Comprehensive Assessment of Water Management in Agriculture

Framework for theComprehensive Assessment of Water Management in Agriculture

Prepared by IWMI on behalf of The CGIAR/Future Harvest Centers and FAO

Overview

Why an Assessment on Water in Agriculture?

Overview

The Comprehensive Assessment of Water Management in Agriculture (CA) is an international research, capacity-building and knowledge-sharing program focused on providing solutions that will reduce poverty in developing countries. It will create a sound factual basis on water use in agriculture that will improve the quality and effectiveness of rural-development strategies and investments.

Through its 5-year program (2002-2006), the Assessment will generate a wealth of useful data, practical knowledge and a synthesis of experiences, and a number of water management and planning tools. These products are designed to help water users, development organizations, governments and research organizations make the best possible investments in water for rural agricultural development. The overall goal is to help countries better manage water to improve the livelihoods of the rural poor.

Why a New Research Program on Water in Agriculture?

A wealth of practical experience exists on topics such as water resources management, river basin management, irrigation and food security, cultivation in wetland ecosystems, small-scale irrigation and a host of related topics.

Despite this, development planners, professionals in agriculture and policy makers do not have a clear perspective on which water development interventions of the past have worked best, and why. Or of what investments in water development for agriculture are the best, or worst, choices in given situations. *What are the best practices and approaches for bringing water to poor people for food production, that meet the needs of all water users including nature, cities and industry?*

Today, we do not know what the best options are. This is because no one has taken stock of this situation. The CA was created to fill this gap. It focuses on the expertise of the CGIAR's Future Harvest Centers, the FAO, international research centers, a large number of developing country partners (ranging from research, water and agricultural planning to development specialists) on the question of how water can be better managed in agriculture to the benefit of all water users.

The Groundwater Dilemma

What are the dangers and opportunities associated with groundwater use? How can the resource be developed sustainably—to benefit poor people?

A cubic meter of groundwater often creates several times more income than a cubic meter of water from large surface-irrigation systems. In many areas, the poverty-fighting potential of this resource is underutilized; in others, livelihoods, food security and supplies of drinking water are now threatened by its overuse.

The CA will draw on IWMI's experience in India, China and South Africa on groundwater governance and recharge technologies. It will refine tools to monitor unsustainable use and determine the current and potential contribution of groundwater to agriculture. Part of this work will be to explore groundwater management strategies for areas of high potential and areas where the resource is at risk.

To achieve these goals, the CA research teams will review and assess investments that have been made to develop water for food production over the past 50 years. They will also study the current investments in water development across developing countries.

Studies are planned at the field, village and irrigation, ecosystem and river basin levels within a regional and global context. Assessments will be made in some 100 locations in Africa and Asia, where people experience the problems and opportunities of water development everyday, then scaled up to give global and regional pictures.

Primary Products and Outputs of the CA

The primary product will be a thoroughly researched CA, which includes a number of new outputs and information on water management in agriculture. A number of products derived from this core of the Assessment will help stakeholders, implementers and policy makers craft better water futures.

- ***An assessment on water, agriculture, rural development and environment.*** The new body of published science resulting from this research will serve as a validation of a number of water uses in agriculture and an assessment of past activities, with suggestions for future approaches. This will take the form of peer-reviewed reports and journal articles, a set of books and a body of packaged, searchable data on water resources in agriculture.
- ***Water-management information and tools.*** These consist of a set of new analyses, information, maps and statistics on irrigated and rain-fed agriculture, cropping patters, impacts on ecosystems and groundwater use. Other tools include models and scenario-development tools that planners can use to support their rural development decisions. These will include decision-support concepts and models for doing assessments of present situations and future needs, including river basin scale water-resources assessment, low-cost remote-sensing tools for developing countries, or food-security planning tools that bring together water-food-diet and economic-trade data.
- ***Innovative water management solutions.*** The CA takes a serious look at promising approaches that may be the key to solving water problems for many poor people. The CA will analyze water management practices in villages in Africa, Latin America and Asia, understand which ones are successful, and why, and encourage their transfer and uptake.
- ***Capacity building program.*** This exercise will support people's capacity to do assessments and to apply new knowledge by supporting 30 Ph.D. and 30 M.Sc. students, doing hands-on work with a variety of partners in the assessments, engaging local communities to carry out assessments and providing scientific substance that will form the basis of training materials and guidelines.
- ***Knowledge sharing—Policy information and communication.*** A key part of the CA's program is policy and technical communication, which will package conclusions and

recommendations for action and present them to the potential user audiences. These will include briefings and guidelines for a variety of users including NGOs doing community development work as well as the international development community and governments making choices about future water development.

The Water-Agriculture-Environment research generated by the CA will be made available to all possible stakeholders through published materials, web and database resources, various types of information services and roundtable discussions and seminars aimed at encouraging interaction and knowledge sharing on the topics being investigated.

An international research initiative led by the CGIAR's Future Harvest Centers

The CA taps the considerable scientific weight of the CGIAR's Future Harvest agricultural research system and of a number of other key partners such as the Food and Agriculture Organization of the United Nations (FAO).

- Crop breeding (drought and salt-tolerant varieties)
- Soil nutrient management (sustaining fertility)
- Managing water for fisheries and livestock
- Technologies (low-cost drip irrigation and water harvesting)
- Irrigation and basin-level management for water savings
- Policies and institutions (pricing allocation, water user organizations, basin management), and water allocation
- Forest management for catchment protection and agro-forestry for income

A range of partners—universities, local research organizations and advanced scientific institutes—will join the team to bring local knowledge, and environmental, health and other agricultural expertise to this research program.

The CA will put in place a foundation of knowledge and information that will allow better-quality decisions on water investment, and better targeting of development funding to rural development, food security and environmental security goals.

1. Introduction

Problem Statement

The Green Revolution, based on modern, high-yielding plant varieties, requiring high inputs of fertilizer and water, has led to increases in world food production at a pace that has surpassed population growth. Food prices have declined markedly. Increased water use in irrigated agriculture has benefited many farmers and poor people.

But behind this success lies much unfinished business, especially in the water-food-environment arena. One of them is the problem of using water to help provide food security. Another is the problem of environmental degradation due to water and land use in agriculture.

In spite of these increases in agricultural production and lower food prices, the task of providing food security to all is incomplete. In 1997, a population of 790 million in developing countries faced food insecurity. Some 60 percent of these people live in South Asia and sub-Saharan Africa, many in areas with economic water scarcity where financial constraints restrict people's access to water. In sub-Saharan Africa, the population with food insecurity rose from 125 to 186 million between 1980 and 1997 (FAO 1999), much of this in regions of economic water scarcity (IWMI 2000) where financial, human or institutional resources constrain the development of water resources.

There are too many examples of dried-up and polluted rivers, of endangered aquatic species and of accumulation of agricultural chemicals in natural ecosystems. Rapidly growing cities, burgeoning industries and rising use of chemicals in agriculture have undermined the quality of many rivers, lakes, aquifers and natural ecosystems. Groundwater resources, a preferred source of agricultural and drinking water, are becoming polluted, or water tables are dropping to levels where access is uneconomical.

Never in the field of human history have we faced such severe water challenges—either to sustainably develop water in needy areas, or to find practical solutions when water use has stretched far beyond its sustainable limits. This is an area where we need more solutions, and even more innovation in how we look for those solutions. We are facing a global water crisis.

Constraining our ability to find solutions is a contentious debate around how to provide water for food and yet maintain environmental security. The World Water Vision, culminating at The Hague in 2000, produced "Vision for Water and Nature" and the "Vision for Water for Food and Rural Development." These two Visions show widely diverging views on the need to develop additional water resources for agriculture, how society should use water, and the benefits and costs that such development would have. One of the major reasons for the divergence is the lack of knowledge on past impacts, and the present situation of water use.

The debate can be focused on the question, *How much water do we really need for agriculture?* Related to this is the question, *How should water be managed for agriculture in the future?* These questions have several answers depending on the objectives of society. Yet even if we can clarify our desires, we cannot adequately answer the questions of what kind of and how much irrigation we need.

A major reason for this lack of foresight is that we do not know how much irrigation there is now, what the contribution of groundwater to food production is, the relation between water use and food security, and what the present use and future potential of rain-fed agriculture are. We do not know the potential of promising locally created water management solutions for producing food in areas of water stress or undernourishment. And we have not adequately employed information technologies to find sustainable solutions to these problems.

Dealing with Drought

What are the positive steps farmers and water managers can take to cope with drought conditions?

With global climate change and increasing water scarcity, drought mitigation will have an increasingly important role to play in ensuring food security and productive livelihoods in many parts of the world.

The CA will evaluate the potential of various strategies to reduce risk in drought-prone areas—including the use of drought-tolerant crops—many developed by CG centers, such as CIAT, CIMMYT and ICRISAT. It will look at a variety of practices for mitigating the ill effects of drought, especially through water-harvesting and conservation technologies and practices.

Agricultural water use holds a key to solving the water crisis, as it is the user of 80-90 percent of all available freshwater in developing countries. Improving the productivity of water in rain-fed and irrigated agriculture will leave more water for other users—including nature, communities and other farming uses. A pro-poor focus on water development and management can help provide access to water and food security. And improved management of agricultural water can meet multiple needs of ecosystems.

The first step towards creating a more equitable and effective use of water for food and nature in developing countries is to take stock of how water is managed for agriculture, and then look at its impacts on food and environmental security. To move forward we can combine knowledge of what has worked and what has failed, with information on promising, but less-conventional approaches. This combination of convention and local community-based approaches may hold the key to future water security. The assessment of the water situation will help us understand the key issues, gain a better understanding of approaches that are likely to succeed, and identify key gaps in knowledge.

The delivery of practical solutions and action derived from the research of the CA will be done through links with two closely related international initiatives. These are the *Dialogue on Water, Food and Environment, and the CGIAR Challenge Program on Water and Food* (see appendix A for details). The *Dialogue* provides for enhanced local stakeholder involvement, and provides a key delivery channel for results. The *Challenge Program* delivers the public-goods research, from drought-resistant plants to improved water policies, in response to the priorities identified by the Dialogue and CA, through to implementation in the field.

Why a research program of this scope and scale?

- The Water Crisis that exists in many countries today.
- Increased competition—more people are struggling to use the same drops of water.
- Degraded ecosystems, access to sufficient safe water, food security.
- More intense competition for scarce water resources between rural areas, cities and ecological uses.
- Poverty and the lack of food security remain a fact of life for millions, despite the huge investments in water and irrigation to encourage growth in food production.
- Agriculture takes more water than other sectors. The more the water is effectively managed for agriculture, the more the water that can be saved and returned to other users (nature, cities, etc.).
- We need to learn more from past successes and failures from our investments in water and food.
- We do not have sufficient information on how water is now being used in agriculture.
- There is a greatly divided vision on how water should be used for food security.

2. Research and Outreach Program of the CA

Scope of the CA

The overall scope of the CA is water management in agriculture, including fisheries, forestry and livestock, and the full spectrum of crop production from rain-fed cultivation through supplemental irrigation and water harvesting to full irrigation.

This research is being done from an integrated water resources management perspective. It considers the relationship of water management in agriculture with health, income, distribution of benefits and costs, poverty, production and the other multiple uses of water. Special attention will be given to the relationship between water management for agriculture and the environment. The CA will use a variety of scales of analyses, ranging from crops, to field and river-basin levels, to countries and regions, and the global scale. It will consider the past, present and future.

Goal and Purpose

The overarching goal of the CA is to:

- Support water investment decisions in agriculture to enhance food and environmental security and to contribute to alleviating poverty.

Contributing to this goal, the purpose of the CA is to:

- Strengthen the knowledge base on water-agriculture environment and promote its use in developing consensus on investment strategies.

See appendix C for the log frame.

Outputs

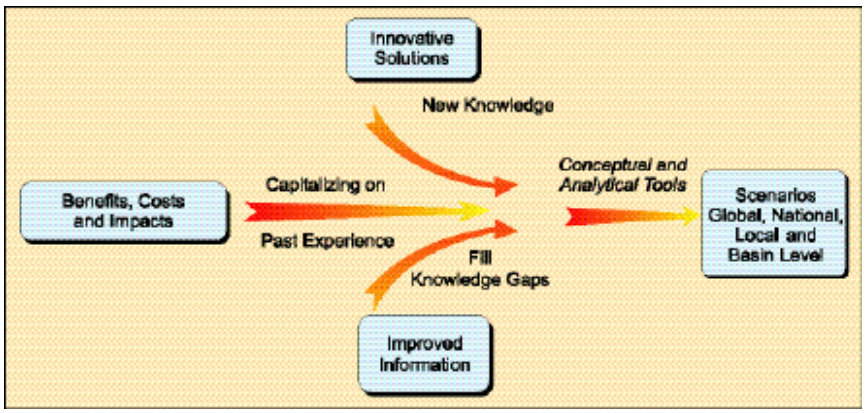
The CA will be focused upon acquiring, synthesizing and communicating contemporary knowledge on critical aspects of water management in agriculture. This approach will generate the following outputs, described in detail below:

1. A Comprehensive Assessment of Water Management in Agriculture.
2. New and improved conceptual and analytic tools.
3. Capacity built to undertake assessments.
4. Water-food-environment problems, challenges and solutions widely communicated.
5. A set of well targeted research themes in the field of water and food.

Output 1. A research-based assessment

The CA will take stock of the current status on how water is managed in agriculture (figure 1). It will consider past trends, to understand about how our actions have placed us on the present trajectory. It will analyze benefits, costs and impacts, in particular those related to livelihoods and environment, to understand what has worked, and what has failed. It will analyze innovative approaches, whether they be traditional systems applied on a broad scale, or newly created solutions to water problems. With this information, the CA will support activities that will help stakeholders to craft better water futures. Appendix B gives key research questions. The CA will produce 100 peer-reviewed articles and information products and a mutlivolume work entitled the *Comprehensive Assessment of Water Management in Agriculture*, which will form the core of the CA and will feed into the Dialogue's Knowledge Base.

Figure 1. The CA will consider past experiences, benefits, costs and impacts combined with promising traditional and new solutions and new information to develop scenarios at the global, national, basin and local level.



a. Assessment of the benefits, costs and impacts of water management in agriculture. In view of the controversy surrounding water use in agriculture this assessment will seek to provide a definitive review of the results of past efforts to design, develop and manage water for agriculture. This retrospective assessment will draw upon existing studies and the CA's additional targeted studies that consider the actual direct and indirect impacts of agricultural water use on production, health, poverty and environment at local, national and basin levels. Irrigation, as it is often at the center of the controversy, will receive due scrutiny.

b. Assessment of promising technologies and management approaches that can strengthen the contribution of water to food and environmental security. It is anticipated that the retrospective analyses carried out by the CA at different geographical scales will identify a suite of approaches—either based on culture, tradition or emerging technologies—that have proved to be particularly effective in resolving problems in water management in agriculture and strengthened food security. These will include policies, institutions, water allocation systems, agronomic and hydraulic technologies and management practices. Therefore, the CA will

analyze these approaches and assess their potential to help address the food and environmental security problems of the future.

c. Assessment of new information required, and filling of key information gaps, to address critical issues in water management for agriculture. The assessments described will identify gaps in existing information on water and land use in agriculture that constrain our ability to explore future scenarios with any accuracy. Many key gaps in information on irrigated area, land degradation, groundwater and rain-fed agriculture are known already, while new gaps will be identified through the retrospective studies, scenario analyses, and assessment of technologies and management approaches. While the CA will identify immediate priorities amongst these information requirements and commission studies to meet immediate needs, this analysis will also be used to set an agenda for longer term research to be carried out through the Challenge Program on Water and Food.

d. Assessment of scenarios and development of options for future use of water in agriculture. The retrospective synthesis of costs and benefits will provide an essential basis upon which to consider future investments in water in agriculture. However, this needs to be complemented by detailed consideration of specific scenarios for future water availability, use, agricultural production and related impacts. The CA will draw upon detailed analyses at local, river basin, national and global scales that will be commissioned and/or supported by the CA. To achieve this, the CA will help stakeholders explore different water development and management options for the future. This will be done at selected local, river basin and national levels and, finally, at the global level.

Output 2. New and improved conceptual and analytical tools developed or adapted and applied

In the course of developing the CA, the CA process will generate conceptual and analytical tools for use by stakeholders, water managers, planners and researchers to strengthen their water, food and environmental security strategies. These will include tools for assessment and development of future options applicable at local, basin and national scales.

Output 3. Capacity to carry out assessments

With rising stress on water resources, it will be increasingly important to more frequently assess water use to take stock and make adjustments for the future. The CA process will take a learning-by-doing approach to build capacity for water users, managers, policy makers and researchers. The CA will support 30 Ph.D. and 30 M.Sc. students who will develop and apply specific assessment analyses and techniques. In addition, 40 NARES will be actively involved in CA activities.

Output 4. Results communicated

To impact key decisions, it is imperative that CA results are widely known, discussed and internalized. This means involving stakeholders in the research through the Dialogue process. It means implementing a carefully orchestrated communications plan targeted to the general public, key policy makers and, broadly, to millions of water users and managers through a variety of channels.

Output 5. Contribution to the Global Dialogue and its knowledge base

Output 6. Research areas in the fields of water and food identified for the Challenge Program

Impact

Ultimately, the success of CA will be measured by its ability to bring sustainable improvements to poor people's health and livelihoods. The CA will impact development and management of water in agriculture—to reduce hunger and improve environments and health. It will lead to:

- Better investment and management decisions for water and agriculture that will improve poor people's livelihoods, whilst maintaining environmental integrity.
- Poverty reduction and greater sensitivity to the needs of the poor in designing and implementing practical solutions to water development and management.
- Reversal of trends of land, water and environmental degradation.

The CA contributes directly to impact where detailed assessments are being done by engaging stakeholders in the identification of key problems, and identifying the way forward to solve those problems whether it be the adoption of key policies, or investment in improved water management strategies. The CA will have a more diffused impact by changing the thinking about how water is, and should be, managed in agriculture. The major role of the CA is in providing and communicating knowledge about water management in agriculture that will solve the water crisis. The CA will carry forward its recommendations using its own outreach and communication strategies, plus linkages to the Dialogue, the Challenge Program and other initiatives.

Activities

1. State-of-the-Art Knowledge and Literature Reviews. Extensive reviews of published and gray literature will provide the state of the art across various topics. Reviews and analyses will provide insights into specific key knowledge gaps. Reviews include:

- Interaction between agricultural water management and other ecosystem services on topics such as irrigation and wetlands, biodiversity in rice, irrigation impacts on the capture-fisheries and irrigation-aquatic ecosystem interactions.
- Key water-food-environment issues for livestock and forestry.
- Water and land degradation.
- Green and blue-green water management (rain-fed, supplemental irrigation and water harvesting).
- Use of low-quality water—wastewater and saline and polluted water.
- Institutional reform, its impact and future perspectives.

2. Field Projects. These are undertaken by CA participating organizations that contribute information to the CA. They benefit from cooperation in the overall CA program, its shared methodology, interaction with external partners and the impact of coordinated dissemination of results. The CA will provide support to field projects so that information collected can be drawn upon in the production of the CA.

Case studies. Specific attention will be given to carrying out case studies at local, national and basin scales to assess impacts of agricultural water use, identify effective governance systems and management approaches, improve current data and explore future scenarios. Examples of the case studies that will be considered include the following:

- National, regional and basin analyses of past impacts, present status and future directions.
- Site-specific basin studies of agriculture-ecosystem interaction.
- Site-specific basin studies of crop-fisheries-livestock interaction.
- Site-specific studies of the health impacts of water management in agriculture.

Analysis of promising approaches. Specific cross-regional and multi-basin studies will be undertaken of approaches to water management that can enhance productivity, improve livelihoods, help the poor and marginalized women and men, and sustain the environment. The potential of these approaches at basin, national and global levels will be assessed under present and future conditions. Examples include the following:

- Pro-poor water management techniques.
- Water productivity and water savings for crops, livestock, forestry and fisheries.
- Approaches to reverse the trends of land and water degradation, including catchment management and salinity management.

Water for Food versus Water for Nature

How can water be managed to ensure food and environmental security? What are the environmental trade-offs associated with developing water for agriculture?

Water maintains natural ecosystems, which sustain biodiversity and bring value to people in the form of goods and services derived from activities in these ecosystems. Irrigation upstream can reduce the flows of freshwater needed to sustain these natural resource areas. Building dams affects the ecology of rivers. The flow of irrigation drainage into wetlands changes water quality and water levels—creating a negative or sometimes positive impact on plant and animal life.

The CA will focus on determining the environmental costs of irrigation development, complementing work by IWMI on assessing the impact of irrigation development on biodiversity and work by ICRAF and the World Fish Center on managing water for crops and valuable ecosystems. It will test methods for determining how much water is needed for wetlands and other natural ecosystems, and will look at water management options, such as environmental flows, that can help preserve these areas. The goal is to find ways of managing water resources to meet the needs of irrigation, local communities and the important ecosystems.

- Policy and institutions, including water rights and laws, and water management organizations.
- Comanagement of water for agriculture and ecosystem services.
- Soil and nutrient management.
- Genetics, genomics, and crop breeding.
- Use of low-quality water in agriculture.

The final product of the CA will include a series of research reports or data products presenting the information and analysis under each heading.

3. Specific Studies to Fill Global and Regional Information Gaps. It is widely recognized that there are major gaps in knowledge that prevent effective planning for future use of water in agriculture. Therefore, a number of specific studies will be undertaken to help fill these. Examples of the studies that will be pursued include the following:

- Quantifying future supply and demand for water in agriculture.
- Developing a map and statistics of global irrigated area.
- Quantifying the contribution of groundwater to agriculture.
- Quantifying the present and future potential of rain-fed agriculture.
- Quantifying the value and water requirements of freshwater-capture fisheries.
- Identifying the potential constraints to productivity and food security due to land degradation.

4. Analytical Tool Development and Application. In the process of carrying out the CA, a variety of tools will be employed including tools for the following:

- Participatory assessment.
- Gender analysis.
- Impacts on poverty, livelihoods and food security.
- Assessment of water for crops, environment, livestock, forestry and fisheries.
- Basin water allocation strategies.
- Water for food and environment scenarios.
- Global and national supply and demand analysis.

Emphasis will be given to adapting and applying existing tools. In cases where these do not exist, or significant gains are to be made, such as with global and national water supply and demand modeling, the CA will support analytic tool development.

5. Research Reporting. At the heart of the CA is credible, science-based knowledge. It is essential that these core pieces are carefully prepared and critically reviewed. The CA will utilize a variety of channels for research reporting:

Productivity of Water

What are the options for improving the productivity of water in agro-ecosystems? To what extent can improving productivity free up water for cities, industries and the environment?

Producing more crops, livestock, fish and forest products per unit of agricultural water use holds a key to both food and environmental security. There are a variety of options for improving the productivity of water in agriculture, e.g., through breeding, better management practices, and supporting policies and institutions.

Leveraging the expertise of all the partners, the CA will identify options for enhancing water productivity in agriculture, assessing their potential and determining the consequences of their adoption.

CA reports. The CA supports a special peer-reviewed research-report series that highlight results of collaborative research efforts, reviews relevant to the CA and works that cut across a variety of themes.

Research reports. Researchers are encouraged to publish results based on CA studies in peer-reviewed journals and in the research report series of their own institute or organization. The CA will target special issues of journals to present findings.

Data products. In filling knowledge gaps, key data and information products will be generated and produced. These will also be well documented and reviewed, then placed on CD or the Internet for broad access.

Reporting at workshops, seminars and major events. To gain input into designing research, feedback on assessments and for presentation of results, CA researchers will participate in a variety of events where results will be presented. Important are the many basin- and national-level dialogues, as well as international events such as the World Summit on Sustainable Development and World Water Forums.

Creation of the CA of water management in agriculture. The final results of the CA will be presented in a multivolume work. This will contain *technical analyses volumes* of key water development and management issues, such as basin-water management, increasing water productivity in agriculture, water and fisheries, and pro-poor water management. It will include *global syntheses* volumes that will pull together state-of-the-art understanding in the field of water management for agriculture on a) impacts of managing water in agriculture, b) promising approaches, c) future scenarios and options, and d) information gaps and needs. The CA volumes will serve as a reference for several other educational and communicational products described below.

6. Formal Training. The CA encourages M.Sc. and Ph.D. students to carry out the assessments at various locations. Students will be engaged in field assessment, literature reviews, synthesis of results, and development and application of tools.

Wastewater Reuse for Agriculture

What is the contribution of wastewater irrigation to livelihoods? How can the environmental and health risks associated with this practice be reduced?

In rural and peri-urban areas of most developing countries, the use of sewage and wastewater for irrigation is a common practice. Wastewater is often the only source of water for irrigation in these areas. Even in areas where other water sources exist, small farmers often prefer wastewater because its high nutrient content reduces or even eliminates the need for expensive chemical fertilizers. Concerns for human health and the environment are the most important constraints in the reuse of wastewater.

The aim of the CA is to build on studies by CIP, ICARDA and IWMI on the costs and benefits of wastewater irrigation. It will assess the current extent and the potential for reuse of wastewater for agriculture, and evaluate associated environmental impacts. The result will be guidelines for improved management of wastewater in agriculture.

7. Communication and Knowledge-Sharing Tools to Drive Impact and Build Capacity. Communication, knowledge sharing and dissemination are key components of the CA research program. These activities will act at several levels to ensure that the research material is published, summarized and packaged for all key target audiences and user groups. These include organizations active at the field level in projects, NGOs and donors who design and implement projects, policy makers and decision makers, university students studying water resources and the international and national research communities.

Examples of the communicational activities and products being considered are the following:

- Short policy briefings explaining issues and solutions to senior advisors in development and government organizations.
- Technical summaries and training materials on water management interventions for use by government departments, NGOs, local universities and others implementing water projects in the field.
- Special websites and web-deliverable data, that are organized for easy access and rapid searching.
- University-level educational materials for water–resources curricula.
- Stimulation and creation of professional communities (communities of practice) to encourage interaction on the topics and findings of the CA.
- Seminars and roundtables for policy and operational people to stimulate discussions on the findings and recommendations of the CA.

An important component of the communications approach is to ensure that the CA's outputs are available to all users, whether or not they have Internet access. The bulk of the outputs will be centered on electronic publishing, but products will be distributed on CD and on paper, as CA users and customers require.

8. Participation in the Dialogue on Water, Food and Environment. The CA contributes to the Knowledge Base on Water, Food and Environment (see appendix A). As such, work in the CA will respond to the needs of the Dialogue to provide demand-driven information and be responsive to stakeholders well beyond the research community. Participation in the Dialogue's Knowledge Base provides other important linkages for the CGIAR including linkages with important initiatives, research programs and professional organizations. Dialogues on Water, Food and Environment will be held where there is stakeholder interest in various countries and basins. CA partners, possessing a variety of skills in water, food and environment, will provide demand-driven research support to the dialogues in areas of assessing past use, current information and future needs. The Dialogue will then shape CA research and provide an important avenue for the uptake of results.

The Local Action component of the Dialogue provides a platform for various actors engaged in implementing water management solutions. The CA will interact closely with this platform to identify and analyze promising solutions based on the experience of local action participants.

9. Interaction with the Challenge Program on Water and Food. The CA is linked to the Challenge Program as a means to assess priority research and outreach areas for the Challenge Program. The CA will prepare special reports to the Challenge Program outlining future research needs, and suggestions on action research to support implementation of promising solutions. The CA, in turn, will provide a window for the Challenge Program to the Dialogue.

10. Managing the CA Process. As the CA relies on a number of partners and activities, communication and coordination amongst partners are essential. The CA is governed by a Steering Committee, which sets the main ground rules (described in section 3 below). The CA will support a secretariat to facilitate information sharing between partners, website development and maintenance, preparation of key workshops, orchestration of proposal calls, evaluation and awarding, and preparation of progress reports.

Fisheries and Aquatic Ecosystems

How can water be managed to sustain and enhance capture-fisheries and aquaculture systems?

Development of water, in particular for crop agriculture and cities, has negatively impacted fisheries and aquatic ecosystems, in many cases adversely affecting livelihoods and food security. On the other hand, there are many opportunities to manage water to benefit both crop production and fisheries.

The CA will build on the significant body of research done by the World Fish Center to determine the role of fisheries and aquaculture in providing food security and supporting livelihoods; refine methods to determine water requirements in terms of quality, quantity, and timing needed to sustain fisheries and ecosystems; and assess various approaches to managing fisheries and aquaculture in light of the multiple uses of basin-water resources.

Timing and Key Milestones

The CA will take place over a 5-year period. The first key milestones are the 3rd World Water Forum and the start-up of the Challenge Program (table 1). At this point, most of the major review works and initial analyses will have been completed giving input into the Challenge Program's research program. Initial results of reviews, analyses and syntheses will be presented at the 3rd World Water Forum. Analyses and syntheses of field studies will be completed well before the 4th World Water forum, contributing to the final summary report. CA field activities will continue up to the end of the program to follow up on key findings, and to continue to provide assessment work for the Challenge Program.

Table 1. Timeline.

	2001			2002			2003			2004			2005			2006		
Milestones																		
Water Week Kickoff																		
Initial Assessment																		
3rd World Water Forum																		
Analysis Documents Complete																		
Synthesis Documents Complete																		
Assessment Summary Document																		
4th World Water Forum																		
Activities																		
Reviews																		
Field Studies																		
Analyses																		
Syntheses																		
Follow-up Assessments																		

3. Implementation Modalities and Governance

Participation in the CA

To reach its targeted goals, objectives and output, the CA requires a well-coordinated team of participating organizations. The overall strategy is to ensure that projects and activities contribute to the overall framework, and to avoid a fragmented set of activities. This will be the role of the CA Steering Committee. Smaller groups will manage individual projects. Participant organizations will be drawn from CGIAR Centers, universities, NARES, IARCs, NGOs, and other research institutes.

Governance of the CA

The CA is governed by a Steering Committee composed of senior researchers from CG Centers, NARES and ARIs.[1] Each participant organization has a main contact person for the CA. More contact persons or members of the Steering Committee will be added as the CA progresses.

The Steering Committee's primary functions are:

- To develop and promote a coherent methodological approach to the CA's research program.
- To identify areas of research for the CA.
- To monitor work, provide quality control, and define and oversee a scientific review process.
- To take responsibility for ensuring that the results of the CA are synthesized and disseminated effectively.

- To allocate funds provided by CGIAR donors to the CA (SWIM 2 funds as described below).
- To play an advocacy and outreach role for the CA.

Responsibilities for carrying out these functions will be divided between the CA Chair, the CA Secretariat and the Steering Committee Members (table 1). The CA Chair and Secretariat will take a lead role in developing concepts and procedures for these functions, taking into consideration ideas and parameters from the Steering Committee. This Committee will review, provide comments, agree and then promote these functions, will be in frequent virtual contact and will meet at least once a year.

1 The Steering Committee members as of June 2002 are David Molden (Chair), IWMI, Francis Gichuki (University of Nairobi), Theib Oweis (ICARDA), Johan Rockström (IHE), Patrick Dugan (ICLARM), SuhasWani (ICRISAT), Mark Rosegrant (IFPRI), Jean Marc Faures (FAO) and To Phuc Tuong (IRRI). Key contacts at the time of writing were: Viki Wide - CGIAR Gender and Diversity Program Peter Hobbs (CIMMYT), Jaqueline Ashby (CIAT), Andreas Oswald (WARDA), Brent Swallow (ICRAF), Roberto Quiroz (CIP), Rodomiro Ortiz (IITA), Coosje Hoogendorn (IPGRI), Michael Spillsbury (CIFOR), Don Peden (ILRI) and Annette Huber-Lee (SEI).

The main activities of the CA will either be funded by SWIM 2 funds channeled through IWMI, funded directly by donors to participating centers, or through ongoing projects that contribute the results of various activities. Types of projects, classified by funding are listed below (detailed procedures are found on the Comprehensive Assessment Website: http://www.cgiar.org/iwmi/assessment).

Directly funded projects are those that address priority areas of the CA, where participant organizations develop proposals, seek funding directly, and manage the projects. The CA will endorse these projects provided that they address priority CA issues.

SWIM 2 projects will be employed to fill in priority areas as identified by the CA Steering Committee. Funding will be actively sought for these CGIAR Systemwide (SWIM 2) activities to fill priority areas of the CA. The CA Steering Committee will develop a mechanism to decide on projects to be funded, and provide oversight of these projects. The funding mechanism will be competitive and include an independent review, a selection procedure and a quality control.

Contributed projects are those where results are contributed by participating partners to the CA. They benefit from cooperation in the overall CA program, its shared objectives, methodology,

Rain-fed Agriculture

What is the potential contribution of rain-fed agriculture to meet the world's food needs? How can productivity of rain-fed agriculture be increased?

Rain-fed agriculture contributes about 90 percent of the total cereal production in sub-Saharan Africa, Central Asia, Eastern Europe and Australia. Increasing productivity of rain-fed areas could increase food security, improve livelihoods of the poor, and lessen the need for more irrigation.

Building on the work of ICRISAT, ICARDA, FAO, IFPRI and others, the CA will explore the potential contribution of rain-fed agriculture to food and environmental security. The CA will draw on the expertise of multiple centers to assess promising approaches to sustainable improvements in rain-fed productivity—including soil-water conservation, supplemental irrigation and water harvesting, and selection and breeding of crops suited to rain-fed agriculture.

Table1. Responsibilities for overseeing different functions within the CA.

Function	SC	SC Chair	Secretariat	Ad-hoc Groups
Assessment design/ Methodology	Agree promote, and provide design parameters	Submit concepts	Develop with Chair	Develop component elements
Identify research areas	Agree, and provide initial ideas	Submit initial proposal to SC		
Fund allocation	Agree on guidelines and allocation	Submit proposal and guidelines to SC	Develop guidelines, collate proposal	Review panel for scientific review
M&E/Quality control	Review progress report	Ensure progress report is prepared	Prepare progress report	
Synthesis/Analysis/ Dissemination	Agree and oversee	Ensure process is managed	Manage process	Working groups for synthesis
Advocacy and outreach	Promote, articulate, link to CP and Dialogue		Oversee communications, dissemination	

interaction with external partners and the impact of coordinated dissemination of results. Participant organizations will be encouraged to adhere to the degree possible with the framework and methodological guidelines developed through the CA.

The Chair of the Steering Committee will be responsible for keeping a Project Portfolio, which will consist of:

- Ongoing, directly funded, SWIM 2, and contributed projects.
- Concept notes for projects required for the CA.
- Proposals for those concept notes requiring funding.

The Steering Committee will accept concept notes, and take the following actions regarding funding of the projects:

- The Committee will play an initial filter role, advising whether the project fits the research agenda of the CA, recommending the applicant to seek independent funding (through the *directly funded* project mechanism), or recommending that the project seek SWIM 2 funding.
- Those submitted for SWIM 2 funding will go through a competitive funding procedure and an independent review procedure.
- All projects that fit within the research agenda of the assessment will be designated as CA projects in order to assist in obtaining funding.

Land and Water Degradation

What are the effects of land and water degradation on farmers and other water users in a catchment? What are the options for addressing problems such as erosion, salinization of water and farmland, desertification and water pollution?

Degradation of land and water resources decreases agricultural productivity and threatens livelihoods and the health of people across the developing world—with poor people bearing the brunt of the impacts.

The CA research will assess the impact of land and water degradation on water productivity and food security. Drawing on research by ICARDA, CIAT, ICRAF, ILRI and other Centers, it will identify and assess promising practices to reverse the process of degradation. It will also examine options for reducing the impact of degradation on agricultural production, such as work by IRRI and WARDA on salt-tolerant varieties of rice.

The Steering Committee will be responsible for developing and overseeing a review procedure for its primary research output. The principle of the review mechanism is that material may be accepted if it represents sound science, even though all parties may not agree with the statement. Areas of consensus and disagreement will be identified, the latter suggesting the need for further research. A summary of key findings of the CA will receive line-by-line review by a panel of disciplines to ensure that it represents statements that are broadly accepted. Where agreement cannot be found, the document will outline key points of controversy and missing information.

4. Budget

Budget

The overall CA program is envisaged as a US$25 million effort (table 2) over 5 years (starting 2002, ending in 2006) consisting of SWIM 2 projects in the amount of 3 million, directly funded projects in the amount of 12 million and contributions in the amount of 10 million (the value is likely to be more than this).[2]

An indicative budget showing the scale and intensity of activities over time is shown below. Each project will have its own detailed budget.

Table 2. Indicative budget, by activity of the CA in million US dollars.

Activities	2002	2003	2004	2005	2006	Total
Field Projects						
a. Case Studies	0.5	1.5	1.5	1.5	1	6
b. Promising Approaches	0.5	0.75	0.75	0.75	0.25	3
2. Information Gaps	0.25	1.5	1	1	0.25	4
3. Reviews	0.3	0.5	0.2			1
4. Tool Development and Application	0.5	1	0.8	0.2		2.5
5. Training	0.2	0.2	0.2	0.2	0.2	1
6. Research Reporting		0.2	0.3	0.3	0.2	1
7. Communication	0.2	0.2	0.2	0.2	0.2	1
8. Participation in Dialogue	0.2	0.7	0.7	0.7	0.2	2.5
9. Linkage with Challenge Program		0.2	0.2	0.3	0.3	1
10. Managing the CA	0.4	0.4	0.4	0.4	0.4	2
Total	3.05	7.15	6.25	5.55	3	25

[2]As of June 2002, the Government of The Netherlands has provided a grant of US$7.5 million, 6.5 directly to IWMI and partners, and an additional 1 million in SWIM 2 funds. The Government of Switzerland has provided an additional $0.3 million for SWIM 2 funds. The remainder will be sought through proposals and partner contributions.

Appendix A: Descriptions of the Dialogue on Water, Food and Environment

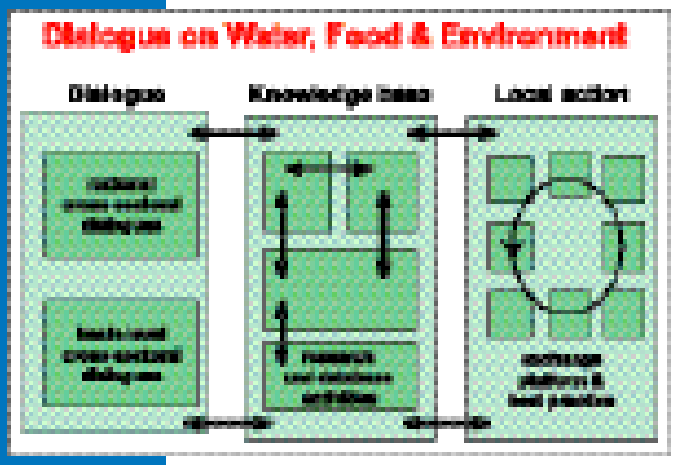
Dialogue on Water, Food and Environment

The Dialogue on Water, Food and Environment (*http://www.cgiar.org/iwmi/dialogue/Index.htm*), an initiative originating from the World Water Vision and Framework for Action process, aims to reduce the gaps between the agricultural and environmental communities on the use of water resources. The Dialogue is an outreach and policy-shaping initiative that builds on the knowledge created by the CA and a number of other research and knowledge-creation initiatives focusing on water, food security and the environment. Its goal is to translate knowledge into practical, workable actions that policy makers can take up to improve their water-food-nature strategies.

The Dialogue offers countries a neutral, truly cross-sectoral, and internationally supported mechanism to develop broad consensus on socially desirable strategies to develop and manage water resources for food security, livelihoods and environmental sustainability.

The three main components of the Dialogue are the dialogue process, knowledge base and its local action networking and outreach function (figure 2). The dialogue process, primarily at the local, basin and national levels, will be open, clear, transparent and inclusive. The knowledge base supports the dialogue process, establishing credible and authoritative knowledge focused on creating and implementing linkages and interactions between ongoing and new activities, which are managed and financed independently. The networking aspect mobilizes and taps into local and basin-level action-oriented projects, which test and evaluate innovative approaches that enhance sustainable water security for agriculture and the environment. This networking process will gather "best management practices." The Knowledge Base consists of three main components: Dialogue Support, Thematic Areas and Tools. The thematic areas identified at this stage are information, innovative approaches, analysis of past experiences and future scenarios. The activities of the CA address these three main components.

Figure 2. Main elements in the dialogue on water, food and environment.



The Dialogue requires a variety of tools, ranging from participatory approaches, to analytical tools to allow dialogue participants to understand past actions and future possibilities. The CA is well placed to adapt, create and enable the application of these tools. For example, CG/Future Harvest Centers, IWMI and IFPRI, based on their experiences in designing their water and food security

scenario tools (Podium and Impact) are teaming up to provide an enhanced water and food security analysis tool to help Dialogue participants design and understand the consequences of future water-related actions.

The CA provides a means to support user-driven and bottom-up initiatives for basin and national dialogues. Its activities will be centered on selected countries and basins, in particular where each participating partner has depth of knowledge and experience. As many activities as possible will be driven and defined by local needs and user needs though not all of them can be precisely defined here. An important component of the CA is a series of case studies at the river basin, local and national levels.

Much of the information generated in the thematic areas of the Knowledge Base is generic, and can be used to support dialogues in various countries and river basins. For example, we anticipate generating a wealth of new knowledge and experience around key issues, such as comanaging water for agriculture and nature, or health impacts of irrigation. The approach is to establish credible knowledge, and highlight controversies where the water-food-nature issues are not so clear, and feed this information into the Dialogue.

The CA will have a direct link to the local actions component of the Dialogue. Here, local experiences will be analyzed and collated. This will help better understand conditions for success, reasons for failure and potential impacts.

In addition to the CA, other ongoing activities contributing to the Dialogue's Knowledge Base include the FAO's Long-Term Forecasting Program, the UN's World Water Assessment Programme, IUCN's Freshwater Programme, the Millennium Ecosystem Assessment, the CBD/ Ramsar River Basin Initiative, and the Text Delivery Service of the International Commission on Irrigation and Drainage (ICID). As the Dialogue process moves forward, more new partners are expected to provide knowledge inputs.

As the CA develops, it will be an ideal link, bringing together the Dialogue partners and the CGIAR/Future Harvest research system to ensure that water and agricultural research findings are combined to maximize impact. Through this linkage, the Dialogue's key stakeholders help the CGIAR system shape the societal needs for research on water and agriculture. The Dialogue creates a bottom-up agenda-setting role, while validating the research agenda as proposed by participating research institutes.

The Challenge Program on Water and Food

To solve a major part of "the world water crisis," the challenge is to grow more food with less water to decrease water use in agriculture to meet environmental goals and other human needs, yet growing enough food, and improving livelihoods of the poor. This challenge requires substantial increases in productivity of water in agriculture. The UN Secretary General concluded: *We need a Blue Revolution in agriculture that focuses on increasing productivity per unit of water—"more crop per drop" (Mr. Kofi Annan, Secretary General of the United Nations, Report to the Millennium Conference, October 2000).*

The challenge for the CGIAR is to catalyze effective and efficient improvements of water productivity in a way that is pro-poor, gender-equitable and environmentally sustainable. The CGIAR Challenge Program on Water and Food is designed to significantly improve the productivity of water in agriculture, and thereby significantly contribute to positive impacts on food and environmental security. The program envisages five thematic areas: 1) Crop Water Productivity Improvement, 2) Multiple Uses of Upland Watersheds, 3) Ecosystems, Fisheries and Wetlands, 4) Water Institutions and Policies, and 5) Integrated Water Resources Management. Research will be focused on selected Challenge Program basins. The Comprehensive Assessment scopes research needs for the Challenge Program and provides a link to the Dialogue.

Expected outputs of the Challenge Program include significant increases in water productivity at field, basin and national levels, in the widest sense, including crop, livestock and fishery yields, wider ecosystem services and social impacts such as health, together with the systems of resource governance that ensure equitable distribution of these benefits; significant improvement of joint management of water for crop-based agriculture with the requirements for aquaculture and fisheries, and with the provision of wider ecosystem services, including biological diversity; development, application and widespread adoption of integrated land and water management tools and practices from crop to field, to system, to basin level. This includes technologies, management approaches, policies, and institutions. The scope includes rain-fed to fully irrigated agriculture, from upper catchment areas to fertile valleys, to the salt-freshwater base, and includes water for aquaculture and capture-fisheries.

Expected impacts are sustainable livelihoods improved for resource-poor fishers and farmers dependent on water; increased access of resource-poor farmers and fishers to water, land and other limiting resources where these exist, and ensured access in situations of scarcity; reduced conflict among agriculture and other users for scarce water resources due to reduced needs for food production, and more adaptive institutional mechanisms to cope with scarcity; reduction in adverse environmental impacts and, in many cases, the enhancement of ecological goods and services; and increased consensus on desirable investments in sustainable development of water resources for food production.

Appendix B: Key Research Questions

The Priority Research Questions to Be Addressed

What are the key water-food-livelihood environment questions? Based on a researcher meeting at Wadduwa, Sri Lanka, in November 2001, and later at the CA Steering Committee, the following research questions were identified.

Concerns that cross each of these questions are household food security, impacts on the poor, gender, equity, social impacts and environmental impacts.

- *What are the key global problems in water for food, livelihoods and environmental security?* Throughout the CA period, this question will be continually sought through stakeholder consultation and through research. An initial list of questions related to what CA participants perceive to be the most important questions for the CA to address is given below.

- *What have been the benefits, costs and impacts of irrigated agricultural development and what have conditioned those impacts?* Of all the means of using water for agriculture, irrigated agriculture is the most contentious because of the magnitude of water use by this sector, and because of the debate as to whether the benefits of irrigation in terms of poverty reduction, economic development and food production have outweighed the social, financial and environmental costs. A focus on this question will shed light on how to make better future investments in irrigation.

- *What is the extent and significance of the use of low-quality water in agriculture (saline and wastewater), and what are options for its use?* With increasing scarcity of water, low-quality water is being increasingly used in agriculture. Its utilization provides new sources of water for higher food production in many areas. But its use could create environmental and/or health hazards. The CA will assess the magnitude, significance and potential for use of low-quality water for agriculture including saline brackish water, agricultural drainage water and sewage water. The productivity of each source of water relative to various crops, levels of water quality and major agro-ecologies will be considered. The potential hazard/benefit to the environment using this water will be assessed. Guidelines for improved management of these types of water will be developed.

- *What are the options for better management of rainwater to support rural livelihoods and land rehabilitation in water-scarce areas?* Rain-fed agriculture in sub-Saharan Africa, Central Asia, Eastern Europe and Australia contributes about 90 percent of the total cereal production in these regions. However, in many countries, productivity remains low due to less-than-optimal rainfall characteristics, unfavorable land conditions and lack of proper management of these resources. Many poor people live in marginal areas dependent on rain-fed agriculture. Increasing productivity of rain-fed areas could increase food security, improve livelihoods of the poor, and lessen the need for more

irrigation. The CA will explore the potential contribution to food and environmental security from rain-fed agriculture, and assess promising approaches to sustainable improvements in rain-fed productivity considering soil-water conservation, agronomic aspects, supplemental irrigation of rain-fed crops, water harvesting to supplement rain, conjunctive use of rainwater and other water sources, germplasm, drought alleviation, land use changes and crosscutting issues such as socioeconomic, institutional and policy issues.

- *What are the options and consequences for using groundwater?* Groundwater has become an increasingly important supply of water for food production. For many rural poor, use of groundwater has had positive livelihood implications. But in other areas, intensive use has led to declining levels of groundwater, increased salinity, threatening the water resource base and livelihoods. An estimate will be made of groundwater use, its contribution to agricultural production and the volume of annual unsustainable withdrawals made at global and, in more detail, at selected national and regional levels. The CA will explore options for sustainable groundwater use for areas of high potential, and for areas of groundwater degradation.

- *What are the options and their consequences for improving water productivity in agriculture?* Producing more crops, livestock, fish and forest products per unit of agricultural water use holds a key to both food and environmental security. There are a variety of options for improving the productivity of water in agriculture through breeding, better management practices, and supporting policies and institutions. The CA will identify a range of means to enhance water productivity in agriculture, assess their potential, and consequences of their adoption. The production systems to be considered can vary from purely rain-fed to irrigated and from dry zones to semi-humid monsoonal areas. The CA should include off-site effects of the interventions, from production and environment point of views.

- *How can water be managed to sustain and enhance capture-fisheries and aquacultural systems?* Development of water, in particular for crop agriculture and cities, has impacted fisheries and ecosystems, in many cases adversely affecting livelihoods and food security. The CA will assess the role of fisheries and aquaculture in providing food security and supporting livelihoods, explore the knowledge on water requirements in terms of quality, quantity and timing needed to sustain fisheries and ecosystems, and assess various approaches to manage fisheries and aquaculture in light of the multiple uses of basin water resources.

- *What are the options for integrated water-resources management in basins and catchments?* Each use of water in a basin potentially affects other users and uses within a basin, calling for more integrated water resources management (IWRM) approaches. Key to IWRM is good governance, including appropriate policies and institutions. The CA will explore various options of governance including institutional frameworks, water rights, policies including water trade and pricing, the conditions where these are successful, and their potential elsewhere.

- *What policy and institutional frameworks are appropriate under various conditions for managing water to meet goals of food and environmental security?* It is widely accepted that getting the right institutional framework is essential to meet goals of food and environmental security. There has been experience within the water sector on institutional development and institutional reforms including water rights, allocation, water markets, prices and privatization, but the path to the future is not clear. The CA will review key water policies and institutions, the conditions where these are successful and their adaptability elsewhere.

- *What are the consequences of land and water degradation on the multiple users of water in catchments?* Improving productivity of water is constrained by land management practices, and sustaining levels of productivity is threatened by severe levels of land and water degradation. The CA will assess the threat of land and water degradation on water productivity and food security, and will search and assess promising practices to reverse the trends of degradation.

- *How much water will be needed for agriculture?* This question is central to the CA because the amount of water developed for agriculture will have tremendous impact on environmental and food security; and finding a balance between these two objectives is paramount to solving the water crisis. This central question of the CA has no right or wrong answers, will vary depending on the particular basin or country, and will vary depending on values of stakeholders. How well this question is answered depends on how well the other questions of the CA are answered.

Appendix C: The CA Log Frame

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal: Support water investment decisions to enhance food and environmental security and contributing to alleviating poverty	Indicators of water-related investments, long-term trends of poverty, malnutrition, ecosystems	National governments/donors policy papers, water-related investment strategies	Willingness of policy makers and donors to use findings
Purpose: Strengthen the knowledge base on water-agriculture-environment and promote its use in developing consensus on investment strategies		Project synthesis report Governments/donor community policy papers Media reports	Acceptance of stakeholders and donor communities
Outputs: 1. A Comprehensive Assessment of Water Management in Agriculture (CA) with supporting research	Production of analysis and synthesis volumes By 2006,100 peer-reviewed technical reports and journal articles at the rate of 20 per year .	Reports, books, journal articles	Additional funds required to do assessment
1a. An assessment of benefits, costs and impacts of water management in agriculture	20 case studies of impacts of irrigation and other means of managing water for agriculture Global analysis of past irrigation impacts completed by 2004.	Technical reports	Possible to analyze impacts
1b. Information gaps filled	Maps and related statistics on irrigated and rain-fed agriculture Quantification of groundwater contribution to agriculture, and degree of unsustainable use Quantification of constraints of land and water degradation on water productivity Quantification of use and potential from rain-fed agriculture completed by 2005.	Technical reports and related databases	Techniques are available to reliably collect and analyze these data
1c. Promising solutions analyzed	30 analytic studies of technical, management, and policy approaches that hold promise for future water use are completed by 2004.	Technical reports	Enough field information is available for analysis
1d. Future scenarios and options for using water for agriculture explored	Global scenarios developed and analyzed Scenarios analyzed for 10 countries and 10 basins by 2004	Technical reports	Interest of stakeholders in participatory exploration of scenarios
2. Analytic and Conceptual Tools developed or adapted and applied at local, basin and country levels	Integrated water-food model for country and global analysis by 2004 Field-level assessment tools developed or adapted by 2005	Documentation of tools	Enough information is available for meaningful results from tools
3. Capacity built to carry out assessments	30 M Sc. and 30 Ph.D. students hands-on involvement to 40 NARES	M.Sc. and Ph.D. theses List of NARES actively collaborating to the CA	Funds available
4. Results communicated to significantly increase understanding and awareness of key water-food-environment issues in developing countries.	100 presentations at conferences and workshops 50 policy briefs	Newspaper clippings Workshop reports List of presentations List of policy briefs	There is broad interest outside immediate research community
4a. Input into the Dialogues Knowledge Base	50 entries into the Dialogue Knowledge Base. Input into 10 dialogues is provided by 2006.	Dialogue reports and Knowledge-Base website	The Dialogue process succeeds in establishing dialogues.
4b. Research areas for the CGIAR Challenge Program identified	2 reports for the Challenge Program Secretariat prepared in 2003 and the second in 2005.	Reports	The Challenge Program is designed to accepted CA inputs

Activities	Conditions
1. Reviews • Comprehensive literature reviews of topics related to assessment (this can be the first activity)	
2.Field Studies • 10 Basin case studies • 30 Local case studies of specific water agriculture (including fisheries/forestry/livestock) and environmental uses	Identification of basins with sufficient information Identification of cases possible
3. Specific Studies to fill information gaps • Irrigated area mapping • Groundwater contribution to agriculture and amount of unsustainable use • Constraints of land and water degradation	
4. Analytical tool development and application • Integrated water-food model for global analysis • Adaptation and application of assessment tools for basin and local case studies (related to fisheries, forestry, livestock, gender, etc.,to support analysis and consultations) • Documentation of these tools	Case studies identified and stakeholders accept collaboration
5. Preparation of Analysis and Synthesis Reports	
6. FormalTraining: University training for M.Sc. and Ph.D. students in situation assessment, tools development and applications and scenario analysis	Availability of students
7. Communication and Outreach • Awareness-building activities (press, media, exhibitions) • Preparation of material for general public • Participation in major water events such as the World Water Forum and World Summit on Sustainable Development Interaction with other initiatives like Millennium Assessment, World Water Assessment Program (WWAP) and HELP	Willingness to collaborate and technical feasibility
8. Participation in the Dialogue on Water, Food and Environment • Preparing material for the Knowledge Base • Participating in basin and country dialogues and tailoring research to meet demands Analysis of promising solutions brought forward by local action group	
9. Interaction with Challenge Program • Preparation of research scoping reports • Participation in challenge program meetings	
10. Managing the Assessment • Project Management Activities • Steering Committee Meetings Workshop at the end of project (discuss results)	

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