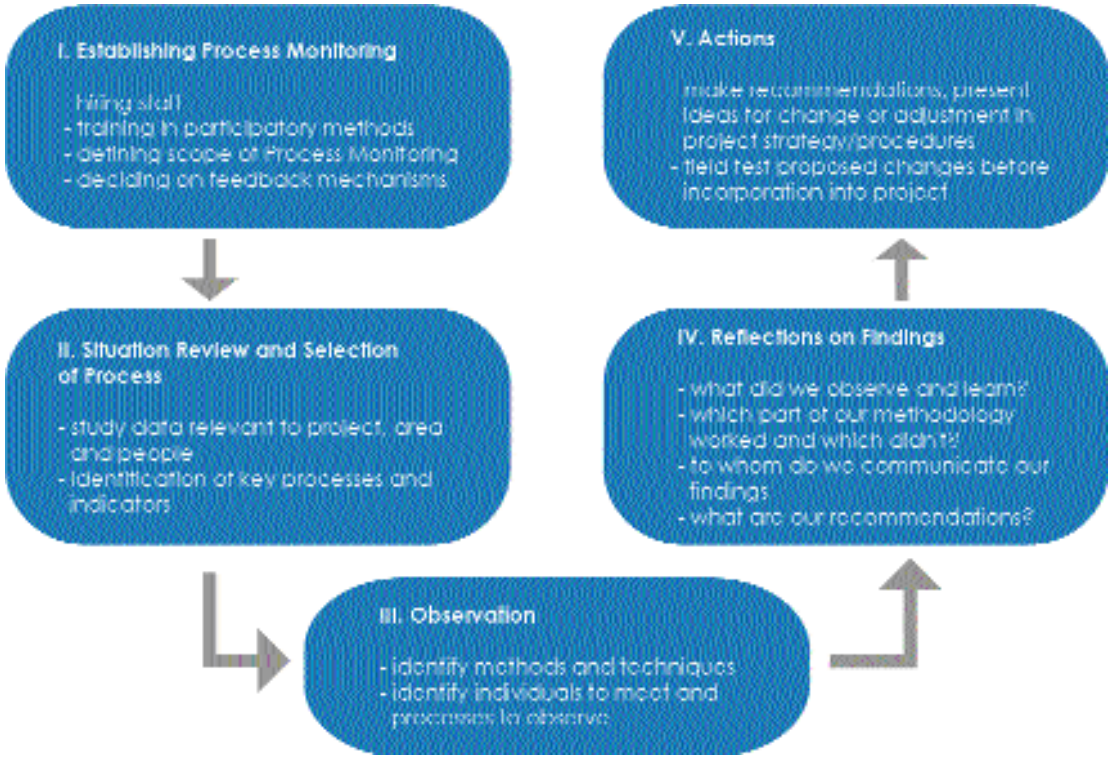
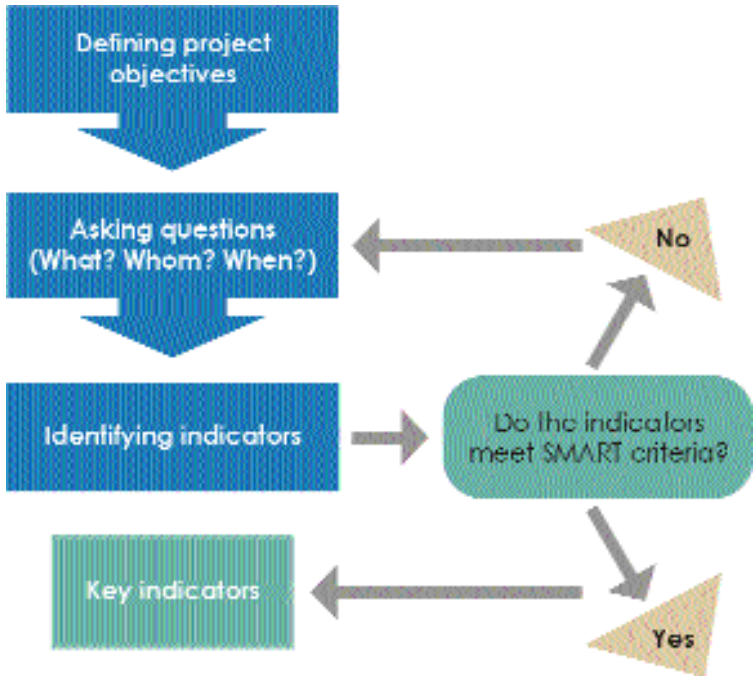


Figure 3. Identifying indicators



the processes produced desired results and which didn not? Was a cross section of views sought? With whom do the findings need to be shared? In what form should these be presented? Answers to these questions should be documented and communicated to relevant project staff and key external stakeholders.

V. Follow-up Actions

From its observations, the Process Monitoring Unit should make recommendations for changes to project management. The Process Monitoring Unit should also identify what results can be expected from the proposed changes.

1.4.2 Identifying Indicators

The most crucial issue in selecting indicators is to identify users of the information. Will the indicator give users information they need to solve important problems? Since indicators must communicate, they must be presented in a language or form that is familiar and understandable. For any activity, there are many possible indicators and many ways of classifying them. For example, indicators can show changes in:

- The presence of something such as, number of community organizations or O&M committees
- The impact of change (such as, are people better or worse off since the innovation/service was introduced?)
- Usage (such as, the frequency with which credit is accessed)
- Extent of coverage (such as, the number of people actively participating in meetings, or number of households receiving water regularly)
- Quality of an intervention (such as, do people feel the training they received is practical and useful? Do communities see the Community Action Plan as being useful?)
- How representative are needs (Do project staff consult a wide range of community members when carrying out needs assessment?)

Three things make identifying indicators diffi-

cult. First, as each objective or activity can be measured by different indicators, it is hard to choose which indicators best communicate what we want to know and are easy to observe and collect. This task is further complicated when one has to decide which aspect(s) of a process one wants to observe, i.e., actors, rules, or outcomes.

Second, indicators may change over time as the project's internal and external environment changes and as project activities change. Because of this, indicators need to be reviewed periodically to insure that they are still relevant. Third, developing useful indicators is a process of negotiating between different and sometimes conflicting interests. Bringing different people together in a participatory process to identify indicators reveals their different needs and expectations. It also generates discussion about what each stakeholder considers 'relevant' and 'trustworthy' information.

A useful way to make a final selection is to ask if the indicators are SMART, i.e., Specific, Measurable, Attainable, Relevant, and Timely.

1. 5 Impact Assessment

Impact assessment attempts to estimate the effects that research has had in the past or that it may have in the future. The main benefits of impact assessment for National Research projects (NARS) are:

- Impact studies can *motivate researchers* by providing feedback from the farm community and other research clients on the use and effects of research results.
- Adoption studies can *help researchers refocus their research efforts* by providing insights into farmers' assessments of new technologies (vis-à-vis their current practices) and into farm-level adoption processes.
- Ex ante assessments can provide managers with a *basis for allocating resources* among competing research demands.
- Ex post studies can provide managers with *evidence of the value of research*, to argue for continued investments.
- Lessons learned from impact assessments can be used to *improve future research* strategies, plans, and management.
- Impact assessments can *show how economic policies and technology interact* in determining the ultimate benefits of agricultural research. This can be useful for discussions between research leaders and policymakers.

In agricultural research, impact assessments have been used mainly to estimate economic returns to research investments and the diffusion and adoption of new technologies should be conducted periodically. The Internal program reviews are open sessions where research managers and scientists review research activities, identify achievements and deficiencies, and establish directions for the future. They are usually annual events at which the research activities of a research institute, program, or station are summarized and discussed collectively by scientists in order to improve research performance and plan for the future. Internal program reviews stimulate professional dialogue and build consensus among an organization's scientists, provide material for annual reports and work plans, and encourage internal critical evaluation and a sense of accountability (Goldsworthy and Gapasin 1997).

The CGIAR has adopted **"impact orientation"** as an approach to evaluate research impact. "Impact orientation" is primarily concerned with targeting agricultural research funds at those areas in which the greatest impact is likely to be achieved. Such "impact orientation" can be achieved relatively rapidly by using a range of impact evaluation tools that do not necessarily involve complex measures of economic returns. The complexity of the technological change processes makes impact assessment (IA) of agricultural

research very difficult. One of IA's main roles is to demonstrate to donors that their investments in agricultural research have been money well spent and has contributed to the donors' own goals. These goals often include poverty reduction as many donors have adopted the Millennium's aim of halving world poverty by 2015. However, rural poverty reduction can come about for many reasons, not just because of agricultural research. Moreover, even if an agricultural research project has had some impact that impact will have been brought about by the efforts and interactions of many stakeholders, not just the agricultural researchers. This makes the attribution of impact virtually impossible.

A second role for impact evaluation that donors are putting increasing emphasis on, is to help make impact more likely by guiding the research process. This is because a move to understanding innovation as a complex, non-linear and social process implies a move from on-station research, where researchers develop technologies by themselves, to on-farm research where technologies are developed together with the end-users. On-farm research needs to be responsive to farmer perceptions and modifications through good monitoring and evaluation. Furthermore, a move from a scientist-led approach to a more participatory model requires organizational learning and change within research centers. This learning also needs to be based on monitoring and evaluation information.

The evaluation of agricultural research usually involves measuring the resources used (inputs) and activities completed (outputs), as well as assessing the extent to which the outside world has adopted outputs and have produced economic, social, or environmental effects (i.e., impact). It may also involve tracking the ***efficiency*** with which inputs have been transformed into outputs and- more difficult to measure- into outcomes and impacts. The ***relevance*** of the research should also be addressed, i.e., the extent to which outputs have been created in fields in which outcomes and impact are likely to be greatest.

Organizations aiming to become more impact oriented can also employ the impact pathway concept. The purpose of this perspective is to re-emphasize the intentions behind the initial research inputs and to construct a possible sequence of events that will lead to significant levels of impact. It provides a way of helping to analyze the various complex interactions involved in creating impact, including those between investment in research, research results, adoption of results, and various peripheral factors such as production conditions, markets, culture, behavior, and so on. Although it builds on a set of logical relationships that are interlinked in a chainlike manner, it does not imply a linear cause-and-effect contribution to impact. Rather, it explicitly acknowledges the feedback mechanisms and effects of synergy that can lead to impact within innovation systems. Strict application of the impact pathway concept implies that when planning research, one should take into account the often uncontrollable factors that determine impact, for example by consulting widely with farmers and other possible end-users of the research to determine if and how the results are likely to be used.

A generic model of the research impact pathway is shown in Figure 4, which indicates the easily observed steps in the impact pathway (i.e., at the input, output, outcome, and impact levels). As one proceeds along the impact pathway, away from the initial (research) process, the observed changes become less and less attributable to this initial process. At the same time, the number and variety of participants—and hence the probability of conflict—increases (Hartwich and Springer-Heinze 2004).

Three processes may be distinguished on the pathway leading from agricultural research to impact:
The research process. Research activities

(which may be conducted in the field, in laboratories, in experimental plots, or in offices), use various inputs (e.g., information and human, physical and financial resources) in a research process that generates outputs in accordance with set priorities and objectives. Outputs are the measurable products of the research process, such as technologies generated, improved, and adapted; procedures, methods and patents developed; scientific papers written; or simply new information generated. Together, they indicate the production of new and more advanced knowledge.

The innovation process. Once outputs have been generated by the research process, the innovation process becomes important, i.e., the dissemination of information and the application of the research outputs. The outcome of this process is the adoption of technologies or the acquisition of knowledge by new users. Outcomes can usually be measured in terms of increases in yield, productivity, and/or production.

Agricultural development process. The agricultural development process determines if, after adoption of an innovation, impacts were achieved. The impacts could be: increased farm income, increased food security, increased environmental sustainability or increased welfare are realized. Whether or not such impacts are achieved will depend very much on the condition of the rural economy and the prevailing social context.

1.6 Information Gathering and Organization

Monitoring of impact indicators presented in the logframe will involve:

- Direct measuring of specific parameters or factors such as Percentage increase in agricultural yields and production by the poor small farmers.
- Undertaking comprehensive surveys, structured interviews and qualitative approaches to determine change in specific factors such as Diversification of sources of income were reached and of percentage of target farmers and villages with increased adoption of research practices and participating in community-based planning to maintain or restore ecosystems services while improving their livelihoods

The M&E system will cover both, the monitoring and evaluation activities. The Monitoring activities will cover the Management Information System (MIS), monitoring the day-to-day activities of the project based on the selection of indicators and methodologies for the different project dimensions (socioeconomic and environmental) providing periodic reports; and monitoring project impacts to demonstrate trends in land degradation over the life of project, including environmental, socio-economic, community involvement and behavior change indicators. Evaluation activities on the other hand, will complement the monitoring activities by measuring the effectiveness of actual impact, hence providing feedback and helping improve the effectiveness of the project.

Monitoring and evaluation (M&E) have long been important for funding agencies to assess actual change against stated objectives, and thus to judge whether development assistance has been successful or not. This has usually involved external experts evaluating against indicators that have been determined externally or through rigid, imposed monitoring procedures. Yet changes are afoot and organizations are increasingly using M&E for internal learning and continual improvement to their work. They also increasingly realize that this needs to happen with a wide range of stakeholders, thus making M&E more participatory.

Participatory Monitoring and Evaluation (PM&E), which should be implemented in this project, involves the assessment of change through processes that involve many people

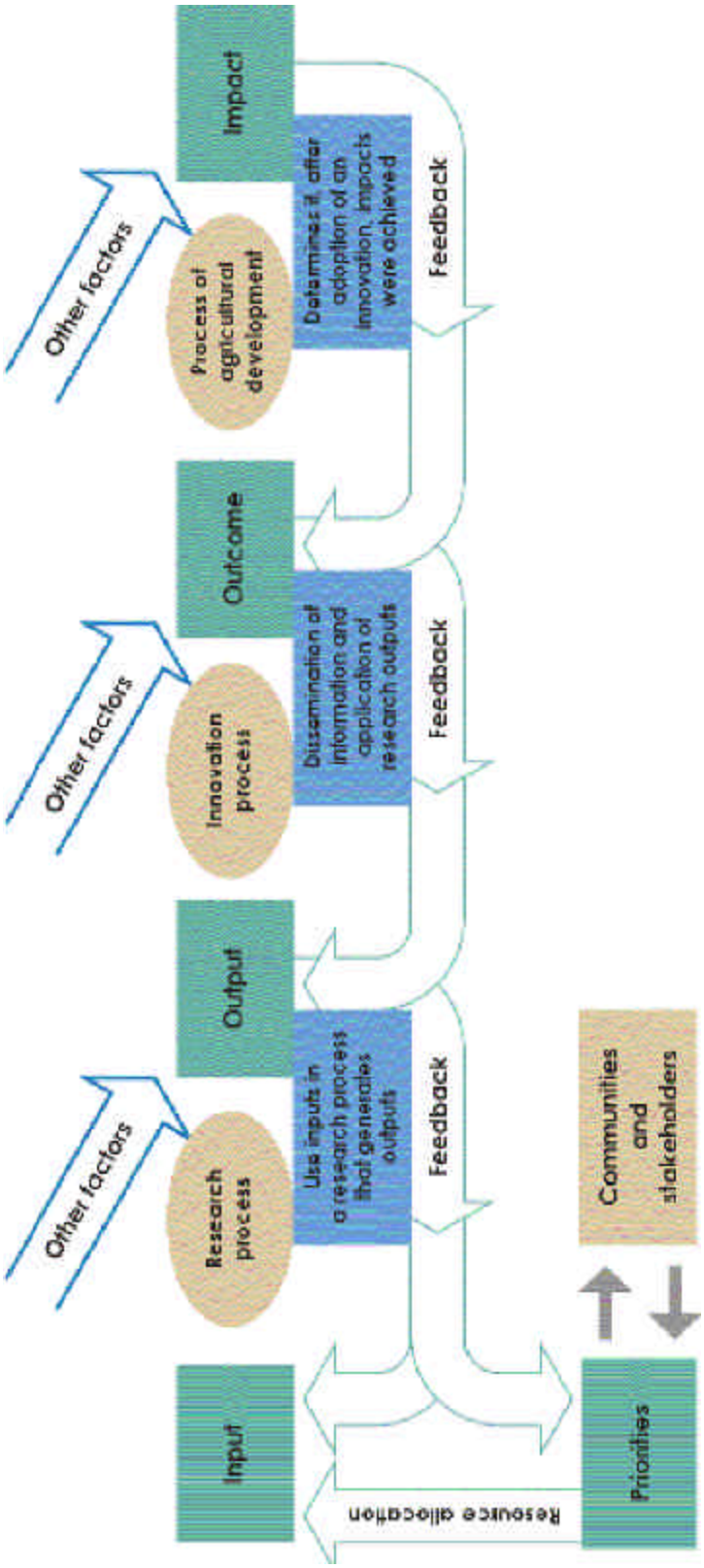


Figure 4. The impact pathway model

or groups, each of whom is affecting or affected by the impacts being assessed. Negotiation leads to agreement on how progress should be measured and the findings acted upon. It is a challenging process for all concerned as different stakeholders must examine their assumptions about what constitutes progress – and together deal with the contradictions and conflicts that can emerge.

The information gathering and organization for the main goal are:

- Baseline surveys undertaken at onset of implementation conducted by PMU technical staff, since M&E by definition compare changes over time, or 'before and after'/ 'with and without-project' situations.
- Representative household surveys at mid-term and project completion (gender-disaggregated) conducted by Project Managemant Unit (PMU) & CSC technical staff.

The main tool that could be used for collecting data and information is the PRA. The PRA sequence with key feedback sessions are as follows (IFAD)

- Review of secondary data: Desk review (literature review, in-country sources and grey literature)
- Primary data gathering Key informant interviews and focus groups (structured/semi-structured) – at the project area (government, primary and other

stakeholders) levels
- Resource mapping
- Transect walks (local level)
- Data collation and analysis
- Initial feedback Graphic: trends, maps, pie diagrams and such with field staff (extension agents, M&E unit, etc.) and primary and other stakeholders
- Quantitative survey: Questionnaires, biophysical measurements during a transect, group discussions, etc. to gather information to cover unanswered questions, fill gaps in the data and substantiate controversial findings
- Final feedback At the national (project management, relevant ministries, donors (IFAD, etc.) and local (primary stakeholders) levels, and inter-organizational seminars (to check validity and pertinence of results pertaining to project goals, activities, ongoing efforts)

1.7 Communication and Reporting

Defining appropriate communication mechanisms should be based on the identified information needs of different stakeholders as well as a good understanding of which media would be most appropriate for each of the different target groups. It is good practice to discuss draft M&E findings with implementing partners and primary stakeholders in order to get feedback on accuracy, reach joint conclusions and agree on next steps. Once the M&E findings are agreed upon, these can be communicated to funding agencies, cooperating institutions, government departments and other projects. This second set of final findings will fulfill accountability needs but can also serve for advocacy purposes.

Monitoring involves the appraisal of projects during their implementation. The appraisal is done annually and is carried out in the entire system. There are six mechanisms used for monitoring the progress of ongoing projects, namely:
- Field evaluation, it consists of visits to project sites at specific dates during project implementation.
- PMU in-house review, it is an annual review of ongoing and completed projects
- Regional coordinated review of ongoing and completed projects;

Table 1.2. Flow of monitoring reports

Person responsible	Report	Sent to whom
Accountant	Monthly or quarterly budgetary statement	- Research/project leader - Chief accountant
Researcher	- Periodic progress report includes financial summary	- Project leader
	- Annual/final research report	- Station head
Project leader	- Summary of progress reports - Annual project summary	Program leader
Program leader	- Summary or progress reports - Annual program meeting minutes and report	Research director
Station head	Summary of station data on resources used needed	Directorate officers in charge of funds, supplies, and facilities
Research director	Annual report	- Technical, planning and financial ministries - Donors

Source: ISNAR. Planning, Monitoring, and Evaluation of Research Projects: A Training Module. 1997

- Regional symposium on R&D highlights. The objectives of the regional symposium are to: 1) present and obtain feedback from users and others on the feasibility and appropriateness of technologies being generated and tested in the system; 2) facilitate dissemination of technologies to users and information for policymaking; 3) formulate an action plan to utilize the identified technologies and information; and 4) assess accomplishment of the past action plan.
- Semi-annual and annual technical and financial reporting. Researchers are required to submit periodic progress reports on the technical and financial aspects of their projects. The annual report is the same report that is presented during the annual program review at the agency level.
- Seminars to discuss research results. Special workshops, seminars, and scientific or policy conferences are periodically conducted to serve as venues for researchers to present their research findings for dissemination to policymakers, special client groups, politicians, scientists, and others.

These mechanisms, while having their own specific objectives, are generally aimed at:

- determining progress and attainment of objectives;
- identifying the status of technologies or information generated or verified so far;
- assessing the appropriateness of the methodology;
- determining the efficiency of the use of resources (budget, scientists' time);
- identifying problems in implementation and recommend solutions;
- identifying new research areas or possible spin-off projects.

Table 1.3 shows the different documents necessary for reporting. They cover the project impact, human resources, financial situation, and inputs such equipments raw materials and machinery.

1.8 Proposed Physical and Financial Resource Requirements

Once the M&E implementation plan has been finalized, physical and financial resource requirements will need to be clearly defined and sources identified to ensure that the M&E activities and processes identified are feasible and planned for (Table 1.4).

Table 1.3 Documents needed for reporting

Monitoring Fields	Planning and Implementation	What to be Monitored?
	Documents	
Project impact	Logframe, Impact Pathway Matrix, M&E Matrix, Implementation Plan, and Achievement Reports	General project impact, the impact of research methods, and models.
Human resources	Number and quality of employees and labor, principles of hiring, level of training, level of efficiency, and Promotion system.	Performance efficiency (quantity, quality and time effectiveness)
Financial situation	Budget (annual, semi-annual, and monthly) and accounting procedures	Expenditure and distribution system, and balance sheets and audits
Equipment, raw materials & machinery	Purchasing system, purchasing plan, and the definition of quality of inputs	Inventory monitoring, maintenance procedures, inventory book keeping

Table 1.4 Examples of physical and financial resource requirements

Category	Specific items
Meetings & Events	Stakeholder meeting to develop the M&E matrix
	Community meetings to develop community based M&E
	Establishment and regular meetings of the Learning and Empowerment Facilitation Team
	Regular review & planning meetings
	Annual Review and Planning Meeting
Technical expertise	Support to development of component logframes
Training costs	Training of staff on basic principles of M&E, in accordance with requirements of M&E plan
	Training of staff in facilitation & participatory techniques
	Training of key staff in data collection, analysis and interpretation
	Training of key staff on the project MIS
	Training in Participatory Impact Assessments
	Promoting exchange of experiences with other projects and/or stakeholder groups
	Training of communities and other key stakeholders in PM&E (e.g. training of CSC and Community Facilitators)
Physical non-contractual investment costs	Monitoring equipment (such as data collection protocols and other tools)
	Redesign of project database
	Establishing a LAN/WAN to network project implementation units
	Publication materials & costs related to other appropriate communication media (posters, brochures, radio etc)
	Appropriate venues for communities to participate in PM&E processes; and for information storage and display to enable access to a wider group of beneficiaries
Project staff and implementing partners (including communities)	Participation in development of M&E matrix
	Participation in the Learning & Empowerment Facilitation Team
	Participation in regular review & planning meetings
	Data collection
	Data analysis and report writing
	Support to community based M&E processes

1.9 Necessary Conditions and Capacities

Adequate institutional arrangements and institutional and human capacity are essential for any M&E project, including functioning of MIS. The level of skills required depends on the complexity of the project. Competitive Research Grant Projects and projects using contracting and involvement of a wide range of stakeholders across several R&E subprojects are demanding in M&E capacity. The implantation of a well-functioning M&E system both at the subproject and the overall program level can be a major challenge.

The following features are recommended for developing institutional arrangements for M&E of research projects:

- **Establish a centralized M&E unit.** For com-

plex Research projects, it is recommended that a centralized M&E unit be established within the main implementing institution.

- **Link the centralized M&E unit to subunits.** The centralized unit should collaborate with M&E units in other co-implementing institutions (e.g., extension agencies, research centers, private sector implementers, enterprise development centers) and in decentralized regions (e.g., province, district, and county level centers) where project activities take place or have influence.

These first two steps aim to guarantee that all project components will (a) provide sufficient project and program level M&E links and a scope for effective communication between and within projects; (b) ensure adequate reporting at the national or program level, and pinpoint any gaps or shortfalls that may not be detected by the M&E system of a single project; and (c) provide an avenue for various project teams or Team Leaders with designated projects under the implementing institution (NCARE in BBP, INRA in RBP, and ARC in IBP) to collaborate, share lessons, and ensure desired results.

Given that many private researchers are not under the umbrella of any research or educational institution, tracking and eventual assessment of grant operation and research results may be very difficult. t is recommended that such individual researchers be monitored by focal M&E persons under the project's technical and supervisory institutions. This would ensure proper administration of the grant and generation of the expected research results.

- **Consider institutionalizing an M&E system within implementing institutions.** NCARTT in BBP, INRA in RBP, and ARC in IBP will be institutions to supervise the projects, this will provide a permanent M&E system beyond the life of the project as well as meet donors needs.
- **Allocate sufficient time and resources to guarantee adequate capacity.** Adequate institutional and human capacity is imperative for effective functioning of M&E frameworks within implementing institutions.

1.10 Monitoring and Evaluation System Structure

The M&E system for Benchmarks is intended in the first instance to help stakeholders at all levels routinely track the progress and performance of project components and activities, including quantity, quality, timeliness, and cost effectiveness of outputs delivered. It will also provide a systematic means for periodic assessment of the relevance, adequacy, equity and sustainability of resultant outcomes and impacts.

In the design of M&E System, recognition is given to the project strategy of empowering local communities and individuals in managing their own development, which calls for making informed decisions about the deployment and use of resources in areas that affect their livelihoods. Figure 3 shows a proposed M&E unit in the project; Moreover, Annex 1 shows the roles and responsibilities of the M&E key staff.

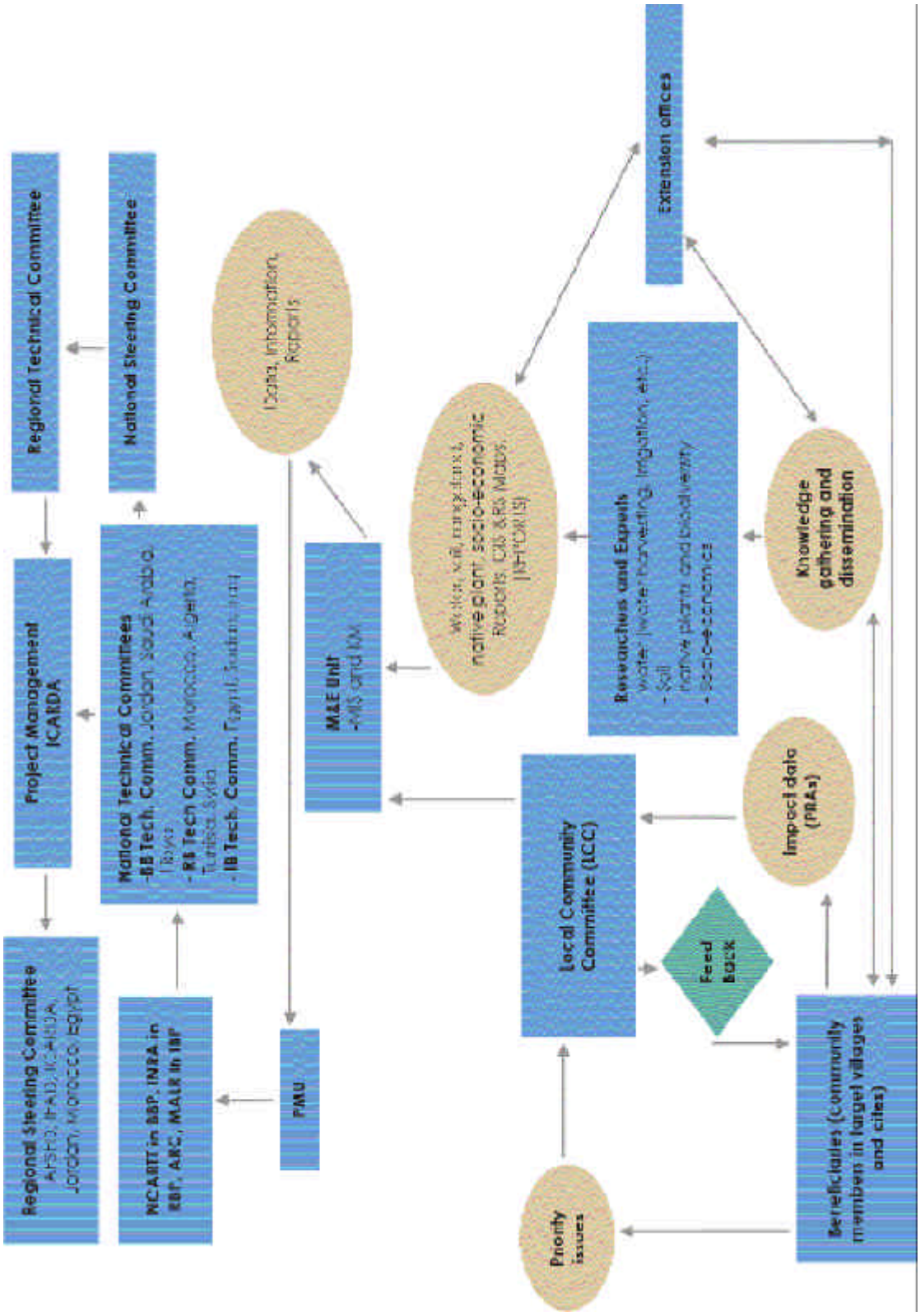


Figure 5: Structure of proposed M&E unit in the project

2. Monitoring and Evaluation System of *Badia* Benchmark Project

2.1 Project Objectives of the Badia Benchmark

The project's objective is rehabilitating and protection of the degraded rangeland through the implementation of technical interventions using water harvesting suitable techniques to capture and efficiently utilize rainwater runoff in more productive and sustainable systems for shrub and crop plantations, based on land use potential and proper grazing management, with full participation of local communities. The Badia Benchmark Project (BBP) research results will be transferred to other similar areas. Two areas were chosen: Saudi Arabia Satellite Site (SA-SS), and Libya Satellite Site (L-SS).

The main objectives of the SA-SS are:

- Development and distribution of water harvesting in each site (Wadi)
- Increase fodder production of range shrubs for livestock in the area
- Combat desertification and promote soil conservation through erosion control
- Develop and improve the area for recreation purposes (using both resource oriented and area oriented multiple use management

The main objectives of the L-SS are:

- Testing of a selected set of WH techniques in order to establish their long-term validity and usefulness to the targeted areas.
- Introducing, adopting and transferring of tested WH techniques to farmers then convincing pilot demonstration models that enhance their adoption.
- Building and improvement of the technical and organizational capacities of the national research institutes and programs of the participating countries in the project.
- Enhancement of training programs and collaborations with international institutions like ICARDA.

2.2 The Impact Pathway of the BBP

Figure 6 shows the impact pathway of the BBP, which includes the main components: inputs, research, outputs, innovation process, outcomes rural development and goal.

The flow of information and impact analysis for the BBP will be as follows (Impact Pathway Model):

2.2.1 Project Inputs

The results of the benchmark research site established in the Jordan Badia are planned to be transferred to other similar areas. The integrated watershed management approach was adopted in the research. A typical watershed of suitable size was selected based on agreed criteria. A research program was designed involving local communities and institutions in a participatory approach.

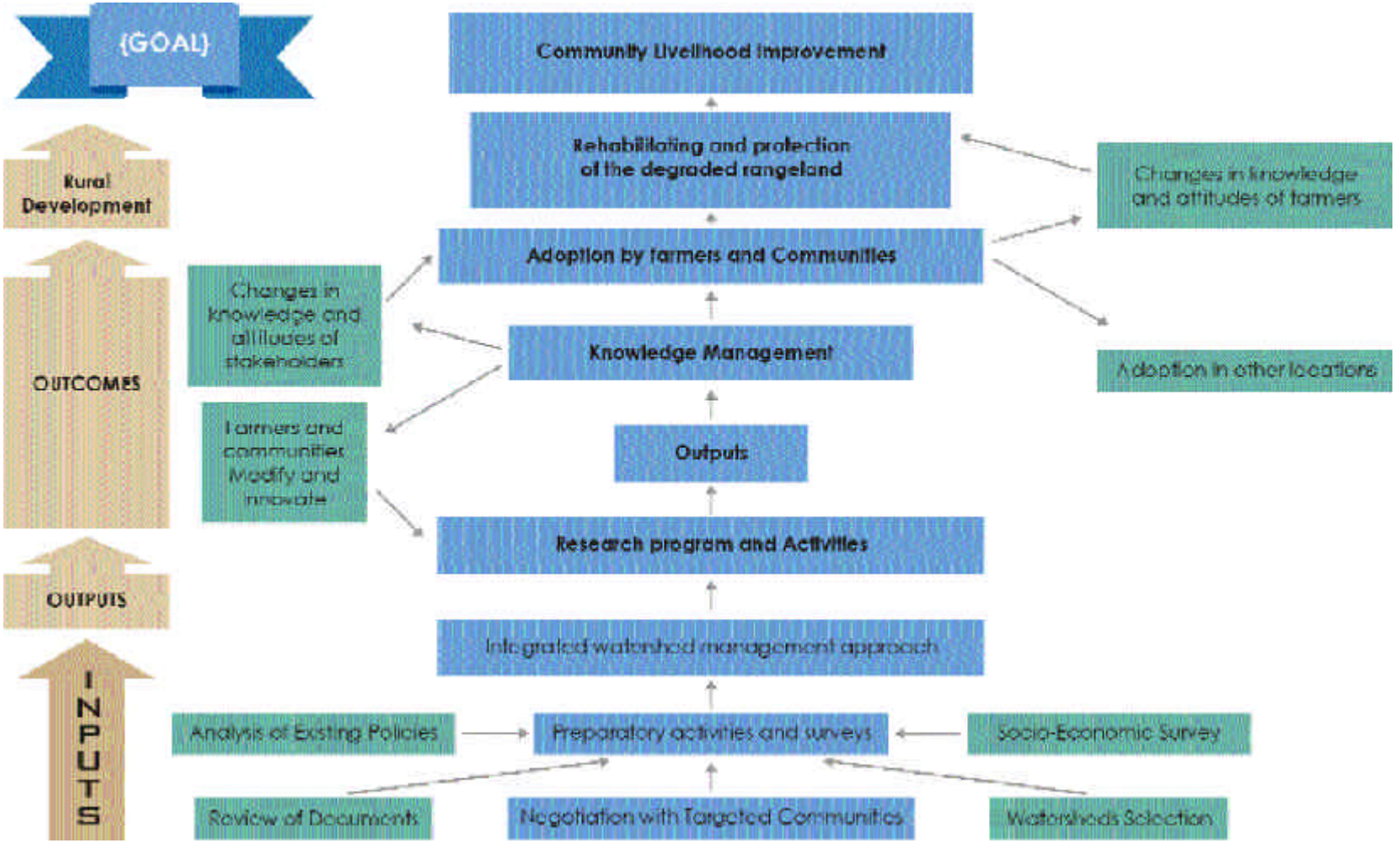
2.2.2 Research Process and Activities (Natural Resource Management, NRM)

The project approach emphasizes community participation, watershed management and multi-institutions and multi-disciplinary teams, with the involvement of the private sector and relevant NGOs. For successful technical intervention, the project will address range land use and land tenure policies and the institution that deal with rangeland management

The activities conducted by this project include:

- Develop methods for the identification of potential sites and suitable techniques for water harvesting using remote sensing, GIS and ground data.
- Develop methodologies for the characterization of rainfall, catchment potential and optimal water harvesting development, while minimizing soil losses through erosion, from these catchments.
- Develop guidelines for a socially acceptable and efficient collection, allocation and use of runoff water within an integrated watershed system.

Figure 6. Impact pathway of the BBP



- Analyze water harvesting costs and benefits (direct and indirect) and based on this analysis identify optimal production systems for maximizing benefits.
- Identify potential institutional constraints to the management of large catchments (common property management) and assess the options for relieving these constraints, including the sustainable community resource- management options, legislation, policy measures, etc.
- Conduct analysis of the existing policies regarding the *badia* areas and develop recommendations for policy measures that support better management of those areas.

2.2.3 Outputs of the Project

The expected outputs of the project are:

1. Improved methodologies for the identification of water-harvesting sites and methods of high potential for various conditions.

Output targets for 2004

- Documents are reviewed: Review and collection of natural and human resources data and database establishment; review socioeconomic studies, review of previous projects
- Site selection: a three phase stages were adopted in site selection
  Phase 1: In this phase criteria for watershed selection were developed by interdisciplinary team
  Phase 2: A more detailed specifications were set
  Phase 3: During this phase and after the field visits the following was conducted and achieved: Rapid environmental impact assessment, Rapid hydrological impact assessment, RRA on the six selected watersheds.

Output targets for 2005

- Negotiations with targeted communities: comprehensive local needs assessment in which communities analyzed local resources and developed plans (Negotiated Community Action Plans) for future resource conservation and sustainable use.
- Technical research intervention with community participation: (i) Water harvesting techniques for shrub and barley plantation to demonstrate to the community the benefits of water-harvesting for improving forage resources in the Badia and (ii) To improve livestock production and associated grazing practices in the Badia.
- Water harvesting complementary site at JUST: site selection and water harvesting experimentation.
- Human resource capacity building (regional training, workshops, traveling, seminars and meetings)

Output targets for 2006

- Water harvesting experimentation, extension and evaluation
- Human resource capacity building (regional training, workshops, traveling, seminars and meetings)

2. Methodologies for the characterization of catchments potential and optimal use of harvested water in these catchments.

Output targets for 2005: Biophysical characterization of selected watersheds

- Data collection: data from the Royal Jordanian Geographic Center (RJGC), Data derived from topographic information, data from the Department of Land and Surveying (DLS), and field data collection.
- Suitability for water harvesting interventions
- Hydrological study

Output targets for 2005: Socioeconomic characterization of selected watersheds

- Primary data was collected from the project site related to socio-economic characteristics of the selected community using: (i) Rapid Rural appraisal; (ii) Formal interviews with selected stakeholders and players in the selected communities

- Secondary data will be collected from available published and unpublished sources

Output targets for 2006
- Establishment of communal nurseries for fodder shrub seedlings production

3. Analysis of potential economic and institutional constraints and recommended policy measures to support the integration of water harvesting in agricultural systems.

Output targets for 2005
- Conduct analysis of the existing policies regarding the badia areas and develop recommendations for policy measures that support better management of those areas
- Institutional characteristics, and market reforms

Output targets for 2006
- Estimating the performance indicators
- Monitoring technology transfer
- Economic evaluation of developed technologies- water harvesting cost-benefit analysis

Output targets for 2007
- Soil and water conservation activities: (i) Implementing the planned interventions that were not executed during the 2005-2006 season: Wadi stabilizing only for the Hafaier site, cisterns, check dams, micro-catchments for an additional area of about 100 ha, pond (hafaier), barley contour strips with atriplex and/or salsola shrubs planted to mark the contour lines, and contour ridges (modified) to be planted with barley. (ii) mapping and general characterization. (iii) monitoring: weather and rainfall data, and soil data. (iv) maintenance for implemented interventions
- Improvement and management of vegetation cover
- Establishment of communal nurseries for fodder shrub seedlings production
- Shrub mechanized transplanting experiment
- Water harvesting demonstrations for fruit trees at Al-Manshia Village
- Human resource capacity building (regional training, workshops, traveling, seminars and meetings)

Output targets for 2008
- Soil and water conservation activities: (i) implementing the planned interventions that were not executed during the 2006-2007 season: wadi stabilizing only for the hafaier site, cisterns, check dams, micro-catchments for an additional area of about 100 hectare, pond (hafaier), barley contour strips with atriplex and/or salsola shrubs planted to mark the contour lines, and contour ridges (modified) to be planted with barley. (ii) mapping and general characterization. (iii) monitoring: weather and rainfall data, and Soil data. (iv) maintenance for implemented interventions
- Start implementing the new technologies in fields outside the project area

4. Techniques for providing sustainable supplies of water from rainfall run-off for economic production from rangeland, field crops and fruit trees and methodologies for designing and implementing such techniques at the field and watershed levels.

Output targets for 2006
- Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options
- Water harvesting experimentation and evaluation
- Community participation in technology dissemination and project sustainability
- Public awareness program

Output targets for 2007
- Water harvesting demonstrations for fruit trees at Al-Manshia Village
- Implement several activities with full par-

ticipation of Mhareb and Al Majedeyaa communities to enhance technology adoption by farmers in the two communities and other communities in the area.

Output targets for 2008
- Human resource capacity building (regional training, workshops, traveling, seminars and meetings)
- Assessing the impact of project interventions on efficiency and sustainable utilization of natural resources

Output targets for 2009
- Scaling-up project achievements (Methodologies, approaches, technical interventions) at the national level.
- Policy modifications will be integrated with the technologies and tested with the communities as a technical policy level and institutional options
- Evaluation of the national level impact

2.2.4 Innovation Process and Other Factors

The dissemination of information and the application of the research outputs on:
- Effort, time and cost of planning water harvesting systems are reduced by utilizing improved packages of site and methods selection.
- At pilot demonstration sites greater part of rain is captured and utilized at improved water use efficiency for crop.
- Information on the socioeconomic constraints and potential policies and actions to overcome them are accessible to decision-makers.
- Improved water harvesting techniques are adopted by communities in their fields in the pilot site.

2.2.5 Outcomes
- Improved technologies, methodologies, and recommendations are available to national programs. Guidelines and recommendations are adopted and implemented by the target communities
- Effort, time and cost of planning water harvesting systems are reduced by utilizing improved packages of site and methods selection.
- At pilot demonstration sites, greater part of rain is captured and utilized at improved water use efficiency for crop.
- Information on the socioeconomic constraints and potential policies and actions to overcome them are accessible to decision-makers.
- Improved water harvesting techniques are adopted by communities in their fields in the pilot site.

2.2.6 Process of Rural Development and Other Factors
- Farmers in the different agricultural production systems use water more efficiently in agriculture.
- WH in various agricultural systems adopted and tested economically viable, socially acceptable technologies that sustainably improve and ensure environmental viability.
- Guidelines for optimal irrigation scheduling that maximize agricultural returns from the irrigation water used.
- Policies required for implementing more efficient water management practices including water valuation, farmer's institutional setups for participatory management of water under scarcity.
- NARS personnel's capability of conducting research on water management issues and application of results increased.
- NARS research quality in supplemental irrigation and water harvesting management problems improved.
- Community leaders capacity in participation in research and technology transfer improved.

2.2.7 Impact

As mentioned earlier, Internal Program Reviews (IPR) should be conducted periodically, thus research impact will be evaluated at each stage, i.e. *ex-ante* evaluation.

2.2.8 Priorities

Since there is always feedback at each stage when using IPE methodology, the priorities should be evaluated and changed if necessary.

2.3 Performance Questions, Indicators and Information Needs

Annex 2 summarizes the performance questions, indicators and information needs for BBP. The key questions for the main objective are:

- To what extent has the project contributed to implement suitable water harvesting techniques? Why? Why not?
- To what extent have the people in badia adopted suitable water harvesting techniques? Why or why not?
- To what extent did the people in badia utilize efficiently rainwater runoff? Why? Why not?
- To what extent did the people in Badia use harvesting techniques in more productive and sustainable systems?

The indicators for these questions are:

- Improved packages and methods selection were utilized to reduce effort time and cost of planning water harvesting systems.
- At pilot demonstration sites greater part of rain is captured and utilized at improved water use efficiency for crop

The baseline information requirements for the questions are:

- The level of Water harvesting in the area
- Area served with water harvesting techniques
- Number of people benefiting with ongoing water harvesting
- Area and location of productive and sustainable systems
- A review of the previous experience of Jordan in Badia research and development approaches, achievements, constraints, and lessons learned that could be utilized by the present project.

The data gathering methods for the above question are:

- Baseline surveys undertaken at the onset of implementation
- Representative household surveys at mid-term and project completion (gender-disaggregated) conducted by PMU & technical staff
- GIS, RS maps
- Reports and documents
- Electronic database

2.4 Information Gathering and Organization

Three types of expected outputs are identified, which are productivity-enhancing environmental, and social outputs. Identification of these outputs and their related indicators will facilitate the process of assessing economic, environmental, and social impacts. The data and information needed for the BBP could be summarized according to expected outputs as follows:

Productivity Enhancing Outputs include: Water Quality, Barley Production, Forage Biomass, and Selling Water. The data and information for these outputs are: yields (kg/ha), water productivity (kg/m^3), gross margin ($/ha), profitability ($/m^3), feeding cost ($/head), livestock watering ($/head), financial analysis (B/C ratio and IRR), and % increase in family farm income.

Environment Outputs include: Biodiversity conservation, decrease soil erosion, soil fertility, and sustainable ground table level. The data and information for these outputs are: top-soil loss (USLE), Carbon content, organic matter, plant species reserved, and monitoring the depth of groundwater table levels.

Table 2.1 Stakeholders Information Flows in the BBP

Stakeholders	Type of Information	Source of Information
Project Manager-ICARDA	- Work Plan - Progress Report	- Regional Steering Committee: - PMU
Regional Steering Committee: -IFAD, AFSED, OPEC Fund, DGs of NARS - National Coordinators (observers)	- Work Plan - Progress Report	- Regional Technical Committee - National Steering Committee - PMU
Regional Technical Committee	-Work Plan - Progress Report	PMU
National Steering Committee	-Work Plan - Progress Report	- PMU - National Technical Committee
National Technical Committee	- Progress Reports	
Project Management Unit (PMU) -MIS Unit -GIS unit - M&E unit		National Steering Committee - National Technical Committee - Research Centers - Government and NGOs - Beneficiaries and communities
Research centers NCARTT, UOJ, JUST, MOTA Univ,	- Work Plan - Technology implementation feedback	- PMU -Beneficiaries and communities -National Technical Committee
Government and NGOs: -MOA - Badia Research Development Project (BRDP) - Queen Rania Organization for Technology Transfer.	Project reports	PMU
Beneficiaries and communities	Work Plan, Progress Reports, Technology	- PMU - Research Centers

Social Outputs include: settlement levels, migration and back-migration levels, and new labor opportunities. The data and information for these outputs are: collecting information on qualitative description to what happened before and after and number of male/female workers (before and after).

2.5 Baseline and Livelihood Characterization

The data in Jordan Badia was collected through a questionnaire which was developed and pre-tested. A sample of 134 households randomly selected from Mhareb & Falej (54), and 80 members from Um Enam & El Shargieh. The Descriptive statistics were used to analyze part of the data including means, medians, percentages and frequencies. In the satellite farm in SA, soil data, climate data and vegetative cover data of the site were collected through survey works. According to soil and climate data collection in SA, two representative soil profiles to characterize the soil of the site were investigated, For vegetable data collection in SA, an investigation survey was conducted in Wadi beds and

found that they were trees and shrubs in limited numbers grown in it.

2.6 Communication and Reporting

Defining appropriate communication mechanisms should be based on the identified information needs of different stakeholders as well as a good understanding of which media would be most appropriate for each of the different target groups. The main stakeholders of the BBP are listed in Table 2.1, which also shows the type of information needed by each stakeholders group, the source of information. Annex 6 summarizes The Badia Benchmark Project Impact pathway.

2.7 Reflection Processes and Events

Table 2.2 summarizes The Annual Work Plan of the Jordanian Badia Benchmark Project During the Period (2004-2007).

Table 2.2. Annual work plan of the Jordanian Badia benchmark project during the period (2004-2007).

Activities	Indicators	Year 1	2	3	4
Review of documents	Past experience of the work in badia will be assessed and evaluated, lessons learned will be identified and utilized in project implementation Review documents on policy, institutions, land tenure, tribal system and community approach will be completed by end of March 2004 Previous and on-going projects reviewed and lessons learned from these projects identified by the end of March 2004				
Identification & characterization of watershed sites and communities	Natural and human resource data collected and entered into the computer to establish the project database ready . Around 20 potential Watersheds will be identified and mapped Characterization of the watersheds (technical and socio-economic) will be completed Final selection of the project watershed(s) will be completed. Sites for interventions will be identified and mapped.				
Identification of M&E performance Indicators	Appropriate and measurable indicators are identified				

Table 2.2. (continued)

Activities	Indicators	Year 1	2	3	4
Develop of methodologies for identification of potential water harvesting sites using GIS + RS	Water harvesting structures will be established.				
Develop methodologies for characterization of catchments and optimal (resource sustainable) water harvesting	Introduced technologies will be finalized by technical staff in cooperation with the community . Implementations of interventions will be completed				
Technical research interventions with community participation	Sites will be selected and interventions for each site will be identified and mapped				
Identify institutional constraints for management of common property and ways to review them	Review and analysis of the current policies is and institutions will be completed				
	Policy and institutional options will be developed by the end of the project				
Analysis of existing policies and recommendations for policy to support these areas	A set of policy and institutional options that support the sustainable use of water in badia will be developed and presented to decision makers Review and analysis of the current policies is and institutions will be completed Review and analysis of the current policies is and institutions will be completed Policy and institutional options will be developed by the end of the project				
Water harvesting cost-benefits (direct & indirect)	Cost-benefits analysis for water harvesting and other interventions will be established. Ex-post economic analysis will be performed for the interventions.				
	Water allocation model for the project watershed(s) will be developed.				
Develop caluden lines on allocation and use of	Decision support system for water distribution within water shed areas and communities will be developed and presented to decision-makers.				
runoff water with watershed monitoring technology transfer and adoption	Adoption rate and intensity of introduced technologies and their impact on farmers' income and livelihood. Adoption and adoption constrain analysis will be conducted and impact studies.				

Table 2.2. (continued)

Activities	Indicators	Year 1	2	3	4
Human resource (capacity building, regional training, forms of workshops, traveling, seminars & meeting)	NARS personnel's capability of conducting research on water management issues and application of results increased. NARS research quality in water harvesting management problems improved. Community leaders capacity in participation in research and technology transfer improved. Degree and non-degree training for the project staff. At the end of the project 4 MSc and PhD will be graduated and trained in the project. Two short-term training courses will be annually implemented Workshops and traveling workshops for researchers, extension workers, officials, and farmers will be conducted annually, locally and at the regional level. Seminars and specialized meetings with decision-makers will be organized				
Project database & management	Management information system and knowledge management and dissemination is established				

3. The Rainfed Benchmark - Morocco (RBP)

3.1 Project Objectives

The Project's objective is helping the farming communities to adopt farming strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas (Annex 4). A typical water basin will be chosen based on agreed criteria between all involved stakeholders. An integrated research program will be designed and implemented involving local communities, institutions and decision makers. Field trials, farmers' demonstrations, etc., will be implemented by NARS with support from ICARDA.

3.2 Impact Pathway of the RBP

Figure 7 shows the impact pathway of the RBP, which includes the main components: inputs, research, outputs, innovation process, outcomes rural development and goal. The flow of information and impact analysis for the RBP will be as follows (Impact Pathway Model).

3.2.1 Project Inputs

The results of the benchmark research site established in the Rainfed benchmark in Morocco are planned to be transferred to other similar areas (Tunisia and Algeria). The integrated watershed management approach was adopted in the research. A typical watershed of suitable size was selected based on agreed criteria. A research program was designed involving local communities and institutions in a participatory approach.

3.2.2 Research Process and Activities (Natural Resource Management NRM)

The project approach emphasizes community participation, watershed management and multi-institutions and multi-disciplinary teams, with the involvement of the private sector and relevant NGOs. For successful technical intervention, the project will address land use and land tenure policies and the institution that deal with land and water management

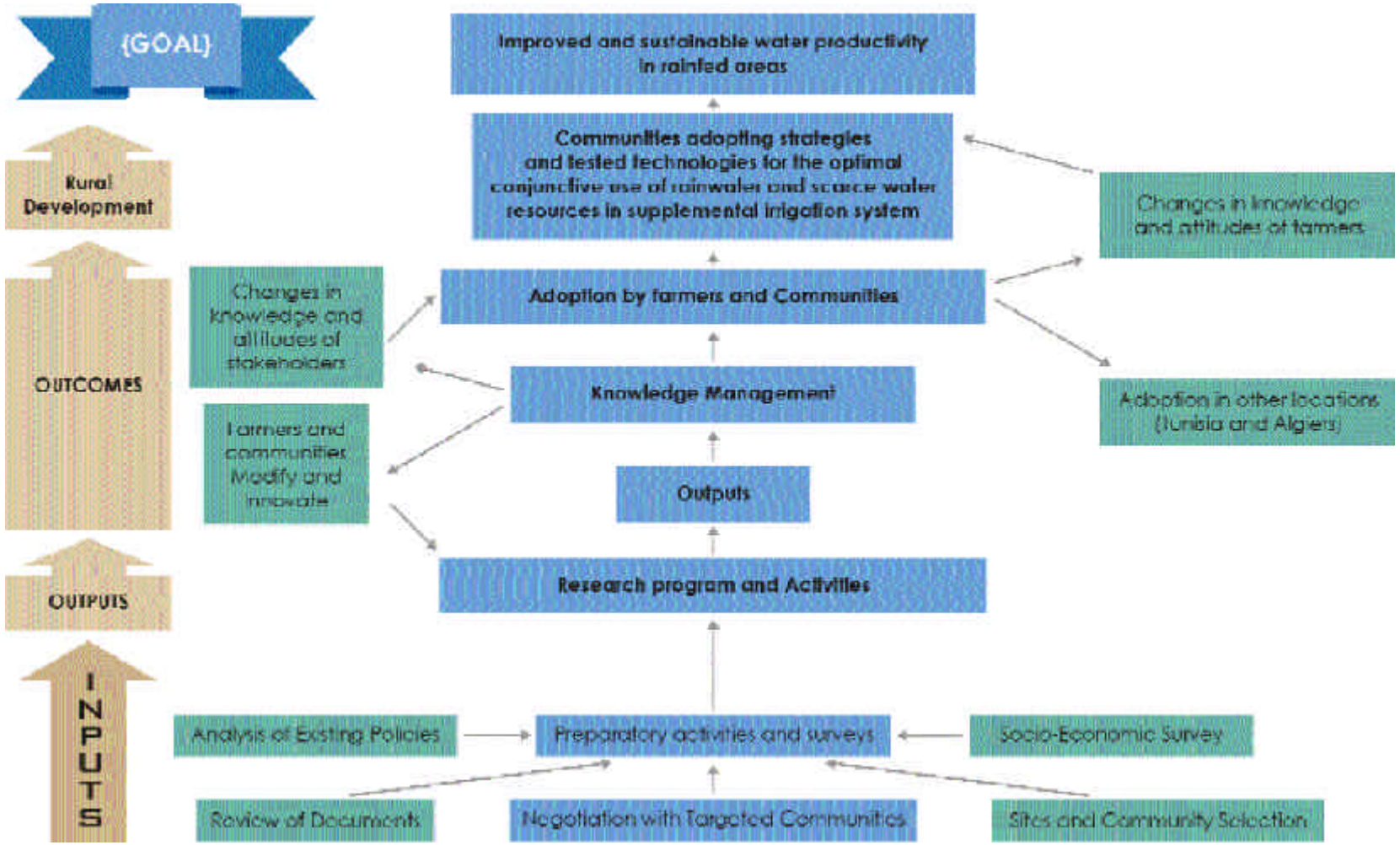
Activities under this project include:

1. Select and characterize the site and communities;
2. Identify and analyze possible constraints to the adoption by farmers of efficient water use options;
3. Assess ex-ante impact of new options of supplemental irrigation system;
4. Analyze existing policies and institutional setups regarding improving water use efficiency and develop recommendations for improvement;
5. Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water;
6. Evaluate, together with the stakeholders, potential strategies that match water requirements with water supply and optimize the use of water within the biophysical and socio-economic environment of the target areas;
7. Develop guidelines, packages and technological, institutional and policy options for improving water managements in the targeted areas

For communities' selection within the selected site, the following aspects were taken into considerations:

1. Communities should be representative for most conditions on the benchmark site;
2. Willingness of beneficiaries, particularly farmers, to participate in project activities and continue beyond project period;
3. Presence of Water Users Association and/or other local institutions;
4. Significant income from agriculture;
5. On good terms with ORMVAT, DPA;
6. Land ownership should be mainly private;
7. Farm size varies from small to large farms;
8. Diverse cropping systems;
9. Water resources (groundwater, surface water, used water, purely rainfed) are

Figure 7. Impact Pathway of the RBM



scarce, but available;
10. Presence of stakeholders (extension, research);
11. Different agro-ecological conditions.

3.2.2 Expected outputs

1. Recommendations for appropriate irrigation systems and schedules to ensure optimal water productivity and net benefits to the rainfed resource users;

Output targets for 2004

- Characterization of the two communities in terms of basic monographic information with specific attention to water resources and allocation, water use policy, irrigation management, cropping systems and practices and water productivity;
- Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options;
- Strengthening of links between community members and project team to insure community participation to the project activities

Output targets for 2005

- The development of a policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas that will reduce poverty and improve crops productivity. The specific objective is the establishment of the key policy and institutional options to improve water use efficiency.
- Sustainable improvement of supplemental irrigation water productivity under conditions of scarce water resources at the farm level.
- Optimization of the use of water within the biophysical and socio-economic environment of Tadla perimeter.

Output targets for 2006

- Economic assessment of the impact of new irrigation systems options.

Output targets for 2007

- Economic assessment of the impact of new irrigation systems options.
- The development of a policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas that will reduce poverty and improve crops productivity. The specific objective is the establishment of the key policy and institutional options to improve water use efficiency.
- Sustainable improvement of supplemental irrigation water productivity under conditions of scarce water resources at the farm level.
- Optimization of the use of water within the biophysical and socio-economic environment of Tadla perimeter.

2. Strategies for conjunctively utilizing rainwater and other scarce water resources in combination to maximize the benefits from each of them and to increase agricultural production in a sustainable way;

Output targets for 2005

- Assess ex-ante impact of new options of supplemental irrigation systems
- Field trials (preliminary results),

3. Effective methodologies to tailor production systems, cropping patterns, and cultivars to match water requirements for agricultural production with sustainable water supply in accordance with the socio-economic environment;

Output targets for 2005

- Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water
- Economic assessment of the impact of new irrigation systems options.

Output targets for 2006

- Develop, test and promote production techniques, alternative innovative approaches and practical tools such as

models and decision support systems giving enhanced output per unit of water
- Economic assessment of the impact of new irrigation systems options.
- Assess ex-ante impact of new options of supplemental irrigation systems
- Field trials (preliminary results)

Output targets for 2007
- Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water
- Economic assessment of the impact of new irrigation systems options.

- Recommendations for operational guidelines to deal with the trade-off between water use efficiency and net benefits under different socio-economic conditions.

Output targets for 2006
- Evaluate, together with the stakeholders, potential strategies that match water requirements with water supply and optimize the use of water within the biophysical and socio-economic environment of the target areas

Output targets for 2007
- Develop guidelines, packages and technological, institutional and policy options for improving water managements in the targeted areas
- Collection of information, test and validation of the model

3.3 Performance Questions, Indicators and Information Needs

Annex 5 summarizes the performance question, indicators and information needs for RBP. The main key questions for the main objective are: Did the farming communities adopt strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas? Why? Why not?

The indicators for this question are:
- A set of improved technologies, methodologies were implemented.
- Recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, and policy and institutional options were proposed and tested.

The baseline information requirements for the above question are:
- Identify and analyze possible constraints to the adoption by farmers of efficient water use options;
- Analyze existing policies and institutional setups regarding improving water use efficiency and develop recommendations for improvement;

The data gathering methods for the above question is:
- Conduct Field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving

3.4 Information Gathering and Organization

The data and information needed for the RBP could be summarized according to expected outputs as follows:

Productivity Enhancing Outputs include: production and water productivity (WP), farm/crop water use, share of irrigation in total cost, efficient gap, technological/yield gap, and yield/production stability. The data and information for these outputs are: Net income ($/m3), WP (kg/m3) at farm level,

share of water cost/ha, Profit($/ha) at crop level, Water cost ($/m3), amount of water per farm/crop, productivity share of water cost per farm.

Environment Outputs include Groundwater (GW) depletion, change in water quality, soil salinity, sustainable GW use, and pollution control. The data and information for these outputs are: Change of water table, Salinity, and Water quality

Social Outputs include Labor force, vulnerability, World Poverty Index (WPI), and community organization. The data and information for these outputs are: Poverty Gap, % of people below poverty line, livelihood analysis.

3.5 Baseline and Livelihood Characterization

The information in Morocco was collected through a participative community workshop that was organized on 12-13 April 2004 in

Table 3.1 Stakeholders information flows in the RBP

Stakeholders	Type of information	Source of information
Project Manager-ICARDA	- Work plan - Progress report	- Regional Steering Committee: - PMU
Regional Steering Committee: -IFAD, AFSED, OPEC Fund, DGs of NARS - National Coordinators (observers)	- Work plan - Progress report	- Regional Technical Committee - The National Steering Committee - PMU
Regional Technical Committee	- Work plan - Progress report	PMU
The National Steering Committee	- Work plan - Progress reports	- PMU - National Technical Committee
National Technical Committee	- Progress reports	
Project Management Unit (PMU) - MIS Unit - GIS unit - M&E unit		- National Steering Committee - National Technical Committee - Research Centers - Government and NGOs - Beneficiaries and communities
Research Centers - INRA, - Direction of the Regional Large Scale Irrigation Perimeter of Tadla (ORMVAT) - the irrigation research unit of the Administration of Rural Engineering (SEEN-DDGI)	- Work Plan - Technology implementation feedback	- PMU - Beneficiaries and communities - National Technical Committee
Government and NGOs: - The Ministry of Agriculture and Rural Development (MADR), Provincial Direction of Agriculture (DPA)	Project reports	PMU
Beneficiaries and communities	Work Plan, Progress Reports, Technology	- PMU - Research Centers

Table 3.2. Timetable and milestones for the RBP

Activity	Period	Reports to be delivered
Select and characterize the site and communities	April-June 04 Sep-Dec 04	Report on secondary data analysis, to be used project team and for site characterization Community workshop reports and RRA survey: Participatory site characterization Project team workshop
Identify and analyze possible constraints to the adoption by farmers of efficient water use options	April-June 04 Sep-Dec 04	Diagnostic, planning and evaluation Workshops reports
Assess ex-ante impact of new options of supplemental irrigation system;	Sep-Dec 04 May -Dec 06 May-Dec 07	Participatory approach course Cost-benefits analysis reports Cost-benefits analysis reports
Analyze existing policies and institutional setups regarding improving water use efficiency and develop recommendations for improvement	April-Dec 04 Sep-Dec 04 May-Dec 07	Policy and institutional measures review reports Appropriate policy and institutional instruments recommended reports
Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water:	April-June 04	Database
Data collection and acquisition	Sep-Dec 04	Models, maps, report
Data processing and elaboration, development of tools	April-June 04 and Sep-Dec 04	Report
Characterization of selected farms		
Collection of the documentation, review and synthesis		
Evaluation of potential technologies for production with the farmer at the farm level (trials)	April-June 04 and Sep-Dec 04	Report Database Report
Economic evaluation of the new technologies	Sep 04-Sep 07	
Collect agronomic, soil, climatic and hydrodynamic data		Technologies, report
Training on the " Expert System "	Sep-Dec 05, 06 and 07	Report
Organization of two field days per site each year for farmers	June 04-May 07	Database
Organization of three training sessions for the technicians and engineers of the ORMVAT	04 and 05	Knowledge
Organization of a visit of farmers of	Jan and March	Knowledge

Table 3.2. (continued)

Activity	Period	Reports to be delivered
ORMVAT to the ORMVA of Moulouya	of 05, 06 and 07	
Production of technical guides, pamphlets and audio-visual material for extension purposes	Sep-Oct 04	Knowledge, courses documents
	March 05	Knowledge
	Jan-Dec 07	Guides, pamphlets, audio-visual materials
Evaluate, together with the stakeholders, potential strategies that match water requirements with water supply and optimize water use inf the target areas;	Jan 05-Dec 06	Database
Collection of information	Jan 06-Oct 07	
Test and validation of the model		Database
		A model
Develop guidelines, packages and technological, institutional and policy options for improving water managements in the targeted areas	Dec 07	Final project report

Ouled Zmam and Bradia communities, respectively. Moreover, monograph of the project zone was analyzed to investigate the possibility of improvement in the selected areas. For the farmer survey, a one-week planning session was held from 17–25 November 2004 with scientists involved in this project. During the session, questionnaire was finalized and pre-tested, and enumerators were trained to use questionnaire.

The methodology for Syria as being one of the satellite sites of the project included non-repetition of any activities conducted in either of benchmark site or other satellite sites. The trend represented by no more research on supplemental irrigation, but there is an urgent necessity to go through social and economic aspects encountering technology transfer and the adoption of SI technologies in wheat production by farmers. For this purpose, rapid rural appraisal covered both 1st and 2nd agro-ecological zones in the three targeted provinces.

Based on RRA results, and considering objectives of the project, the project team members and the supervisors have designed a questionnaire for data collection. The questionnaire included all needed variables to investigate the feasibility of supplemental irrigation, and the impact of supplemental irrigation on water resources sustainability.

In Algeria, site and wastewater were characterized and preliminary experiments on SI using treated wastewater were initiated.

In Tunisia, a crop model for simulating wheat yields and SI at different scales has been validated.

3.6 Communication and Reporting

The main stakeholders of the RBP are listed in Table 3.1, which also shows the type of information needed by each stakeholders group and the source of information:

3.7 Refection Processes and Events

Table 3.2 summarizes the timetable and milestones for the RBP.

The summary of activities and schedules is also presented in a chart (Table 3.3)

Table 3.3. Summary of activities and schedules during the RBP 4-year period

Activities	Year 1	Year 2	Year 3	Year 4
1. Socioeconomics				
1.1 Inventory				
1.2 Site characterization				
1.3 Review of literature				
1.4 Evaluation of results				
1.5 Performance indicators				
2. Model simulation to assess water use efficiency				
2.1 Review and selection of the simulation models				
2.2 Use the selected models				
2.3 Production functions				
2.4 Develop technology adoption indicator				
2.5 Model application and scenario development				
3. Field trials				
4. Policies and institutional setups				
5. Guidelines development				
5.1 Collection of previous data				
5.2 Analysis of results and development general guidelines				
5.3 Select and refine the best technologies				
5.4 Development of improved policies and institutional setups				

4. The Irrigation Benchmark- Egypt (IBP)

4.1 Project Objectives and Outcomes

The Project's objective is to help the farmers to develop and adopt techniques and systems that optimize water productivity in irrigated systems, including water management, alternative crops, use of different water sources and policy and institutional options (Annex 7).

A common research task was designed to develop and integrate techniques and technologies with full community participation for the acquisition and supply of water to agriculture and for the efficient utilization of all sources of water. The expected outputs for the objective are:

- Information on how sustainable and efficient farmers in the different agricultural production systems use water in agriculture and on the sources of inefficiency.
- Adopted and tested economically viable, socially acceptable technologies that sustainably improve WP in various agricultural systems and ensure environmental viability.
- Guidelines for optimal irrigation scheduling that maximize agricultural returns from the irrigation water used.
- Policies required for implementing more efficient water management practices including water valuation,
- Farmer's institutional arrangements for participatory management of water under scarcity.

4.2 Impact Pathway for IBP

Figure 8 shows the impact pathway of the RBP, which includes the main components: inputs, research, outputs, innovation process, outcomes rural development and goal. The flow of information and impact analysis for the RBP will be as follows (Impact Pathway Model).

4.2.1 Project Inputs

The results of the benchmark research site established in the Irrigated benchmark in Egypt are planned to be transferred to other similar areas (Sudan and Iraq). The integrated watershed management approach was adopted in the research. Typical sites of suitable size were selected based on agreed criteria. A research program was designed involving local communities and institutions in a participatory approach.

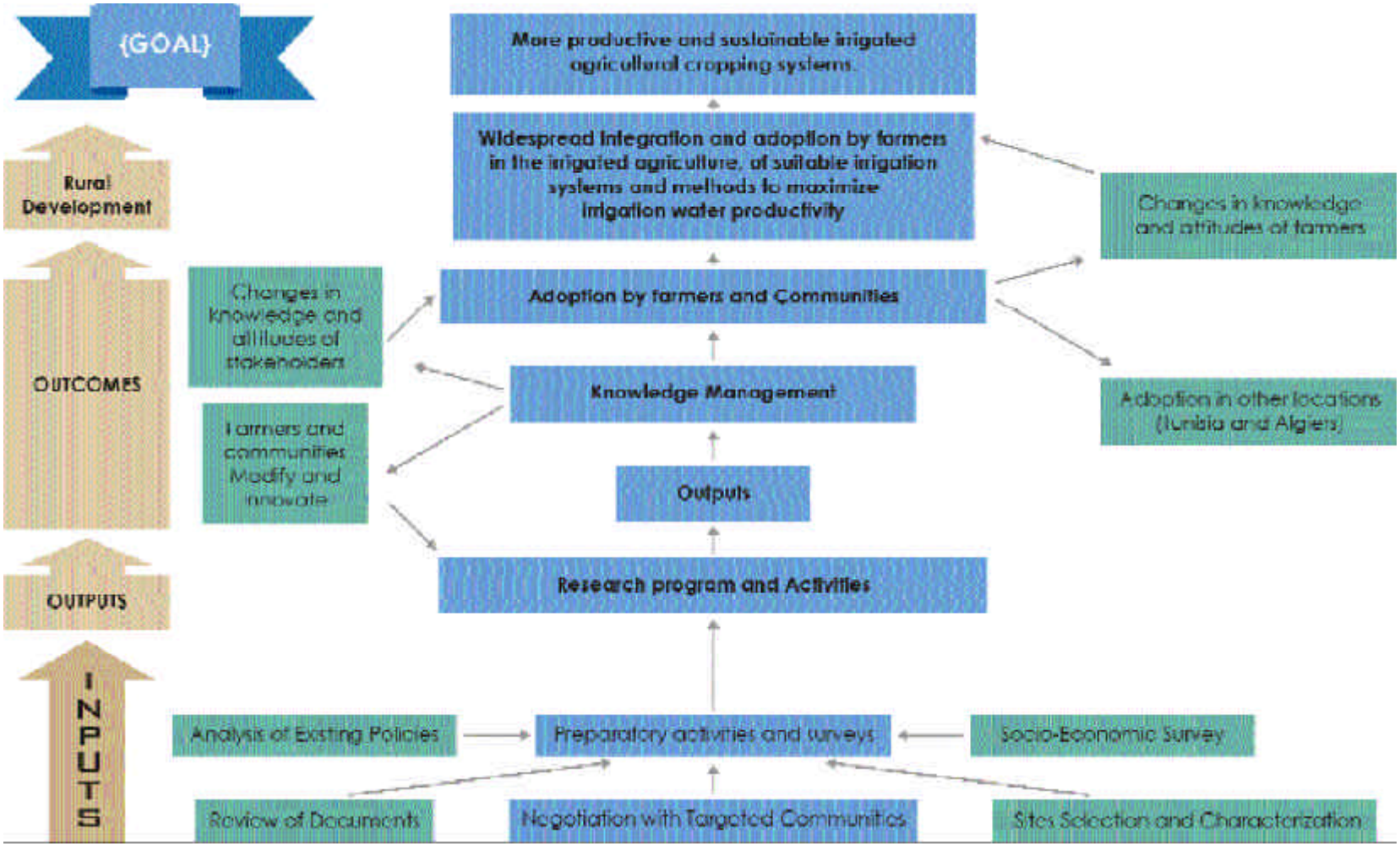
4.2.2 Research Process and Activities (Natural Resource Management NRM)

The project approach emphasizes community participation, irrigated water management and multi-institutions and multi-disciplinary teams, with the involvement of the private sector and relevant NGOs. For successful technical intervention, the project will address range land use and land tenure policies and the institution that deal with irrigated land management

Activities under this project include:

1. Farm survey and analyses to assess the actual water productivity (WP) for multi-cropping systems and to determine the source of inefficiency in water use in target areas.
2. Model simulations to assess water use efficiency and environmental effects of different potential technologies in the different production systems under consideration.
3. Field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management.
4. Analysis of the existing policies and institutional setups regarding improving water productivity (WP) and develop recommendations for improvement.
5. Development of guidelines, packages, technologies, policies and recommendations for improving water productivity (WP) in those areas.

Figure 8. Impact pathway of the IBM



To achieve these outputs, multidisciplinary and multi-institutional teams were established and discussed, in a national workshop, the project document and framework for implementing it. Agreement on the activities that will be implemented during the four years of the project was reached. Around 50 researchers representing 6 institutions in Egypt with representatives from Sudan and Iraq in addition to ICARDA scientists have participated in the workshop. The activities that will be implemented in Egypt benchmark site have the following components:
Component 1: Review Studies
Component 2: Site Selections and Characterization
Component 3: Socioeconomics studies
Component 4: Technical and Socioeconomic Interventions
Component 5: Human Capacity Building and dissemination of the results

Since the project is a community-based and of integrated nature, the communities participated in the design and implementation of its activities. Watercourses were the unit sites in the project where all farmers are participating in using the same source of irrigation water. Selected sites considered the most common farm sizes in Egypt, representation of old lands, new lands and marginal soil lands. The selected canals already having farmer's organizations at both canal and Mesqa levels. The project aims to benefit from the presence of these organizations in project design and implementation.

4.2.3 Expected outputs

1. Farm surveys and analyses to assess the actual water productivity (WP) for multi-cropping systems and to determine the source of inefficiency in water use in target areas.

Output targets 2004
- Inventory studies
- Full characterization of sites and associated problems.
- Review of available information on water use efficiency.
- Evaluation, monitoring and assessment of the adoption and impact of potential options/interventions

Output targets 2007
- Evaluation, monitoring and assessment of the adoption and impact of Potential Options/interventions

2. Model simulations will be carried out to assess water use efficiency and environmental effects of different potential technologies in the different production systems under consideration.

Output targets 2004
- Select the proper simulation models that will be used for monitoring and assessing the impact of project activities on production and environment, and identify the data sets needed to run the selected ones
- Assess the impact of deficit irrigation under different water qualities and environmental conditions.
- Assess the impact of irrigation management on crop-water productivity.
- Assess the impact of different irrigation management on production function of some crops.
- Evaluating developed irrigation expert systems combined with crop simulation models
- Training on how to develop new irrigation systems

Output targets 2005
- Assess the impact of deficit irrigation under different water qualities and environmental conditions.
- Assess the impact of irrigation management on crop-water productivity.
- Assess the impact of different irrigation management on production function of some crops.
- Quantify the status and intensity of technology adoption and identify major constraints affecting the adoption process.
- Evaluating developed irrigation expert sys-

tems combined with crop simulation models,
- Training on how to develop new irrigation systems

Output targets 2006
- Assess the impact of deficit irrigation under different water qualities and environmental conditions.
- Assess the impact of irrigation management on crop-water productivity.
- Quantify the status and intensity of technology adoption and identify major constraints affecting the adoption process.
- Evaluating developed irrigation expert systems combined with crop simulation models,
- Training on how to develop new irrigation systems

Output targets 2007
- Assess the impact of deficit irrigation under different water qualities and environmental conditions.
- Assess the impact of irrigation management on crop-water productivity.
- Evaluating developed irrigation expert systems combined with crop simulation models,
- Training on how to develop new irrigation systems

3. Field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management.

Output targets 2004
- Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information necessary for improving water management

Output targets 2005
- Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information necessary for improving water management.

Output targets 2006
- Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information necessary for improving water management.

4. Conduct analysis of the existing policies and institutional setups regarding improving water productivity (WP) and develop recommendations for improvement.

Output targets 2004
- Review the existing water policies and setups locally, regionally and worldwide and to come up with the best model that suits the local conditions

Output targets 2005
- The research aims at the development of water valuation and the assessment of demand management alternatives and options.

Output targets 2006
- The assessment of the consequences of alternative policies shall be carried out.

5. Develop guidelines, packages, technologies, policies and recommendations for improving water productivity (WP) in irrigated areas.

Output targets 2007
- Assure that each of the previous activities produces an outcome of clear recommendation, package or policies related to improving water productivity

4.3 Performance Questions, Indicators and Information Needs

Annex 8 summarizes the performance questions, indicators and information needs for IBP. The main key questions for the main objective are:

- To what extent has the project contributed to implement suitable irrigation systems and methods to maximize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems? Why? Why not?
- To what extent do the farmers adopt and implement the proposed irrigation practices? Why? Why not?
- Did the farmers get higher water and yield productivities? Why? Why not?

The main indicator for these questions is: a set of improved technologies, methodologies, and recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, and policy and institutional options.

The baseline information requirements for the above questions are:

- Review type and levels of applied technologies. Past experience of the work in the irrigated old land will be assessed, lesson learned, will be identified and utilized in project implementation
- Establish a base line for the selected communities to be used in monitoring and evaluating the project.
- Identify potential options/interventions for water use efficiency.
- Develop performance indicators for:
  - I Water productivity in irrigation system
  - II Water management practices
  - III Alternative crops
  - IV Use of different water resources; and
  - V Policy and institutional options.

The indicators for the above questions are:

- Documents and publications
- Baseline Surveys
- Household surveys
- PRA
- Workshops and field days

4.4 Information Gathering and Organization

The data and information needed for the IBP could be summarized according to expected outputs as follows:

Productivity Enhancing Outputs include: Cropping, Drainage System, Scheduling, Germplasm, Crop management, Irrigation system and water allocation. The data and information for these outputs are: yields (kg/ha), water productivity (WP) (kg/m3), gross margin (GM) ($/ha), net income at farm level, Area under irrigation, and higher market prices.

Environment Outputs include: (i) Positive impact: improve soil fertility of saline area in new lands, prevent salinity in old lands, and control water table. (ii) negative externality: drainage water quality (salinity). The data and information for these outputs are: pollution (water quality), soil fertility, soil salinity, sustainable groundwater, and Drainage water quality

1. Social Outputs include: settlement of farmers (new lands and saline areas), Equity issues, Labor force and World Poverty Index (WPI) - % of farmers bellow poverty line and poverty gap. The data and information for these outputs are: upstream-downstream conflicts, poverty gap, % of people bellow poverty line, health, income distribution, and access to water resources.

4.5 Baseline and Livelihood Characterization

In Egypt, A multidiscipline research team is established at each location. Each team includes a socio-economist and water, soil,

and plant nutrition specialists from ARC, in addition to members of the farming community, local extension offices and/or agricultural cooperatives. An initial pre-test is conducted, during which the objectives, methods and activities of survey are explained to the farmers and local teams in each area.

To achieve the objectives of the project three methods of information collection have been applied in three selected sites (New lands, Old Land and Salt-affected /Marginal Lands), which were selected across three canals' communities (El-Bustan, Alatf and El-Shoka and El-Serw main drain) via three types of preparatory study:

- Inventory studies and Secondary data: to summarize all available information on past and ongoing research and development activities related to issues of natural resource management with emphasize on water resource management
- Participatory Rural Appraisal (PRA): to identify the main water resource management problems and constraints at the farm level; and

Table 4.1 Stakeholders information flows in the IBP

Stakeholders	Type of Information	Source of information
Project Manager-ICARDA	-Work Plan - Progress Report	- Regional Steering Committee: - PMU
Regional Steering Committee: -IFAD, AFSED, OPEC Fund, DGs of NARS - National Coordinators (Observers)	-Work Plan - Progress Report	- Regional Technical Committee - National Steering Committee - PMU
Regional Technical Committee	- Work Plan - Progress Report	PMU
National Steering Committee	- Work Plan - Progress Report	- PMU - National Technical Committee
National Technical Committee Project Management Unit (PMU) - MIS Unit - GIS unit - M&E unit	- Progress Reports	National Steering Committee National Technical Committee - Research Centers - Government and NGOs - Beneficiaries and communities
Research Centers -- Agricultural Research Center (ARC, MALR) -- Research Institutes, National -- Water Research Center (NWRC, MWRI), -- Desert Research Center (DRC), -- National Research Center (NRC), -- Ain Shams University and Cairo University	- Work Plan - Technology implementation feedback	- PMU - Beneficiaries and communities - National Technical Committee
Government and NGOs: - MOA	Project reports	PMU
Beneficiaries and communities	Work Plan, Progress Reports, Technology	- PMU - Research Centers

- Multidisciplinary Surveys (MDS): to fill gaps in the information gathered through the PRA

In the first phase of Sudanese satellite site, the main activities were concentrated on identification and characterization of the selected sites, the community (Gezira, Rahad and Essuki), reviewing the existing studies and collecting data on the following aspects: i) Biophysical aspects which include soil, water, productivity, cropping patterns, water use, and irrigation practices, technology use; and ii) Socioeconomics aspects which include sources of livelihoods, resources endowments (natural, human, social, financial, and physical capital assets).

4.6 Communication and Reporting

The main stakeholders of the IBP are listed in Table 4.1, which also shows the type of information needed by each stakeholders group, the source of information. The primary beneficiaries will be the rural poor who depend on

Table 4.2 Summary of activities and schedule during the RBP 4-year period

Activities	
1. Socioeconomics	
1.1 Inventory	
1.2 Site characterization	
1.3 Review of literature	
1.4 Evaluation of results	
1.5 Performance indicators	
2. Model simulation to assess water use efficiency	
2.1 Review and selection of the simulation models	
2.2 Use the selected models	
2.3 Production functions	
2.4 Develop technology adoption indicator	
2.5 Model application and scenario development	
3. Field trials	
4. Policies and institutional setups	
5. Guidelines development	
5.1 Collect previous data	
5.2 Analyse results, develop general guidelines	
5.3 Select and refine the best technologies	
5.4 Develop improved policies and institutional setups	

rainfed, rangeland areas and irrigated agriculture for their livelihoods and, ultimately, all consumers of water. This may be achieved by direct involvement of the communities in the target environments but also through national researchers, who will acquire experience and skills in advanced research methodologies as well as a range of improved water management practices and options. Also users include national policy makers who will receive information on both the technical and socioeconomic aspects of water management that will assist in formulating national policies to support the adoption of rational water use and management.

4.7 Reflection Processes and Events

Table 4.2 summarizes the Timetable and Milestones for the IBP

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Annexes

Annex 1. *Badia* Benchmark Logframe

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Risks and Assumptions
General Objectives Suitable water harvesting techniques capture and efficiently utilize rainwater runoff in more productive and sustainable agricultural systems integrated and adopted, by people in the WANA drier environments	- Utilizing improved packages of site and tomethods selection reduces effort - Time and cost of planning water harvesting systems - At pilot demonstration sites greater part of rain is captured and utilized at improved water use efficiency (WUE) for crop	Report summarize the approach and the methodology	Abnormal weather conditions over the duration of the project
Purpose: Widespread integration and adoption by people in the *Badia*, of suitable water harvesting techniques to capture and efficiently utilize rainwater runoff in more productive and sustainable systems	Information on the socioeconomic constraints and potential policies and actions to overcome them are accessible to decision-makers. Communities in the pilot site adopted improved water harvesting techniques in their fields	- GIS, RS maps - Reports and documents - Electronic database - Research management indicators onhuman and financial resources	Active and qualified technology transfer and extension system is available at the project area.
Outputs:			
1. Improved methodologies for the identification and characterization of catchments and water-harvesting sites. 1.1- Documentation and analysis of the data, Information and studies available on the Jordan *Badia*. 1.1.1 Potential watersheds will be identified based on the general criteria set by the project. 1.1.2 General characterization for the potential watersheds will be performed. 1.1.3 The watershed(s) where project interventions will be implemented, will be selected 1.1.4 Detail characterization of the selected watershed(s) will be performed. 1.1.5 Detailed criteria for sites selection within the watershed will be developed and applied	- Past experience of the work in *badia* will be assessed and evaluated, lessons learned will be identified and utilized in project implementation - Review documents on policy, institutions, land tenure, tribal system and community approach will be completed by end of March 2004 Previous and on-going projects reviewed and lessons learned from these projects identified by the end of March 2004. - Natural and human resource data collected and entered into the computer to establish the project database ready by the end of March 2004. - Around 20 potential watersheds will be	- Site maps, plans and designs of water harvesting systems in the pilot area - Data and research results in scientific publications	Documents and data are available and accessible to project staff

	identified and mapped by the end of March 2004 Characterization of the watersheds (technical and socioeconomic) will be completed by April-May 2004 - Final selection of the project watershed(s) will be completed by June-July 2004. Sites for interventions will be identified and mapped.		
2. Techniques for providing sustainable supplies of water from rainfall run-off for economic production from rangeland, field crops and fruit trees and methodologies for designing and implementing such techniques at the field and watershed levels. 2.1 Sites and communities for interventions are selected and studied 2.2 Potential techniques and technologies are identified. 2.3 Potential technologies and interventions are discussed and accepted by the community by 2.4 Promising interventions are tested and evaluated with community participation 2.5 Socioeconomic interventions will be identified and agreed upon.	- A package of technical and socioeconomic intervention will be developed and guidelines for their use will be established by the end of project - Sites will be selected and interventions for each site will be identified and mapped by end of July 2004. - Introduced technologies will be finalized by technical staff in cooperation with the community by August 2004. - Water harvesting structures will be established end of November 2004 - Implementations of interventions will be completed by January 2005	- Reports, publications field visits, workshops - Work plan for technology interventions - Reports on the results achieved. - Workshops and field visit to the site - Structures are built and ready to be used .	Assumption: Community ready to cooperate and to participate
3. Analysis of potential economic and institutional constraints and recommended policy measures to support the integration of water harvesting in agricultural systems. 3.1 Establishment of policy and institutional measures to support the integration of water harvesting in agriculture system. 3.1.1 Analysis of the current policies and institutions and their impact on water management and	- A set of policy and institutional options that support the sustainable use of water in *badia* will be developed and presented to decision makers - Review and analysis of the current policies is and institutions will be completed by April 2004. - Policy and institutional options will be developed by the end of the project.	- Reports - Data on increased vegetative cover and improved crops productivity - Report summarize the approach and the methodology - Review document	- Assumption: Availability of different maps for the *badia* and their accessibility to project staff. - Availability and accessibility of information and

natural resource strategies in the *badia* area 3.1.2 Identification of key policy and institutional options reforms and their validation with community members in the target area. 3.2 Establishment of quantifiable performance indicators. 3.2.1 A set of specific indicators for efficiency, equity and environmental sustainability at the watershed level, catchments level and farming system and farm levels will be developed. 3.3 Economics of water harvesting established and optimal production system identified 3..3.1 Cost and benefits analysis for different water harvesting techniques are estimated, and the profitability of potential production systems will be evaluated 3.4 Development of Water allocation model for the target watershed(s). 3.4.1 A decision support system will be developed which will assist decision makers to decide on water distribution within the watershed area and the concerned communities. 3.5 Monitoring technology adoption and impact by farmers and users 3.5.1 Rate and intensity of technology adoption will be measured in the project area. 3.5.2 Adoption constraints will be identified 3.5.3 Impact of introduced interventions (technical or/and socioeconomic) on farmers' income and community livelihood will be identified	- A set of policy and institutional options support the sustainable use of water in that *badia* will be developed and presented to decision makers - Review and analysis of the current policies is and institutions will be completed by April 2004. - Policy and institutional options will be developed by the end of the project - Specific indicators will be identified by December 2004. - Cost-benefits analysis for water harvesting and other interventions will be established by the end of 2006. - Ex-post economic analysis will be performed for the interventions by the end of 2006 - Water allocation model for the project watershed(s) will be developed by the end of 2005. - Decision support system for water distribution within watershed areas and communities will be developed and presented to decision-makers by mid 2006. - Adoption rate and intensity of introduced technologies and their impact on farmers' income and livelihood will be completed by mid 2007. - Adoption and adoption-constraint analysis will be conducted and impact studies will be completed mid 2007	- Publications - Workshops to be organized for this purpose - Reports, publications - Published model	data. - Decision-makers are ready to take appropriate decisions Communities and concern departments will cooperate in providing the needed data. Active technology transfer and extension systems are available in the site.
4- Enhanced capabilities of national programs and the integration of researchers, extensionists, farmers, and decision-makers in a regional program for sustainable management of water	- NARS personnel's capability of conducting research on water management issues and application of results increased. - NARS research quality in water	- Training materials and evaluation reports - Research data, scientific reports and	NARS participate in the capacity building program

resources in WANA. 4.1 Qualify skilled and qualified national researchers in water harvesting and community-based integrated watershed management in the *Badia* 4.2 Greater integration between researchers, extensionists and farmers is performed 4.3 Ensure the enhancement of public awareness among decision- makers on the principle of sustainable and efficient scarce water resource management	harvesting management problems improved. - Community leaders capacity in participation in research and technology transfer improved. - Degree and non-degree training for the project staff. At the end of the project 4MSc and PhD will be graduated and trained in the project. Two short-term training courses will be annually implemented - Workshops and traveling workshops for researchers, extension workers, officials, and farmers will be conducted annually, locally and at the regional level. - Seminars and specialized meetings with decision-makers will be organized	paper by NARS - Survey results on farmers' participation in research and technology transfer - Number of graduate students who have been qualified by the project. - Students' thesis, - number of training courses, seminars, workshops, and - number of participants in each activity.

Activities:

1.1 Develop methods for the identification of potential sites and watersheds based on the general criteria set by the project using GIS and RS including soil, hydrology, topography, human and livestock.
1.2 Scoring and weighing of selection criteria
1.3 RRA for the selected watersheds
1.4 Rapid hydrological assessment
1.5 Rapid environmental assessment
1.6 Final selection of the watershed(s) where project interventions will be implemented.
1.7 PRA will be implemented for the selected watershed(s).
1.8 Baseline data on the site(s) and communities will be established.
1.9 Detailed topography and hydrology maps will be developed for the watersheds

1.10 Identification of sites within the watershed(s) where intervention will be implemented

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2.1 Detailed agro-ecology and socioeconomic studies will be performed in the sites where interventions will be implemented.
2.2 Different water harvesting techniques will be identified.
2.3 Cropping systems interventions will be identified.
2.4 Activities related to crop-livestock integration will be identified
2.5 Potential interventions will be negotiated with community before their implementation
2.6 Implementation of intervention with community participation
2.5 Data to be collected
2.6 Analysis of the data
2.7 Report writing

3.1.1 Conduct a review and analysis of the existing policies and institutional measures regarding the *Badia* areas.
3.1.2 Develop recommendations on improved policies and institutional measures for better management of the scarce water resources and other agricultural resources.
Act output 3-2
3.2.1 Collection of productivity indicators for water, vegetation and production system
3.2.2 Collection of sustainability indicators,
3.2.3 Data processing and analysis and reporting.
3.3.1 Collection of data on the direct costs and benefits of the different water harvesting techniques under the different production systems.
3.3.2 Collect data on the indirect cost and benefits regarding the social and environment cost and

benefits and include them in the analysis
Conduct economic analysis considering both the direct and indirect costs and benefits to arrive to the optimal system that maximize the benefits.
3.4.1 Estimating water supply and demand, with and without the project.
3.4.2Examine the existing and potential cropping pattern and their water requirements, costs and revenues.
3.4.3 Gross margin analysis to find the competitiveness of the different enterprises.
3.4.4 Based on the model findings recommended decision options to be implemented.
3.5.1 Farm surveys will be conducted using a questionnaire to find out the technology adoption by farmers and its impact on their income.
3.5.2 Constrain analysis will be conducted using the questionnaire and other collected data.
3.5.3 Baseline survey will be used in the analysis to establish the baseline information to be compared with.
3.5.4 Data analysis and reporting
4.1 Degree training on socioeconomic, GIS and RS, water harvesting, integrated resource management.
4.2 Non-degree short term training courses on water harvesting, GIS and RS, data collection and analysis and database management,
4.3 Workshops, traveling workshops, seminars and specialized meetings at the regional and the national levels.

Annex 2: Monitoring and Evaluation Matrix for BBP

Performance Questions	Indicators & other Info/ Data requirements	Baseline info requirements	Data gathering methods; frequency & responsibility	Resources required	Information use, analysis, report-ing & feedback
• To what extent has the project contributed to implement suitable water harvesting techniques? Why? Why not? • To what extent have the people in *Badia* adopted suitable water harvesting techniques? Why or why not? • To what extent did the people in *Badia* utilize efficiently rainwater run off? Why? Why not? • To what extent did the people in *Badia* use harvesting techniques in more productive and sustainable systems	• Improved packages and methods selection were utilized reduces effort, • Time and cost of planning water harvesting systems implemented. • At pilot demonstration sites greater part of rain is captured and utilized at improved water use efficiency for crop	• The level of Water harvesting in the area • Area served with water harvesting techniques • Number of people benefiting with ongoing water harvesting • Area and location of productive and sustainable systems • A review of the previous experience of Jordan in *Badia* research and development approaches, achievements, constraints, and lessons learned that could be utilized by the present project	• Baseline surveys under taken at the onset of implementation • Representative household surveys at mid-term and project completion (gender-disaggregated) (PY3) conducted by PMU & technical staff • GIS, RS maps (PY1-4) • Reports and documents (PY1-4) • Electronic Data base (PY1-4)	• External expertise to assist with baseline surveys & household surveys • Questionnaires/ survey formats for baseline & household surveys • focus-group meetings to discuss changes that specific social groups have experienced.	• Quantitative and qualitative analysis of baseline & household surveys; • Reflection during annual review and planning meetings with key stakeholders
• Were the methods for the identification and characterization of catch-	• Past experience of the work in *Badia* has been assessed and evaluated,	• Available research on the methods for the identification	• Baseline surveys undertaken at the onset of implementation	• Questionnaires/ survey formats for periodic	• Quantitative and qualitative analysis of baseline &

ments and water-harvesting sites implemented efficiently? Why? Why not? • To what extent has the project documented analyzed the data, Information and studies available on the Jordan *Badia*. Why? Why not? • Were the criteria for the identification of potential watersheds set by the project? • To what extent has general characterization for the potential watersheds been performed? Why? Why not? • Were the watershed (s) where project interventions selected? • To what extent a detailed characterization of the selected watershed(s) has been performed. Why? Why not? • To what extent detailed criteria for sites selection within the watershed has been developed and applied? Why? Why not?	• Lessons learned has been identified and utilized in project implementation • Documents on policy, institutions, land tenure, tribal system and community has been reviewed completed at the end of PY1. • Previous and on-going projects reviewed and lessons learned from these projects identified at the end of PY1. • Natural and human resource data collected and entered into the computer to establish the project database ready by the end of PY1. • Around 20 potential Watersheds were identified and mapped by the end of PY1 • Characterization of the watersheds (technical and socioeconomic) has been completed by the end of PY1 • Final selection of the project watershed(s)) has been completed by the end of PY1 • Sites for interventions has	characterization of catchments and water-harvesting sites • Available and accessible documents, data analysis,and studies • Available research on the criteria for the identification of potential watersheds • Available Information on the general characterization for the potential watersheds	• Site maps, plans and designs of water harvesting systems in the pilot area (PY1&2) • Data and research results in scientific publications (PY1) • Sample surveys conducted by the project team (PY1-4)	reports conducted by the project team • Specialized reporting system in the M&E unit	household surveys; • Reflection during annual review and planning meetings with key stakeholders

	been identified and mapped				
• To what extend the selected sites and communities represents the local situation? Why? Why not? • To what extent do the communities accepted the proposed technologies? Why? Why not? • Had the promising interventions been tested and evaluated with the community participation? Why? Why not? • To what extent the Socioeconomic interventions were identified and agreed upon? Why? Why not?	• A package of technical and socioeconomic intervention will be developed and guidelines for their use will be established by the end of project • Sites will be selected and interventions for each site will be identified and mapped by PY1. • Introduced technologies will be finalized by technical staff in cooperation with the community by PY1 • Water harvesting structures will be established by end of PY! • Implementations of interventions will be completed PY2	• The characteristics of the area and the community in the project area. • The types of technologies available in the project area. • The available and appropriate technologies needed in the project areas.	• Reports, publications field visits, workshops • Work plan for technology interventions • Reports on the results achieved • Workshops and field visit to the site	• Experts in the project team. • Scientific centers working with the project team.	• Descriptive data and information • Sample surveys • Project reports
• To what extent policy and institutional measures that support the integration of water harvesting in agriculture system were established? Why? Why not? • Had the quantifiable performance indicators been established? Why? Why not? • Had the Economics	• A set of policy and institutional options that support the sustainable use of water in *badia* will be developed and presented to decision makers •Review and analysis of the current policies is and institutions will be completed by PY1. • Policy and institutional	• Information of policies related to the project components	• Institutional surveys • Reports on the results achieved. • Sample surveys conducted by the project team	• Experts in the project team. • Project team	• Quantitative and qualitative analyses

of water harvesting been established? Why? Why not?	options will be developed by the end of the project.
• Had the optimal production system been identified? Why? Why not?	• A set of policy and institutional options that support the sustainable use of water in *badia* will be developed and presen ted to decision makers
• Had the water allocation model for the target watershed (s) been developed? Why? Why not?	• Review and analysis of the current policies is and institutions will be completed by PY1.
• To what extent the farmers adopted the proposed technologies? Why? Why not?	• Policy and institutional options will be developed by the end of the project
• Had the adoption constraints been Identified? Why? Why not?	• Specific indicators will be identified by PY1
• To what extent the in terventions (technical or/ and socioeconomic) have impact on farmers' income and community livelihood. Why? Why not?	• Cost-benefits analysis for water harvesting and other interventions will be established by the end of PY3.
	• Ex-post economic analysis will be performed for the interventions by the end of PY3
	• Water allocation model for the project watershed(s) will be developed by the end of 2005.
	• Decision support system for water distribution within watershed areas and communities

	will be developed and presented to decision-makers by mid PY3. • Adoption rate and intensity of introduced technologies and their impact on farmers' income and livelihood will be completed by mid PY4 •- Adoption and adoption constrain analysis will be conducted and impact studies will be completed mid PY4.				
• To what extent capabilities of national programs and the integration of researchers, extensionists, farmers, and decision-makers has been qualified? Why? Why not? • To what extent the integration was built between researchers, extensionists and farmers Why? Why not? • To what extent public awareness among decision- makers on the principle of sustainable and efficient scarce water resource management had been enhanced.	• NARS personnel's capabiity of conducting research on water management issues and application of results increased. • NARS research quality in water harvesting management problems improved. • Community leaders capacity in participation in research and technology transfer improved. • Degree and non-degree training for the project staff. At the end of the project 4MSc and PhD will be graduated and trained in the project. Two short-term training - courses will be annually	• Establish a data base with respect to qualified researchers in water resource management • National development programs • The level of awareness among decision makers of the principles of sustainable and efficient scarce water resource management	• Institutional surveys • Reports from the MOPIC • Workshops for decision makers	• Experts in the project team. • Project team	• Descriptive data and information

	implemented • Workshops and traveling workshops for researchers, extension workers, officials, and farmers will be conducted annually, locally and at the regional level. • Seminars and specialized meetings with decision-makers will be organized

Annex 3: The *Badia* Benchmark Project Impact Pathway during 2004-2009

Project	Community-Based Optimization of the Management of Scarce Water Resources in Agriculture in West Asia and North Africa- *Badia* Benchmark Site - Jordan			
Goal	Community livelihood improvement through rehabilitating and protection of the degraded rangeland			
Objective	Widespread integration and adoption by people in the *Badia*, of suitable water harvesting techniques to capture and efficiently utilize rainwater runoff in more productive and sustainable systems.			
Output Targets	**Output**	**Intended Users**	**Outcomes**	**Impact**
OUTPUT 1	Improved methodologies for the identification of water-harvesting sites and methods of high potential for various conditions.			
Output targets 2004	Documents are reviewed (natural and human resources information, Socioeconomic information, Policies, institutional constraints for common resource management	NARS Researchers and National Development-Agencies	- The major project achievements, success stories, policy changes,adoption of technologies by farmers and users are identified. - Digital topographic and hydrological maps covering the whole *Badia* at a scale of 1:250000. - Digital topographic and hydrological maps with the most important overlays for the selected	- What are The lessons learned from the project that could be useful to the implementation of the Benchmark project, - What are the project conclusions and recommendations and how the Benchmark project benefit from them. -The level of the social and economic transformation of Bedouin society
Output targets 2005	- Site Selection: M&E indicators are identified dentification of potential water harvesting sites are developed by using participation GIS&RS Technical Research intervention with community - Human resource capacity building	NARS Researchers, PMU, community, and project employees	- Identifying the most suitable watershed(s) to undertake the project activities within the Jordanian *Badia*. - Identification of the biophysical and socio-economical characteristics of the selected watershed(s). - Identifying detailed criteria for site selection within the selected watershed	Are the selected watersheds suitable for the project activities?
Output targets 2006	- Water Harvesting Experimentation and evaluation	NARS Researchers,	Sustainable methods for community-based water harvesting techniques	- Efficiency of harvested water is high increase in vegetation productivity

	- Human resource capacity building (regional training, workshops, traveling, seminars and meetings)	PMU, community, and project employees	and guidelines for socially accepted and efficient approaches to allocation, collection and use of runoff water within and integrated watershed system are implemented.	
OUTPUT 2	Methodologies for the characterization of catchments potential and optimal use of harvested water in these catchments.			
Output targets 2005	Characterization of the selected watersheds	NARS Researchers, and community	- The basic economic characteristics of the selected communities including population characteristics, source of income, Resource Property rights, Land Fragmentation, Agricultural Production system, Rangeland Utilization are identified - The problems that constraints the improvement of watershed management system are identified - Investigate the institutional issues related to water allocation and water management	Are the researcher in the project and policy makers provided with a set of specific characteristics of the agricultural, human and environmental resources of watershed, catchments and rural communities in the project site?
Output targets 2006	Watersheds sites are identified and characterized, - Establishment of Communal Nurseries for Fodder Shrub Seedlings Production	NARS Researchers, and community	Water harvesting techniques are implemented in the selected sites The farmers establish Communal Nurseries for Fodder Shrub Seedlings Production.	Are the nurseries producing and working well?
OUTPUT 3	Analysis of potential economic and institutional constraints and recommended policy measures to support the integration of water harvesting in the agricultural systems.			
Output	- investigating land tenure sys-	NARS	- Different land tenure systems in the	- How each tenure system affects land

targets 2005	tems in the *Badia* region -Analysis of the existing policies are conducted regarding the *Badia* areas and develop recommendations for policy measures that support better management of those areas -Institutional characteristics, and Market Reforms are identified - Review and collection of natural and human resources data and database establishment	Researchers, and policy makers	*Badia* are identified, - Governmental policies in the badia are identified. - Legal and institutional incentives and constraints affecting land use and agricultural production activities in *Badia* region are identified - Activities and grazing rights as well as grazing regulations followed in the *Badia* are identified	and water utilization and resource degradation and sustainability. - To what extent is the human resource are integrated in the institution activities regarding watershed management -To what level beneficiaries, farmers, herders, and resources users are participating in planning and evaluating watershed project management - The level of data-base on human and natural resources.
Output targets 2006	- Estimating the Performance Indicators Monitoring Technology Transfer - Economic Evaluation of Developed - Technologies- Water Harvesting Cost-Benefit Analysis	NARS Researchers Community	Appropriate indicators for efficiency, equity and environmental sustainability are selected.	- Do the evaluated indicators show the success of the activities mplementation?
Output targets 2007	- Community-Based Technology Dissemination and Sustainability and Public Awareness		Technology adoption by farmers in the two (Mhareb and Al Majedeyaa) communities and other communities in the area is enhanced	Are the communities satisfied with the proposed technologies?
Output targets 2008	Soil and Water Conservation Activities: 1- Implementing the planned interventions that were not executed during the 2006-2007 season: - Wadi stabilizing only for the Hafaier site, Cisterns, Check dams, Micro-catchments for an additional area of about 100 hectare, Pond (Hafaier), -Barley contour strips with Atriplex	NARS Researchers PMU, community, and project employees	• Implementing the interventions in large scale, • Establish an information system for weather and soil data. Start implementing the new technologies in fields outside the project area	• Are the interventions economically sound? • What are the best types of interventions? and what is the criteria used for this evaluation? • Are the community out side the project accepting the new technologies?

	and/or Salsola shrubs planted to mark the contour lines, and Contour ridges (modified) to be planted with Barley. 2- Mapping and general characterization 3- Monitoring: Weather and rainfall data, and Soil data. 4- Maintenance for implemented interventions			
OUTPUT 4	Techniques for providing sustainable supplies of water from rainfall run-off for economic production from rangeland, field crops and fruit trees and methodologies for designing and implementing such techniques at the field and watershed levels.			
Output targets 2006	- Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options - Water Harvesting experimentation and evaluation - Community participation in technology dissemination and project sustainability - Public Awareness program	NARS Researchers, communities, national agencies, and international agencies	- Information on the socioeconomic constraints and potential policies and actions to overcome them are accessible to decision-makers. - Improved technologies, methodologies, and recommendations are available to national programs. Guidelines and recommendations are adopted and implemented by the target communities - Community leaders capacity in participation in research and technology transfer improved	- At pilot demonstration sites greater part of rain is captured and utilized at improved water use efficiency for crop. - Communities in the pilot site adopted improved water harvesting techniques in their fields
Output targets 2007	Water Harvesting Demonstrations for Fruit Trees at Al-Manshia Village Implement several activi-	NARS Researchers, communities,	Full participation of Mhareb and Al Majedeyaa communities to enhance technology adoption by farmers	Water harvesting in the selected sites for fruit trees production is implemented in the sites and the other areas

	ties with full participation of Mhareb and Al Majedeyaa communities to enhance technology adoption by farmers in the two communities and other communities in the area.			
Output targets 2008	Human resource capacity building (regional training, workshops, traveling, seminars and meetings) Assessing the Impact of project interventions on efficiency and sustainable utilization of natural resources	NARS Researchers, communities, and national experts	-Skilled and qualified national researchers in water resource management - Greater integration of sustainable water resource management into national development programs - Enhanced public awareness among decision-makers of the principles of sustainable and efficient scarce water resource management.	
Output targets 2009	• Scaling-up project achievements (Methodologies, approaches, technical interventions) at the national level. • Policy modifications will be integrated with the technologies and tested with the communities as a technical policy level and institutional options • Evaluation the national level impact	NARS Researchers, Stakeholders, communities, and National experts	Knowledge dissemination of the project activities, outputs and outcomes are spread at the national level.	• Are the goals of the project chieved? • What are the problems that faced the project? And how they were faced? • What are the lesson learned?

Annex 4. Rainfed Benchmark Logframe

Narrative Summary	Objectively Verifiables Indicator	Means of verification	Assumptions and Risks
Goal			
Help the farming communities to adopt farming strategies and tested technologies for the optimal conjunctive use of rain-water and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas.	- Number of farming communities adopting proposed farming strategies - Increase in productivity and production - Increase water productivity	- Ex- Post surveys for impact analysis	-Level of precipitation is acceptable - Availability of water resources
Outcomes 1.Selection of and characterization of appropriate site and communities that respond to the project criteria.	The benchmark of Tadla area in Morocco is identified and characterized by march 2004	Reports Meetings and workshops minutes	
2. Identification of the main constraints to the adoption of improved water use technologies	Plan of action to solve the problem of adoption by farmers of efficient water use strategies is prepared.	Reports Workshops minutes	
3. Economic assessment of the impact of new irrigation systems options.	Costs-benefits for all irrigated crops are established by December 2004	Reports, Seminars proceedings	Information needed to run the analysis is available
4. The development of a policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas that will reduce poverty and improve crops productivity. The specific objective is the establishment of the key policy and institutional options to improve water use efficiency.	Appropriate policy and institutional measures are identified by the end of the project	Reports Seminars proceedings	
5. Optimization of the use of water within the biophysical and socioeconomic environment of Tadla perimeter.	Management strategies for water and crops is developed and used by the ORMVAT by year 2008	Reports	
6. Development of guidelines for improving water management at farm, community, national and regional levels	Technologies and packages that are potentially adapted to specific areas are identified by year 2007.		

Outputs:

1.1 Characterization of the two communities in terms of basic monographic information with specific attention to water resources and allocation, water use policy, irrigation management, cropping systems and practices and water productivity; 1.2 Strengthening of links between community members and project team to insure community participation to the project activities	Two communities that respond to the project criteria are identified and characterized by march 2004 Contractual agreements with farmers are signed with farmers by march 2004	Thematic working groups reports Contracts documents	
2.1 Quantification of the adoption status of efficient water use options; 2.2 Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options;	The list of irrigation practices is elaborated and analyzed by may 2004 Organizational and methods of technology transfer related to water management are described by may 2004	Research reports Scientific publications	Information needed is accessible
3.1Estimation of costs and benefits for different irrigated crops under alternative supplementary irrigation practices and systems; 3.2 Quantification of water economic productivity for different irrigated crops and alternative irrigation systems; 3.3 Assess the equity implications of using alternative supplementary irrigation practices and systems.	The three major economic indicators (cost, benefit and profitability) are established for the irrigated crops by January 2004.	Research reports Scientific publications	
4.1 Analysis of the impacts of current policy and institutional measures on water use practices and productivity; 4.2 Identification of key policy and institutional options reforms and their validation with both community members.	Policy and institutional instruments are identified by the end of 2004 The main policy and institutional reforms identified by the end of the project	Research reports Scientific publications	
5.1 Benchmark site is agro-climatically characterized; 5.2 Pilot sites (selected farms) are chosen and characterized; 5.3 Potential techniques and technologies are identified; 5.4 Potential production techniques are tested and evaluated agronomically, economically and ecologically; 5.5 Decision support tools are developed and /or validated 5.6 Framers and technicians are informed and trained on	• Data base, maps are developed by December 2004 • Farms data base are constituted by May 2004 • List of potential technologies is prepared by May 2004 • Water productivity, at selected	Annual reports Final reports	Farmers are willing to collaborate and convinced by the technologies

techniques and technologies that improve conjunctive irrigation and rainfall water use efficiency	farms is increased by 25 to 40 0% by year 2007 • Models are validated and used by year 2006 • All selected farmers use the new technology packages and ORMVAT technicians master the use of the technologies by year 2007		
6.1 A model of irrigation water management at the perimeter level is tested and validated; 6.2 Cropping patterns that allow the best use of available water are identified	• Operational models are available by year 2007 • An adapted land use chart is prepared by year 2007	Reports	Network management by the ORMVAT Farmers are convinced
7.1 A report describing the developed technological, policy and institutional packages which contribute to increased water productivity is elaborated.	All the project results and conclusions are published by year 2007	Report	-Collaboration of different ORMVA and satellite sites; -Agro-ecological characterization of the local and satellite sites
Activities 1.1 The output one will be undertaken using available secondary and farms survey data. Visits to representative authorities are may be necessary to complete the set of relevant information; 1.2 The output two will require the organization of a workshop at the community level to explain the project objectives and requirements to be sure that communities are aware of the project needs and to insure their participation in research activities. The key activities are: 1.3 Collection and analysis of secondary data from PRA and RRA, and existing surveys results (RGA) to describe the two communities and to develop a data set about community members; 1.4 Communicate the results of the analysis of secondary data to the project team;		Financial report Expenses justifications	The budget is allocated on the right-time

1.5 Organization of two workshops at the community level using existing institutions, guides and target questions.		
2.1 Data will be gathered from formal technology adoption surveys and different participatory workshops will be conducted in Tadla region with both community members. The first category of workshops will be focused on community constraints and potentials regarding efficient water use strategies. The second category of workshops concerns the development of community plan of work and its validation with community members. All the project team members (biophysics and socioeconomy) must be involved in this activity.	Financial report Expenses justifications	The budget is allocated at the right time
3.1 A household survey of representative sample of farmers in the two communities (the survey will contribute to the development of a baseline data on family members, equipment, cropping system, livestock and irrigation practices); 3.2 The analysis will be carried out, on a representative sub-sample, using capital budgeting, cost-benefit procedure, and econometric techniques (mathematical programming is optional)	Financial report Expenses justifications	The budget is allocated at the right time
4.1 The review of current policy and institutional measures related to water use in agriculture (national, regional and local); 4.2 Conduct quantitative and qualitative analyses to assess the impact of current and alternative water use options (e.g., welfare analysis); 4.3 Develop policy and institutional recommendations for large-scale adoption of supplementary irrigation technologies. Community workshops and focus group meetings will be used.	Financial report Expenses justifications	The budget is allocated at the right time
5.1 Collection of agro-climatic data: 5.2 Climatic data 5.3 Soil data 5.4 Hydrological data 5.5 Land use 5.6 Topography 5.7 Data processing and elaboration and development of tools 5.8 Characterization of selected farms	Annual reports on each activity	The budget is sufficient and allocated on time

5.9 Collection of the documentation (reports, theses...)
5.10 Information analysis and synthesis
5.11 Evaluation, at the farm level, of potential techniques and technologies that improve water productivity:
5.12 Improved supplemental irrigation and crop management packages on wheat, sugar beet, alfalfa, citrus
5.13 Adapted wheat varieties to supplemental irrigation
5.14 Critical stages for supplemental irrigation on wheat and sugar beet
5.15 Economic evaluation of the new technologies and techniques
5.16 Collection of data needed to run models (agronomic, soil, climatic and hydrodynamic data)
5.17 Selection, test and validation of crop growth and crop and water management models (SIMTAG, CROPSYST, Expert system, CROPWAT)
5.18 Training on the " Expert System "
5.19 Organization of two field days per site each year for farmers
5.19Organization of three training sessions for the technicians and engineers of the ORMVAT
5.20 Organization of a visit of farmers from ORMVAT to the ORMVA of Moulouya
5.21 Production of technical guides, pamphlets and audio-visual material for extension purposes

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6.1 Collection of available data concerning water resources, allocation and drainage;
6.2 Collection of existing data and the ones that are measured within this project (experiment studies) concerning agronomic, climatic, soil and hydro-dynamic parameters;
6.3 Diagnosis of the used approach of water allocation and scheduling at the perimeter level;
6.4 Test and validate a model of irrigation management at the perimeter level;
6.5 Develop a land use map using satellite images (spot 5);

6.6 Develop a map of irrigation water requirements of crops; 6.7 Develop and validate scenarios of optimization of crop production taking into consideration the amounts of water allocated to agriculture.		
7.1 Analyses and synthesis of all the project results 7.2 Organization of a regional workshop to debate and validate the project results and outputs 7.3 Elaboration and dissemination of the final project report 7.4 Packaging the project options into expert tools for scaling-out and- up.	Seminar report	Budget allocated on time

Annex 5: Monitoring and Evaluation Matrix for RBP

Performance Questions	Indicators & other Info/Data requirements	Baseline info Resources	Data gathering methods; frequency & responsibility	Resources required	Information use, analysis, reporting & feedback
Did the farming communities adopt strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas? Why? Why not?	• A set of improved technologies, methodologies were implemented. • Recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, and policy and institutional options were proposed and tested.	• Identify and analyze possible constraints to the adoption by farmers of efficient water use options; • Analyze existing policies and institutional setups regarding improving water use efficiency and develop recommendations for improvement;	• Conduct Field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management	• Technical team	Qualitative and quantitative analysis
Had appropriate sites and communities that respond to the project criteria been selected of and characterization? Why? Why not?	The benchmark of Tadla area in Morocco is identified and characterized by march 2004	• Assess ex-ante impact of new options of supplemental irrigation system; • Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water;	• available secondary farms survey data • Visits to representative authorities • a workshop at the community level		
• Had the main constraints to the adoption of improved water	• Quantification of the adoption status of efficient water use	• Collection and analysis of secondary	• formal technology adoption		

use technologies been identified? Why? Why not?	options had been conducted; • Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options had been conducted. • Plan of action to solve the problem of adoption by farmers of efficient water use strategies is prepared.	data from PRA and RRA, and existing surveys results (RGA) to describe the two communities and to develop a data set about community members;	• surveys • participatory workshops		
• Did the project conduct economic assessment of the impact of new irrigation systems options? Why? Why not?	• Costs and benefits for different irrigated crops under alternative supplementary irrigation practices and systems were estimated; • Water economic productivity for different irrigated crops and alternative irrigation systems was quantified; • Equity implications of using alternative supplementary irrigation practices and systems were assessed.	• Economic analysis of the current irrigation systems	• A household survey of representative sample of farmers in the two communities (the survey will contribute to the development of a baseline data on family members, equipment, cropping system, livestock and irrigation practices);	•	•The analysis will be carried out, on a representative subsample, using capital budg eting, cost-benefit procedure, and econometric techniques (mathematical programming is optional)
Did the project establish the key policy and institutional options to improve water use efficiency? Why? Why not?	• The impacts of current policy and institutional measures on water use practices and productivity were analyzed; • Appropriate policy and institutional measures are identified by the end of the project	• The review of current policy and institutional measures related to water use in agriculture (national, regional and local);	• Quantitative and qualitative analyses to assess impact of current and alternative water use options (e.g., welfare analysis,); • Develop policy and institutional recommendations	• External experts	•quantitative and qualitative analyses

			for large-scale adoption of supplementary irrigation technologies. Community workshops and focus group meetings will be used.		
To what extent did the project optimize the use of water within the biophysical and socioeconomic environment of Tadla perimeter.? Why? Why not?	• Benchmark site is agro-climatically characterized; • Pilot sites (farms) are chosen and characterized; • Potential techniques and technologies are identified; • Potential techniques of production are tested and evaluated agronomically, economically and ecologically; • Decision making tools are developed and/or validated; • Farmers and technicians are informed and trained on techniques and technologies that improve conjunctive irrigation and rainfall WUE. • Management strategies for water and crops is developed and used by the ORMVAT by year 2008	• Review the on-going global warming and atmospheric conditions • Collection of agro-climatic data • Analyze the adopted techniques that improve water use efficiency (WUE)	Missing meteorological data will be generated using weather generation models; • Models will be developed and GIS will be used to draw maps characterizing the benchmark site. • All existing ORMVAT and projects reports, theses, etc, concerning potential techniques and technologies will be collected	•	•Evaluation, at the farm level, of potential techniques and technologies that improve water productivity •
6. Did the project Develop guidelines for improving water management at farm, community, national and regional levels? Why? Why not?	Technologies and packages that are potentially adapted to specific areas are identified by year 2007.				

Annex 6: The Rainfed Benchmark Project Impact Pathway

Project	Rainfed Benchmark and Satellite Sites			
Goal	Help the farming communities to adopt farming strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas.			
Objective	Adoption by farming communities of strategies and tested technologies for the optimal conjunctive use of rainwater and scarce water resources in supplemental irrigation systems for improved and sustainable water productivity in rainfed areas.			
Output Targets	**Output**	**Intended users**	**Outcomes**	**Impact**
OUTPUT 1	Recommendations for appropriate irrigation systems and schedules to ensure optimal water productivity and net benefits to the rainfed resource users;			
Output targets 2004	• Characterization of the two communities in terms of basic monographic information with specific attention to water resources and allocation, water use policy, irrigation management, cropping systems and practices and water productivity; • Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options; • Strengthening of links between community members and project team to insure community participation to the project activities	• MADR, Provincial DPA, INRA, ORMVAT, SEEN-DDGI Researchers and National Development Agencies	• The selection and characterization of and of appropriate site and communities that respond to the project criteria were settled. i.e., The perimeter of Tadla • possible constraints to the adoption by farmers of efficient water use options are analyzed and identified	• -What are The lessons learned from the project that could be useful to the implementation of the Benchmark project, • Are the links between community members and project team to ensure community participation to the project activities strengthened?
Output targets 2005	• The development of a policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas that will reduce poverty and improve crops productivity. • Sustainable improvement of supplemental irrigation water productivity under conditions of scarce water resources at the farm level. • Optimization of the use of water within the biophysical and socioeconomic environment	• INRA, ORMVAT, SEEN-DDGI Researchers, National Development Agencies and communities	• Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options. • Identification of key policy and institutional options reforms and their validation with both community mem	• Did the policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas reduced poverty and improved crops productivity ? • Had the water use in Tadla perimeter been optimized?

	of Tadla perimeter.		bers. • Evaluation and test of adapted technologies at the farm level (Bradia, Ouled Zmam). • A model of irrigation water management at the perimeter level is tested and validated; • Cropping patterns that allow the best use of available water are identified.	
Output targets 2006	Economic assessment of the impact of new irrigation systems options	INRA, ORMVAT, SEEN-DDGI Researchers, National technical committee, and National Development Agencies	Estimation of costs and benefits for different irrigated crops under alternative supplementary irrigation practices and systems; Quantification of water economic productivity for different irrigated crops and alternative irrigation systems; Assess the equity implications of using alternative supplementary irrigation practices and system	- Did the new irrigation systems options result in higher economic values
Output targets 2007	• Economic assessment of the impact of new irrigation systems options. • The development of a policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas that will reduce poverty and improve crops productivity. The specific objective is the establishment of the key policy and institutional options to improve WUE. • Sustainable improvement of supplemental irrigation water productivity under conditions	INRA, ORMVAT, SEEN-DDGI Researchers, National technical committee	• Estimation of costs and benefits for different irrigated crops under alternative supplementary irrigation practices and systems; Quantification of water economic productivity for different irrigated crops and alternative irrigation systems; Assess the equity implications of using alternative sup-	• Did the new irrigation systems options result in higher economic values • Did the policy and an institutional framework for the implementation of appropriate water use strategies in low rainfall areas reduced poverty and improved crops productivity? • Had the water use been

	of scarce water resources at the farm level. Optimization of the use of water within the biophysical and socioeconomic environment of Tadla perimeter		plementary irrigation practices and system • Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of efficient water use options. • Identification of key policy and institutional options reforms and their validation with both community members. • Evaluation and test of adapted technologies at the farm level (Bradia, Ouled Zmam). • A model of irrigation water management at the perimeter level is tested and validated; • Cropping patterns that allow the best use of available water are identified.	optimized? • What are the lessons learned from the project that could be useful to the implementation of the Benchmark project, - What are the project conclusions and recommendations and how the Benchmark project benefit from them.
OUTPUT 2	Strategies for conjunctively utilizing rainwater and other scarce water resources in combination to maximize the benefits from each of them and to increase agricultural production in a sustainable way;			
Output targets 2005	• Assess ex-ante impact of new options of supplemental irrigation systems Justification • Field trials (preliminary results	• National and regional technical committees, • INRA, ORMVAT, SEEN-DDGI Researchers, Regional Steering	•Quantification of the adoption status of efficient water use options; • Estimation of costs and benefits for different irrigated crops under alternative supplementary irrigation practi-	• are the implemented new options of supplemental irrigation system justified? • Did the field trials prove the appropriateness of the new technologies?

		Committee, and Project manager	ces and systems; • Quantification of water economic productivity for different irrigated crops and alternative irrigation systems;	
OUTPUT 3	• Identify and analyze possible constraints to the adoption by farmers of efficient water use options • Effective methodologies to tailor production systems, cropping patterns, and cultivars to match water requirements for agricultural production with sustainable water supply in accordance with the socioeconomic environment	• National technical committee, • INRA, ORMVAT, SEEN-DDGI Researchers, Regional Steering Committee, and Project manager	• The current technical, institutional and organizational constraints hindering the adoption of efficient water use options are identified and analyzed.	• were the constraints to the adoption by farmers of efficient water use options solved? • Were the methodologies to tailor production systems, cropping patterns, and cultivars to match water requirements for agricultural production with sustainable water supply effective in accordance with the socioeconomic environment;
Output targets 2005	•Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water • Economic assessment of the impact of new irrigation systems options.	• National technical committee, • INRA, ORMVAT, SEEN-DDGI Researchers,	• Assess the equity implications of using alternative supplementary irrigation practices and systems.	• To what extent did the project optimize the use of water within the biophysical and socioeconomic environment • Did the new irrigation systems options result in higher economic values
Output targets 2006	• Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water • Economic assessment of the impact of new irrigation systems options. • Assess ex-ante impact of new options of supplemental irrigation systems Justification	• National technical committee, • INRA, ORMVAT, SEEN-DDGI Researchers, Regional Steering Committee, and Project	• Assess the equity implications of using alternative supplementary irrigation practices and systems.	• To what extent did the project optimize the use of water within the biophysical and socioeconomic environment • Did the new irrigation systems options result in higher economic values • are the implemented new options of supplemental irri-

	• Field trials (preliminary results)	manager		gation system justified? • Did the field trials prove the appropriateness of the new technologies?
Output targets 2007	• Develop, test and promote production techniques, alternative innovative approaches and practical tools such as models and decision support systems giving enhanced output per unit of water • Economic assessment of the impact of new irrigation systems options.	• National technical committee, • INRA, ORMVAT, SEEN-DDGI Researchers, Regional Steering Committee, and Project manager	• Assess the equity implications of using alternative supplementary irrigation practices and systems	• To what extend did the project optimize the use of water within the biophysical and socioeconomic environment • Did the new irrigation systems options result in higher economic values
OUTPUT 4	Recommendations for operational guidelines to deal with the trade-off between WUE and net benefits under different socioeconomic conditions.			-
Output targets 2006	Evaluate, together with the stakeholders, potential strategies that match water requirements with water supply and optimize the use of water within the biophysical and socioeconomic environment of the target areas	INRA, ORMVAT, SEEN-DDGI Researchers, and communities	A model of irrigation water management at the perimeter level is tested and validated; the best use of available water are identified; Improved strategy for operating the main scheme of the irrigation system so that the water delivery (supply) system matches the demand at the farms is developed.	Did the proposed recommendations prove to be effective in dealing with the trade-off between water use efficiency and net benefits under different socioeconomic conditions
Output targets 2007	• Develop guidelines, packages and technological, institutional and policy options for improving water managements in the targeted areas	National technical committee, INRA, ORMVAT,	• A report describing the developed technological, policy and institutional packages which contribute	Are the developed guidelines, packages and technological, institutional and policy options for improving water

• Collection of information, test and validation of the model	SEEN-DDGI Researchers, Regional Steering Committee, Project manager, and communities	to increased water productivity is elaborated • The model is validated and tested	managements in the targeted areas been implemented? Did they prove to be successful?

Annex 7: Irrigation Benchmark Project Logframe

Narrative Summary	Objective Verified Indicators	Means of Verification	Risks and assumption
Goal			
Widespread integration and adoption by farmers in the irrigated agriculture, of suitable irrigation systems and methods to maximize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems.	A set of improved technologies, methodologies, and recommendations for optimizing water productivity in irrigated systems, including water ma nag ement, alternative crops, use of different water resources, and policy and institutional options.	•Documents and publications • Surveys • Workshops and field days • Software • Computerized Database	• Documents and data are available and accessible by project staff • Assumption: communities ready to cooperate and participate • Financial support is sufficient • Affordability of small farmers • Opposition by less interested and pressure groups
• **Objectives**			
1. Review of previous studies, farm surveys and analysis to assess the actual water productivity (WP) for multi-cropping Systems and to determine the source of inefficiency in water use in target areas	• Past experience of the work in the irrigated oldland will be assessed, lesson learned, will be identified and utilized in project implementation • Establish a baseline for the selected communities to be used in monitoring and evaluating the project. • Identify potential options/interventions for WUE • Develop performance indicators	• Review documents • Database • Surveys	• Documents and data are available and accessible by project staff • Assumption: communities ready to cooperate and participate

2. Establishment of a management package for optimized irrigation.	A set of improved technologies, methodologies, and recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, .	• Document and publications	
3. Establishing field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management.	• Site selection by end of 2004. • Report on gaps and constraints facing water productivity by the end of 2004. • Starting some of the field activities (at least permanent fields) by 2004/2005 winter season • Report on gaps and constraints facing water productivity by the end of winter season 2004-05. • Annual report on time.	• Sites of field trials (permanent and neighbor farmers) • Workshops and field days • Reports on time	• Financial support is sufficient • Document and data are accessible • Community ready to cooperate and participate • Farmers' behavior regarding field trials
4. Collect literature of the existing policies and institutional setups in the field of irrigated agriculture within the network and worldwide	• Review and lessons learned will be completed by the end of December 2004 • An intensive database including all available policies, laws, regulations, rules, ...etc., will be parallel to the review • The following institutions will be consulted • Ministry of Agriculture • Ministry of Irrigation • Cooperatives • Unions of Produces • Unions of Exporters • NGO's • Water User Associations • Water Boards • Irrigation Advisory Services	• Review documents • Computerized Database • Electronic and hard copies	No risk, data is available and accessible

	• Extension		
5. Assure that each of the previous activities produces an outcome of clear recommendation, package or policies related to improving water productivity	A set of improved technologies, methodologies, and recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, and policy and institutional options.	- Document and publications	
Outputs			
1.1 Land utilize all relevant previous projects' activities as a baseline (e.g., LTT/LTM, NVRS projects). 1.2 Full Characterization of sites and associated problems. 1.3 Review of available information on WUE and identifying the data gaps and information needed to improve WUE or water productivity. 1.4 Conduct surveys for filling data gaps on water use. 1.5 Identify potential options/interventions (tech-policies) for WUE. 1.6 Evaluation and adoption of technology. Develop and agree on performance indicators	• Review documents on policy, institutions, land tenure, and irrigation systems. • Previous and on-going projects reviewed and lesson learned from these projects identified • Natural and human resources data will be collected, entered into computer to establish the project database • Fully characterize rural households in the selected communities to allow analyzing farmers capabilities and constraints and enable understanding the potential adoption of the new options/intervention to increase WUE • Potential options • Performance indicators	• Review reports and documents • Collecting information via the following sources of information: • Secondary datanologies, institutions, and • Participatory rural appraisal (PRA) • Formal surveys • Computerized database.	
2.1 Recommendation of efficient water management models that may be applied under the current conditions of biophysical and socioeconomic baselines and data availability. 2.2 Detailed layout of improved irrigation management and schedule under current conditions, according to the models analysis. 2.3 Proper water production functions for the studied crops, suitable to local conditions. 2.4 Local development adoption options indicators of irrigation management.	• Recommended model for water management. • A set of management plans and schedules. • A set of water production functions. • A set of irrigation adoption options • Expert system for water management	• Software • Documents and publications • Documents and publications • Documents and publications • Software	Assumption: Decision-makers are ready to take appropriate decisions.

2.5 Local expert systems representing the developed irrigation management scenarios.

3.1 Report on the gaps and constraints facing water productivity based on available information.
3.2 Selected sites for permanent and farmers' fields representing different types of soils, different irrigation systems and different cropping patterns.
3.3 Report on the gaps and constraints facing water productivity based on available information (from field trials).
3.4 Report on recommendations on how to deal with the negative impacts of the gaps and constraints facing water productivity?
3.5 Reports on evaluation of applying the recommendations and any amendment to them (almost yearly).
3.6 Sets of data required for modeling water productivity.
3.7 Final Report.

4.1 Report on reviewed laws, regulations rules, ...etc.
4.2 Analysis of reviewed articles
4.3 Major advantages and limitations in the reviewed material and lessons to be learned
4.4 Report on the comparison between local, regional and international policies and institutional setups
4.5 Report on the proposed measures needed to improve local policies and reform of institutions
4.6 Minimum modifications which bring about maximum impact will be introduced
4.7 Financial, environmental and socioeconomic implications of the suggested modifications will be analyzed and discussed
4.8 Report on the technical, economic, financial,

Technical measures:
water conservation, cropping pattern, planting and harvesting dates, mechanization, land fragmentation, irrigation improvement project, use of pressurized systems, etc.
Economic and financial measures:
subsidies, taxes, pricing, tariffs, cost sharing, cost recovery, etc.
Administrative measures:
Licenses, regulations, laws, capacity building, participation, role of young and women, ...etc.

Legal measures:
Water laws, water rights, incentives and penalty

administrative and legal impacts of water valuation and the application of demand driven approach 4.9 Report on a time based framework for future development with respect to the introduction of water valuation and demand management 4.10 Report on the impact of proposed policies on different sectors 4.11 Report on the actions to be taken to mitigate the expected negative reactions	systems, etc **Operational and political measures:** Political will, public awareness, level of education, democratic level, etc		
5.1 Guidelines for improving water productivity in the irrigated areas. 5.2 Packages for best technologies suitable for irrigated areas. 5.3 Improved policies and institutional setups.	• Recommended water management Packages. • A set of irrigation adoption options • guidelines for policy and institutional frame work for improved water management	• Documents and publications • Software	Decision-makers are ready to take appropri-ate decisions.
Activities			
1.1 Review existing information and details of the ongoing research and development related to the following: 1.2 Biophysical aspects: soil, water, productivity, cropping patterns, water use, irrigation practices, technology use 1.3 Socioeconomic aspects: Sources of livelihoods and income (on-farm by type of crop, off-farm by type of activity, resources, natural, human, social, financial and physical capital assets). 1.4 Collecting information about the previous studies which covered WUE or water productivity 1.5 Identify potential options for WUE 1.6 Conduct PRA and annual formal surveys to evaluate the new interventions.			
2.1 Selecting the proper simulation models that will be used to assess WUE 2.2 Assessing the impact of deficit irrigation using			

different water qualities and environmental conditions.
2.3 Assessing the impact of different irrigation management on production function of some crops.
2.4 Identifying the data required to develop technology adoption options.
2.5 Calibrating the studied models, develop scenarios, and conducting the final analysis and impact assessment

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3.1 Review of available information related to water productivity.
3.2 Selecting the project sites (permanent and farmers' fields).
3.3 Sites to cover different types of soils, irrigation systems, different cropping patterns as well as important vegetable and orchards.
3.4 Establishing field trials in which the data and information needed for modeling can be easily secured, measured and collected.
3.5 Implementing field activities.
3.6 Collecting data and information regarding factors related to water productivity.
3.7 Establishing field trials in which recommendations to improve water productivity are applied.
3.8 Analyses of the collected data and reports to be produced.
3.9 Links to be established between permanent project sites and neighboring farmers' fields as wide as possible.
3.10 All activities to be carried out in close cooperation and in interdisciplinary manner with other activities

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4.1 Assessment of the advantages and limitations which might reduce possibilities of negative impacts and increase positive opportunities

4.2 Come up with concrete proposal on the steps to be taken towards the improvement of the policies and institutional reform

4.3 produce a timely organized framework that enables to introduce new criteria for water in irrigation use based upon the principles of "user pays" and polluter pays" and convert from supply driven to demand management approach

4.4 produce a plan of actions to be taken if any adverse results are encountered

Annex 8: Monitoring and Evaluation Matrix for IBP

Performance Questions	Indicators & other Info/ Data requirements	Baseline info requirements	Data gathering methods; frequency & responsibility	Resources required	Information use, analysis, reporting & feedback
• To what extent has the project contributed to implement suitable irrigation systems and methods to maximize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems? Why? Why not? • To what extent has the farmers adopt and implement the proposed irrigation practices? Why? Why not? • Did the farmers get higher water and yield productivities? Why? Why not?	• A set of improved technologies, methodologies, and recommendations for optimizing water productivity in irrigated systems, including water management, alternative crops, use of different water resources, and policy and institutional options.	• Review type and levels of applied technologies related to: • Past experience of the work in the irrigated old land will be assessed, lesson learned, will be identified and utilized in project implementation • Establish a baseline for the selected communities to be used in monitoring and evaluating the project. • Identify potential options/interventions for WUE. • Develop performance indicators • Water productivity in irrigation system • Water management practices • Alternative crops • Use of different water resources, • Policy and institutional options.	• Documents and publications • Baseline Surveys • Household surveys • PRA • Workshops and field days	• External expertise to assist with baseline surveys & household surveys • Questionnaires/ survey formats for baseline & household surveys • focus-group meetings Coordinator to discuss changes that specific social groups have experienced.	• Quantitative and qualitative analysis of baseline & household surveys; • Reflection during annual review and planning meetings with key stakeholders

• Did the project establish a management package for optimized irrigation in the proper time? Why? Why not?	• Use simulation models to assess the impact of deficit irrigation on environment, when using different water quality. • Establish production functions for water utilization by different crops. • Model application, calibration and scenario development, final analysis and impact assessment	• Review existing models and process the data from NRM and other research components using available simulation models (DSSAT, APSIM, CropSyst, etc.) and experience (crop-water productivity and management, crop simulation models, economic models). • Develop technology adoption indicators. • Identification of data requirements for both socioeconomic and biophysical activities.	• Mid-term report • Review documents • Database including soil and water analysis • Surveys	• External expertise to conducting the Mid-term report • Focus groups with stakeholders to discuss reviewed documents	• Quantitative and qualitative analysis of the mid-term report • Taking samples for calibration and evaluation
Did the project establish field trials at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management? Why? Why not?	• Number of established onfarm trials for improved cropping pattern related to field crops using different irrigation systems • Number of conducted on farm trials using improved organic package for maximizing water productivity (fertilizer treatments in balance of fertilization in proper time and fertilizer sources and levels, fermented organic appli-	• Types and magnitude of application of irrigation systems in the selected areas. • Level of organic fertilizers applied in the selected areas • Varieties used in the selected areas • Level of water productivity in the selected areas • Effect of over irrigation water amount on soil salinization and sodification.	• Document and publications • PMU reports • Workshops and field days	• Technical experts to evaluate the organic package for maximizing water technology. • Technical experts to evaluate the different varieties used by the farmers. • Technical	• Qualitative and quantitative analysis

	cation) • Number of proper varieties with proper cultural practices introduced and implemented. • Level of increase in water productivity through land preparation, land leveling, size of water stream and plot size under diffesrent soil types and irrigation systems. • Soil amendment application in relation to - physical and chemical soil properties (gypsum, sulfur, compost and fermented organic manure). • Potential water saving through proper irrigation, soil conservation, agronomic practices, pest and disease control (IPM).	• Types of soils amendment applications in the selected areas		experts to evaluate the soil amendment applications	
Had the literature of the existing policies and institutional setups in the field of irrigated agriculture within the network and worldwide been collected and the lessons learned? Why? Why not?	• Review current policies with respect to water allocation, cropping patterns, water valuation and fees, subsidies etc and identify policy constraints to improved water productivity. • Review current institu-	• The current policies related to irrigation water and cropping patterns • The current institutional setup related to irrigation water.	• Review documents • Computerized Database • Electronic and hard copies	• External experts	• Qualitative analysis

	tional setup at the farmer's community, the canal, the irrigation scheme etc. and identify the constraints to improved management of water. • Develop water valuation and demand management alternatives and options. Use market and non-market valuation techniques for water resources and assess its impact on rationing the use of scarce water. • Assessing the potential impacts and consequences of alternative policies on WUE, environmental impact, food security and social impact.			
Did each of the previous activities produces an outcome of clear recommendation, package or policies related to improving water productivity? Why? Or why not?	• The results from various technical and socio-economic research activities and develop general guidelines for improving water productivity in the irrigated areas were analyzed. • Best technologies and the formulation of water productive packages	• Collect technical and socioeconomic research activities and develop general guidelines for improving water productivity in the irrigated areas	• Document and publications • PMU	• Qualitative and quantitative analysis

	that proved suitable for irrigated agriculture based on farmers' response to these technologies were selected and refined. • Improved policies and institutional setups that would if implemented help improving water management and productivity.

Annex 9: The Irrigation Benchmark Project Impact Pathway

Project	The Irrigation Benchmark Project			
Goal	Widespread integration and adoption by farmers in the irrigated agriculture, of suitable irrigation systems and methods to maxi mize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems.			
Objective	Widespread integration and adoption by farmers in the irrigated agriculture, of suitable irrigation systems and methods to maxi mize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems.			
Output Targets	**Output**	**Intended users**	**Outcomes**	**Impact**
OUTPUT 1	*Farm surveys and analyses to assess the actual water productivity (WP) for multi-cropping systems and to determine the source of inefficiency in water use in target areas.*			
Output targets 2004	• Inventory studies • Full characterization of sites and associated problems. • Review of available information on WUE. • Evaluation, monitoring and assessment of the adoption and impact of potential options/interventions	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• Documents and reports that identify and prioritize, with respect to water resource, the constraints to optimum utilization and the threats to sustainable production are prepared • Indicators on WP & WUE are identified. • Report on effectiveness on existing policies on allocation and efficient use of water resources is prepared. • Fully characterize rural households in the selected communities and the conditions under which people live and farm was identified. • A baseline information and database to the selected communities to be used in formulating the strategy and approaches of the project regarding these communities, monitoring and evaluating project performance is established • On-farm WUE quantified and contribu-	• What are the lessons learned from the project that could be useful to the implementation of the Benchmark project, • Are the links between community members and project team to ensure community participation to the project activities strengthened?

			ting factors identified • Technology adoption quantified and constraints of adoption documented • WUE at various levels and different cropping patterns was identified. • Problems and constraints that are facing WUE in the selected area and gaps in information that need to be bridged by the project activities were identification and described • Potential options/interventions (technologies, institutions, and policies) for WUE (economic, social, technical, and environmental) are identified. • The influence of the introduced technologies, options on crop yields water productivity costs and benefits in the selected communities are investigated • The economic, environmental and social impacts of introduced options are assessed	
Output targets 2007	• Evaluation, monitoring and assessment of the adoption and impact of Potential Op-tions/interventions	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• Adoption studies to monitor the diffusion of the new interventions and identify constraints of adoption are conducted.	• To what extent has the project contributed to implement suitable irrigation systems and methods to maximize irrigation water productivity in more productive and sustainable irrigated agricultural cropping systems? • To what extent do the farmers adopt and implement the proposed irrigation practices? • Did the farmers get higher water and yield productivities?
OUTPUT 2	• Model simulations will be			

	carried out to assess WUE and environmental effects of different potential technologies in the different production systems under consideration.			
Output targets 2004	• select the proper simulation models that will be used for monitoring and assessing the impact of project activities on production and environment, and identify the data sets needed to run the selected ones • Assess the impact of deficit irrigation under different water qualities and environmental conditions. • Assess the impact of irrigation management on crop-water productivity. • Assess the impact of different irrigation management on production function of some crops. • Evaluating developed irrigation expert systems combined with crop simulation models, • Training on how to develop new irrigation systems	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• Recommendation of efficient water management models that may be applied under the current conditions of biophysical and socioeconomic base lines and data availability. • Detailed layout of improved irrigation management and schedule under current conditions is designed. • Proper water production functions for the studied crops, suitable to local conditions that can be used to predict crop and water productivity under varying conditions • Local expert systems representing the developed irrigation management scenarios are designed and implemented	• Did The researchers select proper simulation models that will be used for monitoring and assessing the impact of project activities on production and environment, and identify the data sets needed to run the selected ones? • Did the team conduct the assessment of deficit irrigation? What are the lessons learned? - To what extent did irrigation management on crop-water productivity was enhanced? • What are the outcomes of the training sessions?
Output targets 2005	• Assess the impact of deficit irrigation under different water qualities and environmental conditions. • Assess the impact of irrigation	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National	• Quantitative models to simulate the impact of water management options on crop and water productivity are implemented. • Assess the impact of different irrigation	• Did the team conduct the assessment of deficit irrigation? What aare the lessons learned? - To what extent did irrigation management on crop-water

	management on crop-water productivity. • Assess the impact of different irrigation management on production function of some crops. • Quantify the status and intensity of technology adoption and identify major constraints affecting the adoption process. • Evaluating developed irrigation expert systems combined with crop simulation models, • Training on how to develop new irrigation systems	Development Agencies	management on production function of some crops. • The following outcomes will be achieved: • Relative increase in crop yield per unit water or land. • Relative increase in the net economic return of farmers. • Changes in salinity and sodicity levels of soil. • Change in the level of groundwater/ water table. • Change in the livelihood of the community using current livelihood indicators. • Local expert systems representing the developed irrigation management scenarios are designed and implemented	productivity was enhanced? • What are the outcomes of the training sessions?
Output targets 2006	• Assess the impact of deficit irrigation under different water qualities and environmental conditions. • Assess the impact of irrigation management on crop-water productivity. • Quantify the status and intensity of technology adoption and identify major constraints affecting the adoption process. • Evaluating developed irrigation expert systems combined with crop simulation models, • Training on how to develop new irrigation systems	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• Quantitative models to simulate the impact of water management options on crop and water productivity are implemented. • The following outcomes will be achieved: • Relative increase in crop yield per unit water or land. • Relative increase in the net economic return of farmers. • Changes in salinity and sodicity levels of soil. • Change in the level of groundwater/ water table. • Change in the livelihood of the community using current livelihood indicators. • Local expert systems representing the developed irrigation management scenarios are designed and implemented	• Did the team conduct the assessment of deficit irrigation? What are the lessons learned? - To what extent did irrigation management on crop-water productivity enhanced? • What are the outcomes of the training sessions?

Output targets 2007	• Assess the impact of deficit irrigation under different water qualities and environmental conditions. • Assess the impact of irrigation management on crop-water productivity. • Evaluating developed irrigation expert systems combined with crop simulation models, •Training on how to develop new irrigation systems	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• field trials to evaluate the selected models under study (evaluation field trials) are conducted • Local expert systems representing the developed irrigation management scenarios are designed and implemented	• Did the team conduct the assessment of deficit irrigation? What are the lessons learned? - To what extent did irrigation management on crop-water productivity enhanced? • What are the outcomes of the training sessions?
OUTPUT 3	• Field trails at selected locations and farmers' fields to generate data required for modeling water productivity (WP) and sustainability and fill the gaps in the available information necessary for improving water management.			
Output targets 2004	• Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information necessary for improving water management.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers	• Recommended irrigation practices and management options to maximize on-farm water productivity with minimized environmental impacts.	• Is the data collected through field trials adequate to build the water productivity model?
Output targets 2005	• Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information ne-	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers	• Sets of data required for filling gaps in modeling water productivity is collected and analyzed. • Is the data collected through field trials adequate to build the water productivity model?	

	cessary for improving water management.			
Output targets 2006	• Establish field trials at farmers' fields and research stations to generate data required for modeling water productivity (WP) and sustainability to fill the gaps in the available information necessary for improving water management.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers	• Technological packages in form of printouts to be used as extension tools are designed.	• Is the data collected through field trials adequate to build the water productivity model?
OUTPUT 4	• *Conduct analysis of the existing policies and institutional setups regarding improving water productivity (WP) and develop recommendations for improvement.*			
Output targets 2004	• Review the existing water policies and setups locally, regionally and worldwide and to come up with the best model that suits the local conditions.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers,	• Updated review of current policies and institutional setups.	• Had the literature of the existing policies and institutional setups in the field of irrigated agriculture within the network and worldwide been collected and the lessons learned?
Output targets 2005	• Develop water valuation and the assessment of demand management alternatives and options.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, and National Development Agencies	• Proposed alternative policies and institutions from within the network and outside. • Water valuation and demand management alternatives and options	• To what extent water demand management alternatives and options succeeded.
Output targets 2006	• The assessment of the consequences of alternative policies is carried out.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers,	• Assessment of potential impacts and consequences of alternative policies and institutional setups.	• Pros and cons of the current policies are identified and corrective recommendations were proposed.

OUTPUT 5	• Develop guidelines, packages, technologies, policies and recommendations for improving water productivity (WP) in irrigated areas.			
Output targets 2007	• Assure that each of the previous activities produces an outcome of clear recommen dation, package or policies related to improving water productivity.	• ARC, MALR, NWRC, MWRI, DRC, NRC, ASU researchers, National Development Agencies and steering committee.	• Guidelines for improving water productivity in the irrigated areas are designed. • Packages for best technologies suitable for irrigated areas are prepared. • Improved policies and institutional setups are designed.	• Are all the outcomes achieved? What are the lessons learned?

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