CGIAR Challenge Program
on Water and Food

Full Proposal

Submitted to the CGIAR by

The Challenge Program on Water and Food Consortium

Consortium Members

IWMI (lead), ARC, AREEO, CARE, CIAT, CSIRO, EMBRAPA, ICAR, ICLARM, IFPRI, IRD, IRRI, JIRCAS, NWRC, SEI, UC-Davis, WRI, YRCC

Consortium Members

IWMI	-	International Water Management Institute
IRRI	-	International Rice Research Institute
IFPRI	-	International Food Policy Research Institute
CIAT	-	Centro Internacional de Agricultura Tropical
ICLARM	-	The World Fish Center
EMBRAPA	-	Brazilian Agricultural Research Corp.
AREEO	-	Agricultural Research, Education and Extension
ARC	-	Agricultural Research Council
NWRC	-	National Water Research Center
ICAR	-	Indian Council of Agricultural Research
YRCC	-	Yellow River Conservancy Commission
CSIRO	-	Commonwealth Scientific and Industrial Research Organization
IRD	-	Institut de Recherche pour le Développement
JIRCAS	-	Japan International Research Center for Agricultural Sciences
UC Davis	-	University of California, Davis
CARE	-	Cooperative for Assistance and Relief Everywhere
SEI	-	Stockholm Environment Institute
WRI	-	World Resources Institute

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Summary

Global Challenge Program on Water and Food

The Water Productivity Challenge: Growing More Food with Less Water

Some 200 researchers representing 20 countries and 50 institutions have contributed to the discussion, brainstorming, drafting and research planning sessions that led to the creation of this proposal.

Simply put, the CGIAR Challenge Program on Water and Food (CP Water and Food) proposes to launch an ambitious research, extension and capacity building program that will *significantly increase the productivity of water used for agriculture*. The CP Water and Food is managed by an 18-member consortium, composed of 5 Consultative Group on International Agricultural Research (CGIAR)/Future Harvest Centres, 6 National Agricultural Research and Extension Systems (NARES) institutions, 4 Advanced Research Institutes (ARIs) and 3 international NGOs.

The program's interlocking goals are to allow more food to be produced with the same amount of water that is used in agriculture today, as populations expand over the coming 20 years. And, do this in a way that decreases malnourishment and rural poverty, improves people's health and maintains environmental sustainability.

CP Water and Food: Key Characteristics

Development objective

To increase the productivity of water for food and livelihoods, in a manner that is environmentally sustainable and socially acceptable.

Intermediate objective

To maintain the level of global diversions of water to agriculture at the level of the year 2000, while increasing food production, to achieve internationally adopted targets for decreasing malnourishment and rural poverty by the year 2015, particularly in rural and peri-urban areas in river basins with low average incomes and high physical, economic or environmental water scarcity or water stress, with a specific focus on low-income groups within these areas.

The **immediate objectives** of the CP Water and Food:

***Food security* for all at household level.**

1. *Poverty alleviation*, through increased sustainable livelihoods in rural and peri-urban areas.
2. *Improved health*, through better nutrition, lower agriculture-related pollution and reduced water-related diseases.
3. *Environmental security* through improved water quality as well as the maintenance of water related ecosystem services, including biodiversity.

These form the four key dimensions in which progress towards the overall goal is measured.

The Combination of Expertise Needed to Deliver this Research

The CP Water and Food consortium partners harness expertise in a number of ways to deliver the research approach presented in this proposal.

Applying 'frontier science' to the *more food, less water* problem, the consortium expects to create new combinations of cutting edge science and research knowledge, including functional genomics and molecular biology; the use of remote sensing and GIS tools; and global modelling linked to the global change research projects. These approaches offer opportunities for breakthroughs that range from breeding drought resistant plants to possibilities for real-time water management control systems.

A quantum leap in knowledge is possible by bringing together parts of the water and food research picture that reside in various Future Harvest centers. By linking these complementary activities, the CP Water and Food helps create the connection between plant breeding, field to basin-scale water modelling and social science and policy. The core of this integrated natural resources management (INRM)-style approach to water resource management is the river basin scale. It links downward to the field and farming system and upward to the regional and international scales. This perspective is expected to bring breakthroughs in policies and institutional options, showing the best approaches for managing water and related natural resources—at the field, basin and national/global levels.

This proposal's partnership aspect is also designed to breed innovation in the collaboration among—Agricultural Research Institutes (ARIs), the CGIAR and NARES and the NGO communities. The CP Water and Food Consortium—where each partner has a specific, recognized strength—is set up as an open and competitive research system. This interaction should lead to breakthroughs in how knowledge is produced, packaged and targeted at solving problems at basin and field levels. NARES and NGO partners play the vital link to the field and community level for broad implementation of results and as drivers of impact.

A New Quality of Partnerships

The CP Water and Food also introduces new approaches to how agricultural research for development is organized and managed. It proposes a new quality of partnership. Eighteen partners, of which five are CG centres, have agreed to use majority voting on all critical and strategic issues regarding the program. Some 75 percent of the total program funding is organized around a process for open, competitive grant financing —a formula designed to open the field to many new partners, and to allocate at least 33 percent of funding for each project to NARES.

There are clearly defined roles for each consortium member. CG centres lead thematic groups. NARES lead benchmark basin work, giving a close link to regional and locally defined priorities, to help drive implementation of research ideas which, working with partner NGOs, drive impact. ARIs ensure a strong link for this research to the global change research agenda.

The CP Water and Food is one of the pilot programs designed to re-invent the business model for the CGIAR. These five key points characterize the new business model approach of this program.

1. **Consortium**: Truly shared decision-making on strategic management and quality control through the CP Water and Food Consortium of 18 IARC, NARES, ARI and NGO partners.
2. **Thematic groups**: Setting research agendas through communities of practice (thematic groups) in five key, linked research themes coordinated primarily by CGIAR centers.
3. **Benchmark basins**: Providing geographical focus, regional/local priorities and emphasis on impacts through benchmark basins coordinated primarily by NARES partners.
4. **Competitive grants**: Driving the research agenda forward through competitive grants made from core funds of the CP Water and Food, with grant awards based on independent peer review mechanisms to determine merit and alignment with thematic and basin priorities.
5. **Global change agenda**: Linking to the global change research agenda to build on, and contribute to, the water-related global change research agenda, primarily through ARI partners.

The Joint Venture Agreement

The CP Water and Food builds on tried and tested models from the private sector—for the creation of a legal non-incorporated association through the joint venture agreement which governs the consortium of partners; and on the approaches of European Union and World Bank Science and Technology competitive grant financing programs—to put in place transparent mechanisms for managing the quality and relevance of this research program and to ensure objective and independent review of outputs and allocation of funds. All consortium partners have signed the legally binding joint venture agreement that defines their responsibilities, the governance over the research agenda and dispersal of funds.

Capacity building

The CP Water and Food partnership reaches well beyond the core consortium partners to share the majority the funds (some 75%) with a much wider group of partners. A capacity building component of the program, targets an additional set of river basins—especially in sub-Saharan Africa—where NARES have lower capacity and where the basins are characterized by low income and high water stress. The Niger and Zambezi are the first candidates identified for capacity building, and more of these types of basins will be added later.

The CP Water and Food will be put into action using a matrix structure that provides a dual thematic and geographic focus.

Five inter-related research themes provide the breadth of scope. They will ensure that the same core of key research topics is addressed in all locations. Themes will serve as the focal point for synthesizing results from the various countries and regions, and bring out generic conclusions from the overall research program.

Benchmark basins provide the geographic scope. The river basin is where the water problems and issues converge, especially in the developing world. And this is where the majority of the CP Water and Food research projects will be done. The leading partners here will be NARES, working with local communities and community based and farmers' organizations, development NGOs, universities and government agencies.

The initial group of six benchmark basins has been chosen, among other reasons because they have strong NARES, who can deliver a solid research program and encourage matching funds for that basin. A further six basins are proposed for possible inclusion. The final number that can start as benchmark basins at the beginning of Phase 1 of the program depends on reactions received from partners and available funds.

The CP Water and Food's call for concept notes is expected to be in December 2002. The first set of research grant awards is planned for September 2003, to fund projects of some 50-100 partners, including ARIs, International Agricultural Research Centres (IARCs), NARES and NGOs, located in the benchmark basins and other research locations.

Initial set of CP Water and Food Benchmark Basins			
Asia	**Africa**	**CWANA**	**LAC**
Yellow River	Limpopo	Amu Dariya	Sao Francisco, Brazil
Mekong	Volta	Karkheh, Iran	Andean Basin (s)
Indus-Gangetic	Nile Basin	Euphrates	Ulua, Honduras

Research Themes and Sub-Themes

Theme 1—Crop Water Productivity Improvement

- Plant level perspective: Impact and future directions of plant breeding
- Crop and field level perspective: New opportunities for integrated natural resource management
- Agro-ecological system perspectives: Integrating land and water management
- Policies and institutions facilitating adoption of improvements

Theme 2 —Multiple Use of Upper Catchments

- Water, poverty and risk in upper catchments
- Potential for improved water management
- Enabling people to benefit from improved management of land and water resources

Theme 3—Aquatic Ecosystems and Fisheries

- Policies, institutions and governance
- Valuation of ecosystem goods and services, and the costs of degradation
- Environmental water requirements
- Improving water productivity

Theme 4—Integrated Basin Water Management Systems

- Interactions and scales of analysis
- Integrated decision support tools
- Good governance

Theme 5—The Global and National Food and Water System

- Globalization, trade, macroeconomic, and sectoral policies
- Investment and financing for agricultural water development and water supply
- Transboundary water policy and institutions
- Global water cycle change

Budget and Funding

The CP Water and Food is proposing a minimum core budget of US$82 million from the CGIAR for the first 5-year phase, a sum which it (conservatively) projects will attract a further US$50 million in matching funds. Other national and regional sources will provide a significant amount of funding throughout the life of the CP Water and Food. To realize this ambitious and relevant program, a sustained high level of funding will be required.

The size of this proposed *global* challenge program and the budget need to be seen in perspective with sectoral development programs in a given country that receive international support from international donors such as the World Bank. Many of these are in the order of US$10-30 million to create significant long-term change. Compared to the goal of significantly changing water management in agriculture on an international scale, an investment of several hundred million dollars is a modest, and we believe, well placed development investment.

To have a significant impact, the expected duration of the CP Water and Food will be considerably longer than the initial five-year phase. Assuming that the first five years show sufficient progress, the duration of the program should be at least 10-15 years.

A. Research Agenda

1. Introduction

A key component of the Green Revolution was the investment of many billions of dollars in irrigation infrastructure. Development of reliable irrigation has been crucial to realizing the benefits of high-yielding modern crop varieties[1]. The increased food production associated with the Green Revolution has come hand-in-hand with sharply increased water use in irrigated agriculture that has benefited farmers[2] and the poor[3] variously, as well as damaged the environment[4].

As populations rise, incomes rise, and countries industrialize. This progress creates a demand for water in urban areas of developing countries which will increase significantly in the coming decades. The majority of environmental goods and services are provided by lakes/rivers, wetlands and marine waters (Costanza et al. 1997).[5] These include water regulation, water supply, erosion control, nutrient cycling, waste treatment, habitat/refuge, food production, recreation and cultural value. Many of these services depend on the integrity of resident aquatic ecosystems. Large-scale development of river and groundwater resources is less acceptable and less cost effective now than it was in the 1960-1990 period, when most of the world's 45,000 large dams were built. A parallel development is that the water infrastructure built in recent decades is becoming obsolete. Reservoirs are silting up, irrigation networks are crumbling and there appears to be a decreasing willingness to fund rehabilitation and replacement of this infrastructure. Groundwater levels are falling in key aquifers that have contributed substantially to food security in recent years, by providing rapid and easy water-on-demand to millions of farmers that tapped them directly through tubewells. In all these developments, as resources become more scarce, it is the poor and vulnerable in society that are hit the hardest and suffer most.

The agricultural sector has appropriated a large share of available freshwater supplies over the last four decades. But other water user sectors - mainly growing urban areas - are also calling for and appropriating their share of the water. Groundwater sources are drying up and the willingness to develop new resources has declined for financial as well as environmental reasons.

The agricultural sector has grown used to receiving cheap and plentiful water in irrigated areas. As the human population tripled in the

[1] While not a generally accepted fact, this is shown clearly in the literature, e.g. Hazell and Ramasamy (1991), Janaiah et al. (2000), Pingali et al. (1997), Pingali and Hossain (1999), Batia (1999).

[2] A review by the World Bank of 585 irrigation projects found an average economic internal rate of return (IRR) of 15%, substantially above the assumed opportunity costs of capital (World Bank, 1994). Many irrigation projects, particularly in Africa, under-performed however, or had major social and environmental external costs. This has led to strongly held differences of opinion concerning the benefits and costs of irrigated agriculture.

[3] There is no consensus on the poverty alleviation impacts of irrigation. Recent research led by IRRI, for instance, concluded for 6 villages in Madhya Pradesh, India, that incidence, depth and severity of poverty were substantially lower in the villages where there was irrigation – compared to rainfed villages (Janaiah et al., 2000). Similar research in Myanmar concluded that recent expansion of irrigation infrastructure in the 1990s has not increased household income, due to farmers' inability to cope with the economic and technical demands of the new rice-based technologies (Garcia et al., 2000). The acrimonious debate on dam development has convinced many that water resources development threatens livelihoods. A recent article on the Mekong in Newsweek, for instance, was titled "Strangling the Mekong: A spate of dam building has stopped up Southeast Asia's mighty river and may threaten the livelihood of millions who lie along its banks (Newsweek, March 19, 2001).

[4] A comprehensive review of the impacts of irrigated agriculture on wetlands and wildlife conservation (Lemly et al., 2000) concludes that the conflict between irrigated agriculture and wildlife conservation has reached a critical point on a global scale.

[5] Constanza et al. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387 15 May 1997.

twentieth century, water use multiplied six-fold, mostly for agriculture. Agricultural productivity has risen sharply in recent decades due to higher yielding varieties and increased fertilizer use; and due to major investments in water resources infrastructure and massive subsidies on energy for pumping groundwater. These investments and subsidies are not likely to be repeated in coming decades. All these diversions of water have been made with little regard to the impacts on fisheries and wildlife and those who depend on them.

Water management practices in rainfed agriculture have important implications for food and environmental security as well. Increases in the productivity of rainfed agriculture lessen the need for more irrigation. Water harvesting and supplemental irrigation show promise to increase production, to improve livelihoods and household food security for many of the world's rural poor. But rainfed agriculture is not necessarily an environmentally neutral activity. The land required for agriculture replaces other - often natural - uses and mismanagement of intensified farming leads to pollution and to land and water degradation. The spectrum of water use for agriculture must consider options from fully irrigated, to rainfed, and choices in between, such as supplemental irrigation and the use of small rainwater harvesting structures.

Increased competition for water in agricultural and non-agricultural sectors in developing countries reduce the access to water for the rural poor, especially rural women. For example, in the water towers of East Africa (Mount Kilimanjaro, Mount Meru, Mount Kenya, Mount Elgon, and the southern Arc mountains of Tanzania), there is strong evidence that increased water abstraction in the hillside areas leaves less water available for downstream users. In most of the East African settings, downstream users include pastoralists, agro-pastoralists, and wildlife. Increased water scarcity leads to frequent conflicts, loss of life, and generally to the marginalizing of the poor and powerless in terms of access to fresh water.

As water use intensifies, water quality becomes more of a concern. Aquatic ecosystems are affected by polluted discharges from agricultural and non-agricultural uses. Agricultural users are also affected by poor quality water. In many cases, farmers cannot grow high valued crops because of polluted water supplies. An increasing number of small holder irrigators rely on untreated city effluents for the supply of water and as a source of nutrients for their crops. For many rural people, agricultural water is the main source of drinking water, a benefit when the water is clean, but a health risk for millions if they have to drink water contaminated with arsenic or fluoride. The health and environment factors of water use are not well known, yet essential in any strategy for sustainable water use.

1.1 Water for food as a critical challenge for society

The 2nd World Water Forum in March 2000 in The Hague was a powerful expression of the increased importance of water on the political agenda. Over 120 ministers, over 5000 stakeholder representatives and water professionals, and over 600 journalists put water on the map as a "major issue". Agriculture and fisheries are key players in the use of water for human purposes. The Global Water Partnership concluded: "*On the one hand, the fundamental fear of food shortages encourages ever greater use of water resources for agriculture. On the other, there is a need to divert water from irrigated food production to other users and to protect the resource and the ecosystem. Many believe this conflict is one of the most critical problems to be tackled in the early 21st century*" (Global Water Partnership, Framework for Action, 2000, p58).

The challenge, then, is to grow more food with less water. This means decreasing water use in agriculture to meet other needs and 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).* Indeed, at the field or farm scale the focus on water productivity in physical terms, crop output per unit of water, is a necessary and useful framework. But at the river basin scale, water productivity needs to be better understood in the widest possible 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.

In preparation for the World Summit on Sustainable Development (WSSD), Mr Kofi Annan has outlined water as one of the five areas at the top of the agenda: *"First is water and sanitation. More than 1 billion people are without safe drinking water. Twice that number lack adequate sanitation. And more than 3 million people die every year from diseases caused by unsafe water. Unless we take swift and decisive action, by 2025 as much as two thirds of the world's population may be living in countries that face serious water shortage. We need to improve access.* ***We need to improve the efficiency of water use, for example by getting more "crop per drop" in agriculture, which is the largest consumer of water****. And we need better watershed management, and to reduce leakage, especially in the many cities where water losses are an astonishing 40 percent or more of total water supply." (Kofi Annan in a speech delivered on May 14, 2002).*

Of the targets proposed for adoption at WSSD, several deal with water. A target for water for productive water use is formulated by Willem-Alexander, Prince of Orange and water ambassador to Mr Kofi Annan (www.nowaternofuture.org): "*Increased food production, to achieve targets for decreasing malnourishment and rural poverty, without increasing global diversions of water to agriculture over the 2000 level.*" If such a target were adopted by WSSD or thereafter, in this or a similar form, then this would be a powerful target to adopt for the CGIAR Challenge Program on Water and Food.

1.2 The challenge for the CGIAR

The international research centres supported by the CGIAR and their partners bring together an immense pool of resources, knowledge and technologies, capable of producing breakthroughs in the productivity of water used for food production. The public goods nature and poverty alleviation focus of the CG system is crucial to ensure that advances in increased water productivity are directed at foodstuffs and agriculture, livestock and fisheries systems that are relevant for the poor. And that they contribute to reducing malnourishment and rural poverty, increase levels of human health and maintain or improve environmental quality and biodiversity.

It is proposed that the CGIAR takes on the challenge of increasing water productivity in food production through the CGIAR Challenge Program on Water and Food.

2. Challenge Program on Water and Food

To address the challenge on water for food through the CGIAR, this proposal works out a CGIAR Challenge Program on Water for Food (called the CP, in this proposal). The CP is envisaged as major program of research, extension and capacity building over a period of ten to fifteen years. This proposal works out detailed plans for a first five-year period or first phase of the CP. It is expected that a major investment by the members of the CGIAR in CP core funds (of at least 82 million US$, as proposed here) would also catalyze, leverage and direct considerable additional funds, so that the research agenda developed through the CP becomes the agenda that drives research in the water and food community at least in the

developing world – and possibly globally. First (conservative) estimates are that an $82 million investment by the CGIAR would yield immediate matching funds of another $50 million and have an impact on much larger flows of funds at national levels.

The key characteristics of the proposed CP Water and Food are as follows:

Development Objective
To increase the productivity of water for food and livelihoods, in a manner that is environmentally sustainable and socially acceptable.

Intermediate Objective
To maintain the level of global diversions of water to agriculture at the level of the year 2000, while increasing food production, to achieve internationally adopted targets for decreasing malnourishment and rural poverty by the year 2015, particularly in rural and peri-urban areas in river basins with low average incomes and high physical, economic or environmental water scarcity or water stress, with a specific focus on low-income groups within these areas.

The **immediate objectives** of the CP Water and Food (described in the Logical Framework, Annex 2) aim at:

1. *Food security* for all at household level.
2. *Poverty alleviation*, through increased sustainable livelihoods in rural and peri-urban areas.
3. *Improved health*, through better nutrition, lower agriculture-related pollution and reduced water-related diseases.
4. *Environmental security* through improved water quality as well as the maintenance of water related ecosystem services, including biodiversity.

These form the four key dimensions in which progress towards the overall goal is measured.

This proposal develops the research agenda for the CP Water and Food in the remainder of Section A of this document, in the business plan in Section B and in the Process Framework in Section C.

3. Research Themes & Benchmark Basins

The CP Water and Food has adopted a matrix approach that provides a double thematic and geographic focus. The thematic focus is achieved through five inter-related research themes. The geographic focus is achieved through an initial set of Benchmark Basins that may be expanded during the program to achieve greater geographic coverage. The thematic approach is important to achieve the global public goods nature of the proposed program and will support the drawing of generic lessons across geographically defined locations. The benchmark basin approach is important to integrate research across themes and to help achieve concrete impacts.

Individual research projects selected for competitive grant funding could either focus on a specific thematic area and address this across a number of Benchmark Basins in a comparative fashion (indicated by Project Y in Table 1), or alternatively, focus on a specific basin and integrate across themes (as indicated by Project X in table 1).

Table 1: The matrix approach of the CP Water and Food.

Themes : / Basins :	Agro-ecosystems	Upper Catchments	Aquatic Ecosystems	River basins	National and global policies
Yellow River					
Mekong					
Indo-Gangetic plains					
Limpopo					
Volta					
Nile					
Etc.					

Project X

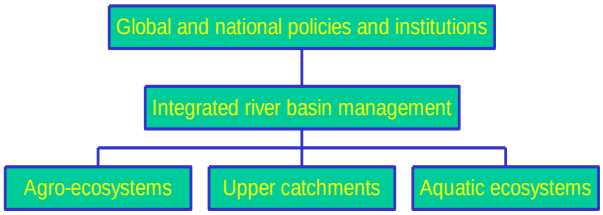
Project Y

Research Themes

For the purposes of the CP, the Food-Water System is defined as presented in figure 1 in five key sub-systems. This system representation distinguishes between three scale levels:

- The lowest scale level embraces the *plant-field-farm-system* level. At this level three key sub-systems are distinguished for the CP: agro-ecosystems, upper catchments and aquatic ecosystems.
- The second scale level is the *river basin*. At the basin scale the different water uses (agriculture, domestic, industrial, environmental) are integrated. At this level the focus is on the interactions and trade-offs among and across water uses, as well as the interaction and integration of different sources of water and (surface water, groundwater, precipitation) and the upstream-downstream interactions.
- The third level is the *external environment* in which the river basin is situated. This comprises the national and global level and focuses not only on the water sector, but on all other sectors of macro-economic policy that impact the water sector, e.g. trade in food and fiber, or energy policies.

Figure 1. The Water-Food System as defined by the CP Water and Food



The five key sub-systems in the Water and Food System coincide with the five thematic areas in the CP Water and Food. For each Theme a Thematic Group has been established that has developed the research agenda for that theme. For each of the groups the objective is to undertake research, outreach, and institution building to improve water productivity, to have impacts on the four development objectives of the CP (food security, poverty alleviation, improved health and environmental security).

The primary roles of the Thematic Groups are (see Section B - the Business Plan, for more detail) : (1) to develop the research agenda for their thematic area; (2) to develop the methodology and analytical framework that should be adopted by all research projects within the thematic area; (3) to serve as a mechanism to address research questions that go across thematic areas, e.g. those related to policies and institutions; (4) to synthesize the lessons learned across the projects in the thematic areas in order to develop more generalized knowledge in the form of global public goods.

The initial focus of the Thematic Groups during proposal development has been on the Research Agenda, which will form the basis for the first call for proposals for research projects. During the Inception Phase of the CP it is planned that the working groups will focus on the development – or adoption based on earlier work or similar work ongoing elsewhere – of the shared methodology and a sound conceptual framework. This is worked out further in the Process Framework (Section C). As the competitively funded projects start to generate results, the focus of the Thematic Groups will shift to the synthesis of lessons learned and the development or evolution of the Research Agenda to prepare for the second call for proposals. The Thematic Groups are also the primary mechanism for producing the key program level outputs: the thematic and overall CP synthesis reports.

Benchmark Basins

The geographic focus in the CP on areas of high water stress and low income, as well as the representation of the different regions important to the work of the CGIAR is provided by the Benchmark Basins. Large river basins have been specifically chosen, so that impact achieved here will affect a significant number of people, and so that the relevant processes at different scale levels can be taken into account. This also implies that, within each CP Benchmark Basin, there will be a number of research sites for work at lower scale levels, and possibly a number of tributary rivers that are studied in more detail at an intermediate scale level.

The primary functions of the Benchmark Basins are: (1) to integrate research across themes; (2) to work closely with stakeholders in each basin; (3) to prioritize research questions within each Theme as most relevant to the basin; (4) to develop a baseline against which progress and impacts can be measured; (5) to work on field testing and adoption of technologies and other innovations developed through the CP.

The Benchmark Basins are discussed further in section 6 below, and details of the basins chosen, together with key statistics for the basins, may be found in Annex 4.

4. Research Approach

During the development of the CP Full Proposal primary attention has been given to the development of the Research Agenda and the Business Plan. It is recognized, however, that the CP also needs a coherent analytical framework that will allow effective integration across research projects. This analytical framework will be further worked out during the Inception Phase of the program, both through the Thematic Working Groups and through the Benchmark Basins. A number of key elements in the research approach have been identified already, however.

Research in the CP Water and Food will be:

- ✓ **Pro-Poor**

  A pro-poor approach requires a good understanding of the relationship between water and poverty and the causes of poverty,

so that strategic poverty reducing interventions can be identified. The assessment of impact on poor people will verify appropriateness of the research priorities. Institutions with a proven pro-poor approach will have a comparative advantage in choice of partners. Overall the program will aim at creating an enabling environment for poor people to benefit from improved water productivity.

✓ **Gender Equitable**

Women play a crucial role in many of the issues related to water and food, while they are still under-represented in research communities and decision-making fora. The CP Water and Food, in all projects, will therefore take special care to design research frameworks that take gender issues into account wherever relevant.

✓ Implemented in an **Integrated Natural Resource Management** framework

It is recognized that for many research questions in the CP Water and Food, an INRM approach is the appropriate research framework.

✓ Proactive with respect to **stakeholder participation**

Stakeholder participation is important at different levels and at different stages in program design and implementation, and is crucial to achieve impact. This will take place through partnerships, exchange mechanisms, and participatory approaches in research and implementation. The stakeholder groups that will be created will play a key role for all Benchmark Basins[6].

✓ **Focus on Impact**

The impact of research is determined by the scale and extent of its influence on decisions in the real world. By definition, these decisions are made beyond the scope of original research. Impact relies on processes, often poorly defined, of:

- *Adaptation*: Modifying action at the point of impact using information about the 'outside world'.
- *Generalization*: Identifying the modifiable 'whole', which is influenced predictably through the known function of its 'parts'. Generalized knowledge about the system is a prerequisite for extrapolation. Institutions in the broad sense provide the vehicle for this process.
- *Extrapolation*: Where are specific insights accurate and relevant? Where is inference unsound? What is the extent of measurable impact?

Impact will be achieved through on-the-ground collaboration between research institutions, implementing agencies and user groups. The CP Consortium itself, particularly the NARES and NGO partners, and partnerships in the basin provide the basis for broad sharing and implementation of research results. Research project design will incorporate linkages with local organizations and user groups facilitating direct impact. Indirectly, cooperation between researchers and users in priority setting and evaluation of results will lead to broader acceptance and ultimately impact.

As mentioned above, a sound and consistent research methodology and the development of an analytical framework are pre-requisites for synthesizing, generalizing and extrapolating. These will lead to guidelines and criteria for the actual research projects and become part of the call for proposals. During the Inception Phase, time will be set aside for methodology developments led by the Thematic Groups, and for prioritization of issues in each basin by stakeholder groups in the Benchmark Basins. This is explained in detail in the Process Framework (section C).

[6] For some Benchmark Basins there are ongoing mechanisms to which the CP can link, e.g. the Nile Basin Initiative for the Nile Benchmark Basin. In other basins the activities of the Dialogue on Water, Food and Environment will be helpful in establishing appropriate relationships with stakeholder groups.

5. Research Agenda for each sub-system

The Research Agenda for the CP Water and Food was developed through a highly participatory process. The basic structure was developed during a water productivity workshop in November 2001 in which about eighty researchers participated. Starting in February 2002, Lead Researchers for each of the five themes have developed draft Background papers through a growing group of researchers. The first draft of these papers was widely circulated by email and through the IWMI website (www.iwmi.org). The second draft of the papers, together with summaries that highlight the research questions, was discussed at a researcher level workshop in May 2002 in which about 55 researchers participated. In this workshop 15 Future Harvest Centers, 15 NARES partners and several ARI and NGO partners were represented.

At the Research Agenda workshop the background papers and particularly their summaries, were revised considerably. Lead Researchers have subsequently revised their Summaries and the background papers. The research agenda for each of the five subsystems described in the following sections consists of summaries of the five background papers. The complete versions of these background papers are available on the IWMI website (www.iwmi.org). The current membership of the Thematic Groups responsible for the five background papers can be found in Annex 5.

Table 2. Origin of researchers in May 16-17 Research Agenda workshop.

The Workshop had 48 participants and 9 facilitators and rapporteurs

CG Centres	**NAREs**	**ARIs**
ICLARM	NARC (Nepal)	CSIRO (Australia)
IPGRI	Dept of Agricultural Extension, Government of Bangladesh	University of California, Davis (USA)
IRRI	University of Peradeniya (Sri Lanka)	IRD (France)
CIAT	Embrapa (Brazil)	
ISNAR	Southern Waters (South Africa)	
IWMI	NACA (Thailand)	
CIMMYT	University of Nairobi (Kenya)	
WARDA	ICAR (India)	
ICARDA	University of Colombo (Sri Lanka)	
ILRI	Chang Mai University (Thailand)	
IFPRI	ARC (South Africa)	
ICRAF	UNFA (Uganda)	
CIFOR	NWRC (Egypt)	
ICRISAT	ITCAD (Thailand)	
	AEERO (Iran)	

5.1 Crop Water Productivity Improvement (Theme 1)

5.1.1. Introduction

Increasing water scarcity and competition for the same water from non-agricultural sectors drive the need to improve crop water productivity to ensure adequate food for future generations with the same or less water than is presently available to agriculture. This can be achieved because available information indicates that there is a wide gap between actual and attainable crop water productivity, especially in rainfed environments. Quantifying crop water productivity reveals gaps in knowledge regarding the best ways to increase crop water productivity. Most of these gaps relate to our inability fully to quantify all flow components in the domain of interest, their interactions with the plants, agricultural inputs and the environment in the process of producing marketable yields. Interactions among the hierarchical scales add to the complexity of the problems. It is hypothesized that breakthroughs in molecular breeding and advances in modeling, information and communication technologies will accelerate our understanding of the above interrelated factors, and the identification of interventions that will lead to improved crop productivity at various scale levels.

5.1.2. Objective

To increase crop[7] water productivity such that food security can be ensured and farmers' livelihoods enhanced without increasing water diverted for agriculture over the amount diverted in the year 2000.

This may be achieved through applying the following three broad principles, regardless of whether the crop is grown under rainfed or irrigated conditions and of the scale being studied :

- ✓ Enhancing marketable yield of the crops for each unit of water transpired of the crop;
- ✓ Reducing the outflows from the domain of interest and atmospheric depletions other than the crop stomatal transpiration;
- ✓ Enhancing the effective-use of rainfall, water stored in the domain of interest, and water with marginal quality.

5.1.3. Research Areas

Interventions that will lead to improved crop water productivity require a systems approach at different spatial scales, i.e. plants, fields, farms, and agro-ecological systems (both rainfed and irrigated), especially in high water stress areas. The key research questions for each scale are addressed below. The institutional structure and practice promoting farmers' adoption of the developed technologies will also be addressed.

Plant Level Perspective: Plant Breeding for higher water productivity

It is expected that DNA-assisted backcross breeding, using the discovery of genes underlying water productivity-related traits, will quickly enhance abiotic stress tolerance and crop water productivity in new or already popular varieties. The success of breeding within the CP for water productivity depends heavily on the use of physiological, molecular and genetic tools to exploit useful alleles. Some of these alleles are already available, while others remain to be discovered by the CP on Genetic Resources. Key research questions include:

- ✓ What are the main impediments to translating an appraisal of abiotic stresses present in a river basin into an integrated program of breeding and natural resource management for improved crop water productivity?
- ✓ Do the genes responsible for improving water productivity in rice and wheat

[7] In this study, "crops" include the main mandated crops of the CG centers; crops (including forage) that are important to farmers' livelihoods in the selected sites of the Benchmark Basins.

through higher harvest index and shorter crop duration have equally effective homologues in other crops?

- ✓ To which traits should priority be given in using molecular techniques to increase the efficiency of conventional plant breeding to improve water productivity of the mandate crops of the CGIAR[8]?
- ✓ For rainfed and water scarce environments, how can the yield numerator in water productivity be maintained for crops growing under extended periods of mild water deficit or brief periods of severe water deficit?

Crop and Field Level: New Opportunities for Integrated Natural Resource Management

New information and communication technologies, such as remote sensing, wireless transmission, and simulations, open new opportunities for investigating complex crop–soil–water and environment systems. Simulation models facilitate ex-ante evaluation of technological interventions on crop response, crop yield, water productivity and soil and water quality. They are also valuable in the identification of possibility for out-scaling the experimental findings to new environments. At the same time, improved and affordable new irrigation techniques, tillage and land leveling offer farmers a wide range of options for improving production and water productivity. Key research questions include:

- ✓ How can advances in information technologies, simulations and crop physiology help develop better frameworks to analyze/predict crop water productivity in different environments? And to characterize the environment for better matching the desirable traits of the cultivar to the target environment?
- ✓ What are cropping patterns and management practices that enhance production and farmers income without increasing water input?
- ✓ How can the trade-off between yield (land productivity) and water productivity in deficit irrigation be managed to provide win-win situations?
- ✓ In rainfed agriculture, especially in dry zones, what are the key indicators of risks? What risk management strategies and technologies (e.g. supplementary irrigation, water harvesting) are appropriate?
- ✓ What are appropriate management strategies for sustainable use of water of marginal quality?

Agro-ecological System Level: Land and Water Management

In moving from field to system level scale, the level of heterogeneity increases. Environmental characteristics and land use vary spatially and temporally. An integrative, regional approach is needed to ensure that interventions that increase water productivity at a particular locality will not reduce water productivity and production elsewhere in the system. Key research questions include:

- ✓ What research tools and methods are required for cost effective data collection for water accounting and water productivity quantification at hierarchical scales within the system, especially in data–sparse environments?
- ✓ How can seasonal weather forecasting be used to reduce risk and enhancing water productivity?
- ✓ What tools can be developed to optimize water productivity in the system, taking

[8] Proposed breeding activities are e.g.: Breeding for increased harvest index and reduced crop duration where appropriate; Breeding for reducing non-beneficial depletion by incorporating genes with traits for seedling vigor and waxy cuticle; Breeding temperate and tropical aerobic rice that give high yield and are responsive to inputs when grown in non-flooded conditions; Breeding for drought escape (short duration), drought avoidance (deep or penetrating roots), and drought tolerance at reproductive stage; Breeding for increased submergence tolerance, salt stress tolerance.

into account the underlying process of interaction among the hierarchical scales within the system (e.g. return flows)?

- ✓ How can the management of irrigation systems be improved to match water supplies to field water requirements, and to make more effective use of unevenly distributed rainfall and water storages (groundwater, small reservoirs, drainage canals....) in the system?
- ✓ What are sustainable strategies to improve production and water productivity in land that is degraded due to water logging and salinization?

Policies and Institutions Facilitating Adoption of Improvements

There are a number of technologies that have the potential to increase water productivity. However, the rate of farmers' adaptation of these technologies has been slow. Too often in agricultural research the lead-time from study to field impact is decades. Considering the current and anticipated problems arising from water scarcity, such a lead-time is unacceptable. Key research questions include:

- ✓ What type of policies and institutional arrangements will promote farmers' adoption of water productivity-enhancing technologies?
- ✓ Which factors (environmental and socio-economic) influence farmers' adoption of improved technologies?
- ✓ How can lessons from experiences in participatory research and extension in other areas be applied?

5.1.4. Outputs

Expected outputs will include: (1) Varieties with superior abiotic stress tolerance and improved water productivity; (2) Technologies that enhance farmers' livelihood and water productivity at field level; (3) Interventions that enhance water productivity at agro-ecological system level; (4) Tools and methodologies to assess the impact of interventions on crop performance, water productivity, water balance components, soil and water quality; (5) Institutional arrangements that encourage farmers to adopt water productivity enhancing technologies.

5.1.5. Impacts

Anticipated impacts will include: (1) Reduced conflict among agriculture and other users for scarce water resources due to reduced needs for food production; (2) More adaptive institutional mechanisms to enhance water productivity; (3) More water made available for ecological goods and services; (4) More viable development of water resources for food production; (5) Increased access of resource-poor farmers to water, especially in areas with high water stress; (6) Sustainable livelihoods improved for resource-poor farmers dependent on water.

5.2 Multiple Use of Upper Catchments (Theme 2)

5.2.1. Introduction

Potential improvements in water management can be limited by the complexity and diversity of water uses and water users within upper catchments. Substantial modification in water use at one location influences the resource at another, so a systemic approach is required which links changes in catchment and basin hydrology with the people who create it. Such an approach also anticipates the impacts of complex interactions which occur between socially, economically or politically diverse groups. Resolution of the 'hydrologic dyslexia', that is, the institutional disconnectivity that occurs between hydrologically-connected people, will increase the potential gains offered by advances in biophysical performance.

'Hydrologic dyslexia' may occur at community, catchment and basin scale. It results from a deficiency of institutions that could enable more

effective use of shared resources. It reflects the barriers that prevent 'collective' or 'coordinated' management.

This complex challenge can be divided into three facets, each of which will need to be generalized: water and livelihoods; catchment hydrology; and social organization. These facets overlap within catchments, but the knowledge of the processes they represent is not congruent. This lack of congruence presents a major challenge for researchers, but also an opportunity for new, integrating activities that can underpin significant and measurable progress in enabling people to benefit from improved water productivity.

5.2.2. Objective

To improve sustainable livelihoods for people who live both in upper catchments and downstream, through significant and unambiguous improvements in water productivity.

This will be achieved through comparative research at benchmark sites that will identify opportunities and incentives for measurable improvements in use of the water resource, develop useful tools and methodologies, and enable the learning processes that influence groups of people to adopt them.

5.2.3. Research Areas

Water, Poverty and Risk in Upper Catchments

Water is critical to the sustainable livelihoods of both rural and urban poor through the range of services it provides. In addition to the provision of water for agriculture, sanitation and drinking for their inhabitants, upper catchments are valued for their environmental services to downstream urban, agricultural and industrial users. Where upper watersheds are forested, powerful external economic interests may conflict with both environmental and local economic objectives. These upper catchments are intrinsically risky. They tend to be difficult to manage, difficult to access and prone to processes of land and water degradation, such as erosion and landslides. Key research questions include:

- ✓ What is the significance of water to the livelihoods of inhabitants of upper catchments, especially the poor, and how is this reflected in their role as managers of watershed resources?
- ✓ What is the sensitivity and resilience of catchments to changes in land and water use, or external shocks? What are the definable characteristics of sensitivity and resilience?
- ✓ What are measurable and predictable impacts of changes in water management on poverty alleviation?

Potential for Improved Water Management

We assume that significant, if patchy, potential exists for increased water productivity within most catchments, through improvements in crop water productivity and better management of land and water resources. Better water quality and availability can, in turn, improve water productivity within neighboring components of the landscape, more equitable distribution among them, and enhanced incentives for protection of collective land and water resources. To recognize the potential for such improvements, decision-makers at all levels, including individual resource users, will need to be made aware of possible gains, through the use of models, landscape design criteria, decision support tools and robust field tools for local monitoring, suitable for application in data-poor environments. Key research questions include:

- ✓ What are the opportunities for improved water productivity within upper catchments and what risks are associated with specific land management changes?
- ✓ What are key indicators of risks? What risk management strategies are available/appropriate?
- ✓ Where can technological and management advances provide win-win situations? Are trade-offs between uses

and users significant, if so, how can decision-makers assess them?

- ✓ How can the outcome of specified changes be assessed for large areas for which data is sparse? How can participatory action research and inclusion of local knowledge contribute to this assessment?

Enabling people to benefit from improved management of land and water resources

Where the potential for improvement exists, what has hitherto prevented improvement taking place, and how can it be realized now? Gain is often obstructed by complex problems such as uncertainty, the lack of institutions to implement change, and possible conflicts between diverse groups of people. This will require unambiguous identification of the factors that influence people to engage in a long term, adaptive process of improved water resource management. People organize themselves in response to a variety of influences, including social, economic, political, technological and biophysical. In upper catchments, the implications on water resources of individual decisions may not be considered due to extreme uncertainty, externalities[9], or overriding economic or social pressures. As a result, many of the institutions and policies that influence how people use resources in upper catchments are not designed to maximize benefits from water. Yet, top-down, engineering approaches to watershed management have generally not been effective, precisely because they do not take into account the multiple uses and users of resources in upper watersheds. Key research questions include:

- ✓ How do people organize themselves with respect to water? What are the critical points of interaction between human and hydrologic systems which could provide entry points for better organization and control?
- ✓ What are the consistent and detectable influences of policies and other instruments which are deployed to modify stakeholder behavior?
- ✓ How can the system accelerate overall improvement in water productivity without exacerbating inequalities in power? What are the generalizable characteristics of effective institutions for managing water resources?
- ✓ How can experiences in participatory research and extension and common property management from individual catchments be generalized for global application?

5.2.4. Outputs

Expected outputs will include: (1) Explicit definitions of interactions between water and poverty in the livelihoods of residents of upper catchments; (2) Validated methods to assess the impact of better water management in upper catchments on poverty alleviation; (3) An inventory of effective land and water use technologies (current best practices, identification of gaps, and areas for further research); (4) Decision support tools to enable users to identify the likely consequences of land use change on water availability and quality and to diagnose specific land management problems; (5) Guidelines for adaptive, participatory planning and decision-making processes among stakeholders; (6) Institutional and organizational options for management of upper catchments; (7) Policy instruments encouraging protection of catchment function.

5.2.5. Impacts

Anticipated impacts will include: (1) Improved livelihoods of residents of upper catchments through better access to water and improved crop water productivity, reduced vulnerability to water-related risks, and an increased recognition of the economic value of their role in providing environmental services; (2) More efficient and equitable water management, resulting in global

[9] Externalities occur when the consequences of a decision are felt by someone other than the decision maker.

benefits for stakeholders, including downstream and off-site users; (3) Improved organizational mechanisms in place to facilitate collaborative management of resources within and outside the catchment, based on adaptive learning processes that incorporate scientific and local knowledge; (4) Policies and institutions for catchment management which support the claims of the multiple uses and users in upper catchments.

5.3 Aquatic Ecosystems and Fisheries (Theme 3)

5.3.1. Introduction

Aquatic ecosystems provide a wide range of benefits to people. As efforts to improve water productivity intensify, there is growing recognition that future investments in water management need to consider how to sustain these ecosystems and the benefits they provide. This is particularly so where aquatic resources such as fisheries are used intensively by poor communities and sustain rural livelihoods.

In order to maintain the productivity of aquatic ecosystems and improve dependent livelihoods, policies, institutions and governance arrangements that foster sustainable and equitable use of these resources need to be developed. These in turn will need to be supported by improved technical capacity to design and implement innovative approaches to managing the biological and physical resources of these systems, so as to optimize their contribution to food security and poverty alleviation. Such improved governance and management will need to be based on in-depth understanding of the social, economic and institutional viability of the approaches being taken, and of the capacity and constraints of the ecosystems being managed. In particular, the full value of the range of aquatic ecosystems within different river basins, the resources they provide, and the trade-offs among different uses, need to be better understood; the environmental flows required to sustain aquatic ecosystems and their values need to be quantified; and ways to improve water productivity by incorporating aquatic ecosystems need to be identified.

5.3.2. Objective

To enhance food security and livelihoods by maintaining aquatic ecosystem services and optimizing fisheries.

This will be achieved through developing and promoting systems of management that improve the benefits to people from these systems. Tools and methodologies will be developed and applied, to foster the effective governance of the aquatic ecosystems and their resources, and to provide quality information on the functions, values, productivity and water requirements of these ecosystems. Capacity to use these tools and techniques within the Benchmark Basins will be strengthened.

5.3.3. Research Areas

Policies, Institutions and Governance

Effective policies, institutions and governance arrangements for management of aquatic ecosystems and their resources are the exception rather than the norm in most developing countries. As a result the development of much more effective and equitable systems of governance is the primary concern of those communities whose livelihoods depend upon aquatic ecosystems, and who are currently marginalized from decision-making concerning water and ecosystem use. Efforts to achieve this engagement of poor stakeholders will however need to be grounded in a better understanding of how these policy-making processes function. The research must identify how responsibilities for managing aquatic resources can be shared between government and community organizations; how different stakeholder groups in society affect policy-making and implementation; and how improved information can lead to decisions that benefit the poor. Key research questions include:

- ✓ What are the factors that influence people's access to, and control over, aquatic ecosystems and their resources?
- ✓ What kinds of governance systems and enabling policies and institutions foster equitable and sustainable management of aquatic ecosystems?
- ✓ What stakeholder engagement processes are most effective in building the capacity of national and local institutions to better understand the livelihoods of poor people and their use of aquatic ecosystems, and to take account of their needs in policy development and governance processes?
- ✓ What knowledge systems, including research and practitioner networks, are needed to help build this capacity and to support development and application of these policies, institutions and governance systems?

Valuation of Ecosystem Goods and Services, and the Costs of Degradation

The development and effective application of improved policies, institutions and governance systems for aquatic ecosystems and fisheries, needs to be supported by better information on the ecological characteristics of these systems, of the functions they sustain, and the benefits they provide. Only rarely however is this information available, and much of the existing data are fragmented, dispersed and dated. Information on the biophysical characteristics of different aquatic ecosystems, on the functions they sustain, and levels of use by different communities and social groups needs to be improved. Building upon this information the consequent economic and social values of these systems, and their contributions to sustaining livelihoods, reducing poverty, and improving food security need to be assessed and communicated. This must be done in such a way as to improve capacity to effect such analyses, wherever this information will assist in improving governance and the quality of decision making about aquatic ecosystems and water use. Key research questions include:

- ✓ What are the primary biophysical characteristics of different aquatic ecosystems and how does their ecological functioning depend upon these characteristics?
- ✓ What are the monetary and non-monetary values of the goods and services provided by these different ecosystems, and what proportion of household/community economies do they comprise?
- ✓ What are the social and economic costs of the degradation of aquatic ecosystems, the decline of the ecological functions they sustain, and the loss of their goods and services?
- ✓ What are the most appropriate tools to generate this information rapidly and for use by poor stakeholders?

Environmental Water Requirements

Several international initiatives have resulted in an increased awareness of the need for a new approach to managing water productivity at the basin level. For example, the importance of assessing the water requirements of fish populations and the mitigation of fish losses on downstream floodplains through flow releases is now recognized. The challenge today however is to build on this growing awareness and to provide policy and management processes at local, national and regional level with information on the specific requirements of individual river systems. There is an urgent need to provide accurate information on both the quantity and the quality of water required to sustain different biological and physical features of these ecosystems, and the different levels of benefits they can provide. This will require a major investment to improve understanding of the ways in which river flows sustain aquatic ecosystems, their biological and physical characteristics, and the functions that depend upon these. Key research questions include:

- ✓ What are the quantitative relationships between the pattern and timing of water flow, water quality, sediment loading, and

other hydrological factors, the characteristics and functions of aquatic ecosystems, and the goods and services that are of high priority for food security and livelihoods?

- ✓ What rigorous predictive hydrological, biological and social assessment tools and methodologies exist or need to be developed for the determination, management and monitoring of environmental flow requirements in different aquatic ecosystems?
- ✓ What are the specific freshwater requirements for coastal ecosystems?
- ✓ What are the patterns of river flow, habitat structure and other biophysical factors that are necessary to sustain river fisheries production at specific levels?
- ✓ What models of fish production dynamics can be integrated most effectively into these modeling methodologies?

Improving Water Productivity

Various hydrological and engineering approaches have been developed to improve water productivity by reducing water losses. However, strategies for increasing output have so far been limited to crop cultivation. Major opportunities exist to increase water productivity by integrating fish and other living aquatic resources into farming systems at field level, as well as in larger irrigation systems and flood-prone areas. Key research questions include:

- ✓ When and how can water productivity and livelihoods be improved by integrating fish production and harvest of other aquatic animals and plants into farming and irrigation/flood-prone systems?
- ✓ How do the monetary, social and nutritional values of these additional water-use benefits compare with those for crops?
- ✓ What new technologies can be designed to further improve the integration of fisheries into farming systems?

5.3.4. Outputs

Expected outputs will include: (1) Assessment of the factors determining access to aquatic resources by target communities and social groups, and how these can be managed in each Benchmark Basin; (2) Specific guidance on the form of governance systems, policies and institutions that foster equitable and sustainable management of aquatic ecosystems and their resources in each Benchmark Basin, and generic guidance on approaches that can be used in other basins; (3) Improved technical capacity and information systems that will support the development and application of such governance systems, policies and institutions; (4) Assessments of the ecological functions of key aquatic ecosystems, and valuations of the goods and services provided by them, and the costs of ecosystem degradation; (5) Improved tools and methodologies for generating such information rapidly and in an accessible manner; (6) Projections of the impacts of specific degrees of hydrological change on the ecological functions of different aquatic ecosystems in selected basins and of the different goods and services they provide; (7) Improved methodologies for assessment of environmental water requirements of different aquatic ecosystems; (8) Quantification of the freshwater requirements of coastal ecosystems in selected basins; (9) Development and application of river fisheries production models; (10) Assessment of the current and potential contribution of aquatic resources to water productivity in different farming systems, notably irrigated and flood-prone systems; (11) Quantification of the benefits that can be obtained by integrating fish production and harvest of other aquatic animals and plants into farming systems; (12) Improved technologies for integrating aquaculture and fisheries into different farming systems.

5.3.5. Impacts

Anticipated impacts will include: (1) Empowerment and engagement of poor stakeholders in the management of aquatic ecosystems and of the water required to sustain

these; (2) Improved livelihood opportunities, food security, and health for these vulnerable communities; (3) Sustained production from river fisheries, and increased production from aquaculture; (4) Improvement in overall water productivity at farm, community and basin levels; (5) Arrested degradation of aquatic ecosystems.

5.4 Integrated Basin Water Management Systems (Theme 4)

5.4.1. Introduction

This research theme seeks to identify ways and means to achieve the overall target of the Challenge Program at basin level. At this level, water productivity in agriculture is interpreted broadly to encompass productivity of agricultural production systems - crops (for food, fibre, fodder and tree products), livestock and fisheries resources. In identifying the most important areas of intervention and integration that will mitigate the water crisis, two important future challenges are considered. The first is for those river basins (or sub-basins) where the current levels of water withdrawals and use are low, constrained mainly by inadequate water resources development for agricultural use (i.e. basins with economic water scarcity). In such basins, the pressure to develop more water resources is increasing, and the challenge is to use water more sustainably, avoiding the institutional, environmental and poverty pitfalls experienced in other basins. A second and different challenge is for those river basins (or sub-basins) where water resources have already been intensively developed, and the current levels of water withdrawals and agricultural water use are approaching or have passed sustainable limits. In these cases, the challenge is to restore the system to within sustainable limits, mainly through demand management and re-allocation.

5.4.2. Objective

To improve the productivity of water (in crop, livestock and fisheries production systems and ecosystem services) within the basin, by generating and applying knowledge on how to manage trade-offs and promote synergies to enhance water productivity, while maintaining or improving food security and environmental sustainability.

This will be achieved through research, capacity building and outreach activities in three key areas at a basin level : 1) integrated decision support tools and information; 2) innovative technologies and management strategies; and 3) effective policies and institutional mechanisms.

5.4.3 Research Areas

Integrated Decision Support Tools and Information

Effective integrated management of water resources at basin level is complicated by the fact that the use of water and land at one location affects how water is used at another location, often in counterintuitive or complex ways. Misunderstandings can lead to policies that adversely affect one set of users, while trying to improve conditions for others. There are at least two major dimensions to this: the consequences of upstream use on downstream availability, and how actions taken at one scale affect uses and users at other scales. Improved information and appropriate decision support tools are needed to understand fully the constraints, opportunities and consequences of different intervention strategies. It is expected that through such improved understanding policy makers, planners, development agencies, and resource users will make more informed decisions at a basin level. The key issues and questions to be addressed will include:

- ✓ Resource status and use options must be explored. What are the prospects for agricultural, fisheries, and livestock intensification, for the optimization of fisheries, farming and forest systems, for preserving unique ecosystems such as wetlands and upland catchment areas? What are the most efficient, equitable, and sustainable water allocation mechanisms for agriculture, fisheries, electricity generation, and urban and industrial use, acceptable to all basin stakeholders?
- ✓ Effective basin water management requires a better understanding of the complex set of water-related interactions that occur across temporal and spatial scales, especially the upstream-downstream interaction. What are the consequences of various upstream interventions of the downstream ecosystem and its people? Are there win-win solutions?
- ✓ Trade-offs between food and environmental security must be understood. Livelihoods are derived both from natural and managed eco-systems. There is a pressing need to reduce impacts of managed eco-systems on natural ones, and to manage water to meet the needs of both. How can trade-offs between different uses be managed to ensure a pro-poor development approach and improved food security?
- ✓ Monitoring and evaluation provide valuable management information, and yet most of our agricultural ecosystems are inadequately monitored and evaluated. What indicators are required for different basins and sub-basins? What is the minimum data set requirement? How should such data be collected, stored, analyzed and disseminated to ensure that it is accepted by all stakeholders and that it is effectively used for decision making?
- ✓ "What-if" scenarios generated using predictive tools assist in understanding the consequences of possible interventions in terms of food security, poverty, ecological services, and other important objectives. What tools are available and under what conditions should they be used? How can local stakeholders be involved in predicting the future of their environment and food security status? How do the results of such studies be integrated into the decision-making processes of the policy makers, planners, development agencies and resource users?

Innovative technologies and management strategies

In most basins water and land resources are not being allocated, used and managed optimally. This research will seek ways of enhancing food security, by developing, adapting and applying innovative technologies and management strategies for the use of rainwater, surface water, and groundwater, and the reuse of urban wastewater. Special effort will be devoted to developing technologies and management strategies that enhance both food and environmental security by examining how synergies between different uses can be promoted to enhance water productivity, whilst maintaining or improving environmental sustainability. Key issues and research questions include:

- ✓ Rainwater is the only source of agricultural water for many rural poor. What are appropriate management strategies for dealing with climatic variability and droughts, at different scales within a river basin context? What pro-poor technologies should be promoted in different ecological and socio-economic settings? What landuse and management practices should be promoted to reduced landuse-related surface water degradation?

- ✓ Agriculture accounts for the largest withdrawal of river water in most basins. What are the sustainable limits in different ecological and socio-economic settings? What are the options for reducing agricultural water withdrawals, if the limits are being exceeded? What is the untapped potential of the basin and how can it be tapped? How can withdrawals be managed to minimise conflicts and environmental degradation, and to protect wetland ecosystems? What flood water storage strategies should be promoted under different ecological and socio-economic settings?
- ✓ Groundwater is recognized as enabling increases in agriculture production through providing a flexible and reliable water supply. However, over-exploitation and degradation of groundwater is occurring in many areas, with negative implications for the poor, the environment and food production. How can research enhance groundwater recharge, protect groundwater quality, and reduce the cost of groundwater development? What agricultural production strategies make more effective and efficient use of groundwater, in conjunction with the use of rainwater and surface water? How can the conflicts between using groundwater for food versus using it for maintaining aquatic ecosystems be managed?
- ✓ Wastewater reuse seeks to recapture water and nutrients transferred to urban areas, creating health problems as well as opportunities for urban and peri-urban food (crop and livestock products) and employment. What are the actual and health risks related to wastewater reuse and what are the appropriate interventions points in the wastewater chain for maximum impact to reduce associated risks? What are holistic approaches for safe wastewater use in agriculture?

Effective policies and institutional mechanisms

Effective governance is a prerequisite to achieve integrated water resources management. With water scarcity and increasing competition for water, the need for more effective and adaptive governance through better stakeholder participation, improved policies and institutional mechanisms for managing river basin water resources is increasingly critical. Many developing countries are in the process of reforming their water sector and are experimenting with different strategies. However, if the past is anything to go by the mismatch between normative prescriptions of good water policy and institutional mechanisms and actual practices is likely to persist. This research aims to address this by ensuring that policies and institutional mechanisms create an enabling environment for resource users to take the right actions. Key issues and research questions include:

- ✓ What are the policy, investment and subsidy requirements for achieving the objective of the Challenge Program at the basin level? How can policy making be transformed into a more inclusive process, to ensure that it reflects the wishes and aspirations of the stakeholders? How should economic instruments be used in order to encourage poor resource users to conserve resources? How can sectoral policies affecting water development and use be harmonized?
- ✓ What models of river basin management work and how should they be adapted to fit different basin and country contexts? What is the appropriate combination of central government, local government and community management agencies? How should roles and responsibilities be shared? How should they be financed, monitored and evaluated? What institutional mechanisms are most effective in minimizing transaction costs and resolving conflicts? What are the dynamics and lessons of institutional

reform and what lessons are there for the design of good institutions?

- ✓ Past approaches for river basin planning have often not been implemented, due to lack of funding and because they were top-down and did not adequately involve the basin stakeholders. It is now recognized that participatory planning and negotiated basin development is the way forward. How can participatory planning and negotiated basin development be promoted?
- ✓ What types of water rights (formal/informal, tradable/non-tradable, etc.) are most effective under alternative water allocation systems and what are the processes by which water rights are recognized or conferred? How do these processes influence access by the poor, women, and landless? What are the impacts of alternative water allocation mechanisms on farmers' water use, choice of inputs, investments, productivity of water, food production and income?

5.4.4. Outputs

Expected outputs will include: (1) Improved understanding of issues of scale, upstream-downstream interactions and basin governance requirements, documented in publications; (2) Effective technical and management strategies adapted to specific locations, addressing the conjunctive management of surface water, groundwater and rainwater, as well as the rural-urban, and agriculture-ecosystem interfaces; (3) A basket of tools for sustainable river basin management; (4) Improved data and information for local, regional and global use; (5) Capacity built to put understanding into practice and to utilize tools; (6) Capacity built to manage basin water resources sustainably; (7) A methodological framework for use by researchers and practitioners of integrated river basin management.

5.4.5. Impacts

Anticipated impacts will include: (1) Increased food security in the Benchmark Basins, and improved or conserved environmental integrity; (2) Secure access to water by the agrarian poor, especially in the light of water reallocations; (3) Improved productivity with less soil and water degradation in rainfed areas; (4) A decrease in the rate of groundwater decline; (5) Improved agricultural and ecosystem water productivity at basin scale; (6) Improved health in peri-urban areas reusing urban wastewater for agriculture; (7) Uptake of methodologies beyond the Benchmark Basins.

5.5 The Global and National Food and Water System (Working Group 5)

5.5.1. Introduction

Global and national policies and institutions and the dynamics of global change will profoundly influence future progress in (1) maintaining growth in irrigated and rainfed agricultural production; (2) reversing the ongoing degradation of watersheds, irrigated land, and water-related ecosystems; (3) increasing incomes and enhancing and safeguarding the rights to domestic and irrigation water supplies for the poor, women, and socially-excluded groups such as minorities and indigenous groups; (4) improving the effectiveness of water use in rainfed agricultural areas, including less favorable and dry-land areas; and (5) managing conflicts over water use.

5.5.2. Objective

To facilitate better policy-making and the implementation of necessary changes within the food and water system, at international, regional and national levels.

This will be achieved by undertaking research on how policies, institutions, and processes of change in the global and national food and water system affect food security, livelihoods, health, and the

environment, and by engaging in action research, outreach and capacity-building at the individual and institution level

5.5.3 Research Areas

Globalization, Trade, Macroeconomic, and Sectoral Policies

The process of globalization, which includes increased integration across countries through liberalized trade, financial flows, technology flows, and information flows, can in the long run generate significant economic benefits for developing countries. But globalization and economic liberalization also carry the risk of economic and political instability, worsening inequality and vulnerability of the poor, and the loss of agricultural production and income to other countries that subsidize their own agricultural producers. Moreover, globalization and trade and macroeconomic policies can have profound effects on water and key related natural resources such as land and forests, through their impacts on growth, technology, and institutions. A better understanding of the impact of global and national policies on water resources and food systems is therefore essential to mitigate the adjustment process and to avoid long-term damage. Key research questions include:

- ✓ How can rights and access to water by the poor, women, and socially excluded groups be established and safeguarded, in the processes of global and national demographic, economic and political change that are shaping the developing regions?
- ✓ How can globalization and trade and economic liberalization be managed to best enhance environmental policy and the management of water quality and water-related ecosystems?
- ✓ How can globalization and trade and economic liberalization be managed to best encourage technological and institutional change in water use that improves the efficiency of water use and water quality and water-related ecosystems?
- ✓ To what extent can imports of virtual water through food imports be utilized to conserve water domestically and achieve water and food security goals?
- ✓ How can water markets and the use of other economic incentives in water sector assist national economies to respond to the demands of increasing trade and economic liberalization?

Incentives, Investment and Financing of Agricultural Water Development and Water Supply

In much of the world, low water prices and high subsidies for capital investment and operations and maintenance threaten the effectiveness of water allocation and the financial viability of water development for agriculture and urban water supply. This problem is particularly serious due to the huge future needs for financial resources for these sectors. New sources of water are increasingly expensive to exploit, and the development of new dams often imposes high environmental and social costs, including the displacement of communities from dam and reservoir sites. In order to guide policy makers, available estimates of total investment requirements must be carefully refined for individual countries and regions; the most effective allocations across different types of investments and different regions must be assessed; and appropriate incentives and methods for financing of needed investments must be determined. Key research questions include:

- ✓ To what extent can and should capital and/or operations and maintenance costs be recovered from water users and other beneficiaries in each sector and what are the distributional and poverty consequences of alternative cost recovery policies?
- ✓ What water pricing and water rights policies and institutions will best

contribute to appropriate levels of cost recovery and more efficient and effective water use?

- ✓ What should be the relative role of private and public investment for expansion and maintenance of irrigation, water supply and sanitation systems?
- ✓ What should be the allocation of investment in water development vs. other kinds of investments, including agricultural research and other types of physical infrastructure and social investments such as education, health, and nutrition?
- ✓ What should be the allocation of investment within agriculture, between irrigated, rainfed and dryland agriculture, livestock, fisheries, and other agro-ecosystems?
- ✓ What should be the future investment in dams, taking into account future water needs as well as the financial, social, and environmental costs of dam building?

Transboundary Water Policy and Institutions

River basins and groundwater aquifers that cross national or sub-national boundaries present major challenges to effective water management. Water resources have contributed to tension and conflict between competing users around the globe, including between nations, tribes, water-use sectors, or states and provinces. The primary challenge is to get ahead of the "crisis curve," to help develop institutional capacity and a culture of cooperation in advance of costly, time-consuming crises, which in turn threaten lives, regional stability, and ecosystem health. This research will investigate the mechanisms by which transboundary waters are shared, including institutions, allocation mechanisms, and processes for conflict prevention and resolution. Key research questions include:

- ✓ What is the role of international and national institutions, agricultural research organizations, civil society organizations, water user organizations, and NGOs in the prevention of conflicts over water resources and in the assistance of transboundary negotiations?
- ✓ What is the potential of market-oriented approaches in transboundary water sharing that emphasize equitable allocation of the economic returns to water, rather than allocation of quantities of water?
- ✓ How can agricultural development, rural livelihoods, and the food security concerns of domestic stakeholders best be integrated into transboundary river basin agreements?
- ✓ How can water quality, environmental concerns, and social concerns, including health and nutrition, best be integrated into transboundary river basin agreements?

Adapting to Changes in the Global Water Cycle

In addition to its value for direct human consumption, water is integrally linked to the provision and quality of ecosystem services—the conditions and processes through which ecosystems sustain and fulfill human life, including the provision of food and the regulation of the quantity and quality of water. But global ecosystems face the prospect of changing climates and global water cycles that could adversely affect the goal of meeting global food needs, and drastically increase the risk of water and food shortages for vulnerable populations. Global warming and associated changes in hydrological regimes and other climatic variables can lead to higher temperatures, shorter growing seasons, changing moisture regimes and extreme weather patterns, and can also have secondary effects on social and economic systems, induced by increasing concentrations of greenhouse gases from human activities, especially carbon dioxide (CO_2). In the nearer term, human alteration of land use patterns, urbanization, elimination of wetlands, nutrient overloading in water systems, and other biophysical changes could dramatically affect the ability of the global water cycle to

support needed food production. Key research questions include:

- ✓ What is the impact of global and national economic and population growth and changing land and water use patterns on global water cycles?
- ✓ How will changes in global water cycles affect food provision and the access of the poor, women, and disadvantaged groups to ecosystem services?
- ✓ How can global and national policies and institutions prevent or mitigate adverse human impacts on global water cycles?
- ✓ How can global and national policies and institutions prevent or mitigate the negative impacts of changes in global water cycles on water and food security and on the livelihoods of the poor, women, and the socially excluded?

5.5.4 Outputs

The expected outputs of the working group include, firstly, a body of cross-cutting research, and the synthesis of cross-cutting research on policy and institutional issues that affect global and national water and food systems. The synthesis will be developed through the forum function operated by the thematic group, and through the establishment of reliable benchmark data and comparative analysis of the Benchmark Basins. Secondly, outreach activities will be undertaken in order to disseminate knowledge and to build capacity at the individual and institutional levels. Outreach activities will be integrated and run concurrently with the research program.

Expected outputs include : (1) Publication of state-of-the-art research methodologies, research reports, journal articles, books, policy briefs, and media briefings that evaluate and explain policies, institutions, and the dynamics of change in the global and national food and water system; (2) Development of institutional capacity for evaluation of appropriate global and national water and food policies in NARES, NGOs, national governments (including ministries of water, agricultural, finance, and planning), and international institutions; (3) Conversion of policy and institutional knowledge for dissemination through training courses, distance learning, leadership training, policy dialogues, conflict resolution and mediation techniques, and development of decision support systems; (4) Establishment of a forum for cross-country learning; (5) Development of databases and comprehensive methodologies, models and analytical frameworks for assessing global and national food and water systems.

5.5.5. Impacts

The anticipated impacts of the research and outreach and dissemination program include : (1) Improvement in policies and institutions in the global and national food and water system; (2) Increased food production and food security with reduced use of water in agriculture; (3) Improved livelihoods and reduced poverty; (4) Improved water quality and environmental quality; (5) Reduced frequency and intensity of water-related conflict; (6) Enhanced transparency, accountability, and public participation in national policy processes; (7) Empowerment of civil society groups within national policy processes; (8) Enhanced effectiveness of national research systems.

6. Benchmark Basins

The CP Benchmark Basins are the river basins where the CP Water and Food chooses to focus a large part (e.g. at least three-quarters) of its core funded research, to implement an eco-regional focus on rural and peri-urban areas in river basins with low average incomes and high physical, economic or environmental water scarcity or water stress, with particular focus on low-income groups within these areas.

Choosing Benchmark Basins is important from a perspective of sharing basic data and information, developing longer term partnerships, developing baselines and measuring impact. Not all CP work would necessarily have to be done in the Benchmark Basins, and new ones could be added at a later stage as well – but the initial choice would be a very important guide in where to work in the first phase. The role and function of the Benchmark Basins in the CP Water and Food is further detailed in the Business Plan (section B).

The number of Benchmark Basins initially selected will be limited, but is expected to grow during the CP implementation, as more knowledge on research priorities becomes available through the CA and the Dialogue on Water, Food and Environment as well as the early results of the CP itself (i.e. in subsequent CP Calls for Proposals). Criteria that play a role in Benchmark Basin selection are:

1. Basins that have high water scarcity or water stress[10].
2. Basins that have low average incomes, and an opportunity to focus on low income and vulnerable groups within those basins.
3. Willing and able NARES partners that are prepared to contribute and participate, and have given priority to the basin in question.
4. Basins where the CP Water and Food has a comparative advantage.
5. Basins where there is a high probability of interventions that lead to impacts.
6. Opportunities to cooperate with, and build on, ongoing research in related areas; and
7. Regional distribution of the resulting set of initial basins over the priority focal areas of the CGIAR.

The basins need to be relatively large (certainly compared to the usual scale of measurement in agricultural, often field-based, research) so that upstream-downstream issues as well as institutional and policy issues can be effectively addressed, as well as from the perspective of wanting to have considerable impact on the lives and livelihoods of a sufficiently large number of people to warrant the investment. Additional criteria for Benchmark Basins are a representative range of eco-regions, geographic regions, etc. Also important are the nature and urgency of the water and food related issues, the position of the basin on the water development curve, and the willingness and ability of the assorted stakeholders to take action (political will and management capability).

When choosing large basins, criteria will include the opportunities for working at different scales – from the full basin scale for basin-level water management institutions, to sub-catchments for analysis of - for example - catchment management programs, down to the farm or field-scale for testing and analysis of drought resistant plant varieties.

Some basins might be chosen because they exhibit urgent agriculture-related water scarcity issues – such as the Yellow River basin in China or basins in the CWANA region. Others might be chosen because they have a very high level of ecosystem services that are threatened by

[10] Water scarcity and water stress have many relevant dimensions. The most obvious factor is lack of rainfall, but low population density or high capacity to deal with stress (through different forms of capital) may negate this potential stress. In other areas, medium rainfall combined with intense (over-) development may lead to very high water stress. In addition, many other factors, from water quality to access to water for vulnerable, low-income groups, need to be taken into account when defining water stress.

potential development such as the Okavango delta or the Mekong River basin. Other basins have the advantage of many years of prior work that allow a quick start. Some basins may be particularly attractive because of the ongoing process of reform or cooperation that offers opportunities to have impact on poverty alleviation, e.g. the Nile basin and Nile Basin Initiative.

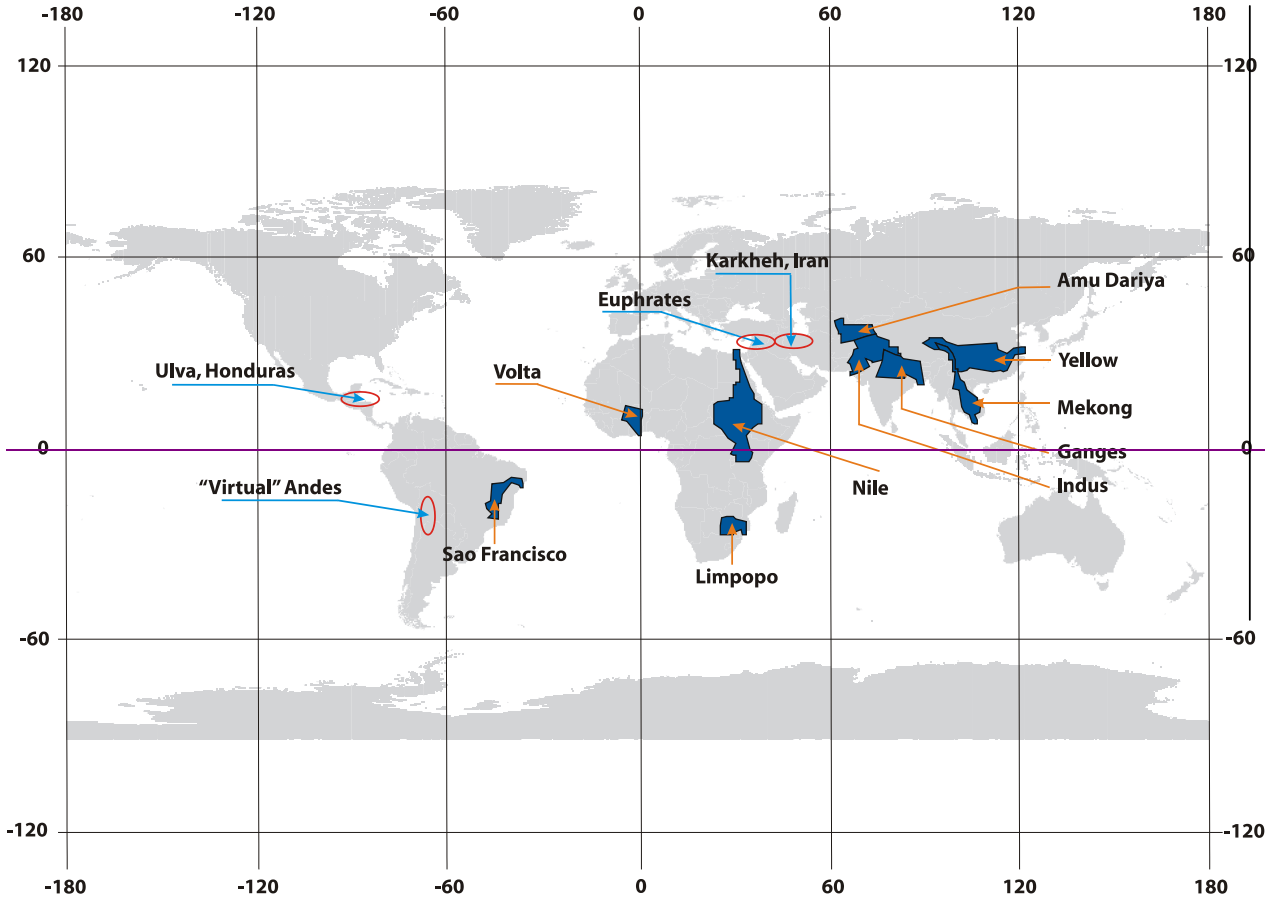
6.1 The initial set of CP Water and Food Benchmark Basins

An initial set of basins has been selected to focus on: low income basins, areas of high water scarcity and water stress, regional distribution, existing or ongoing work that can be built on and active partners that desire collaboration. The initial set of CP Water and Food Benchmark Basins is given in Table 3 and figure 2. More detailed descriptions of key statistics, main issues, and the degree to which the basin meets the selection criteria, are provided in Annex 4. In addition, two basins in Africa have been identified, the Zambezi and the Niger, that will be the focus of CP capacity building activities and are priorities for subsequent additions to the set of CP Benchmark Basins at a later stage.

The actual number of basins in which the CP Water and Food will initiate research during the first phase will be determined in November, 2002, depending on the reactions and feedback from key stakeholders to this Full Proposal, as follows.

1. There is a minimum of 6 basins in which work will be initiated, because there are strong NARES in each of these that are able to take responsibility and provide (matching) resources – these are the Yellow River, Indo-Gangetic plains, Limpopo, Nile, Karkheh and Sao Francisco basins
2. In addition, feedback is being sought from NARES partners and donors in the period up to November 2002 to ascertain the priority – and financial feasibility – of adding an additional number of basins to the set of six mentioned above.
3. In November 2002 the CP Consortium will decide which basins will be included in the first round and which may be developed for inclusion later. The CP will provide capacity building support to additional basins, particularly in Sub-Saharan Africa. It is also expected that through cooperation with other research programs, such as HELP, UNESCO's river basin program, or several of the global change research programs (see Section 1 of the Business Plan), there will be cooperation with basins in OECD countries where there is research ongoing on similar issues. These basins will be referred to as associated basins.

Figure 2. Location of Proposed Benchmark Basins.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Ganges
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Nile
Volta
Ulva, Honduras
"Virtual" Andes
Sao Francisco
Limpopo

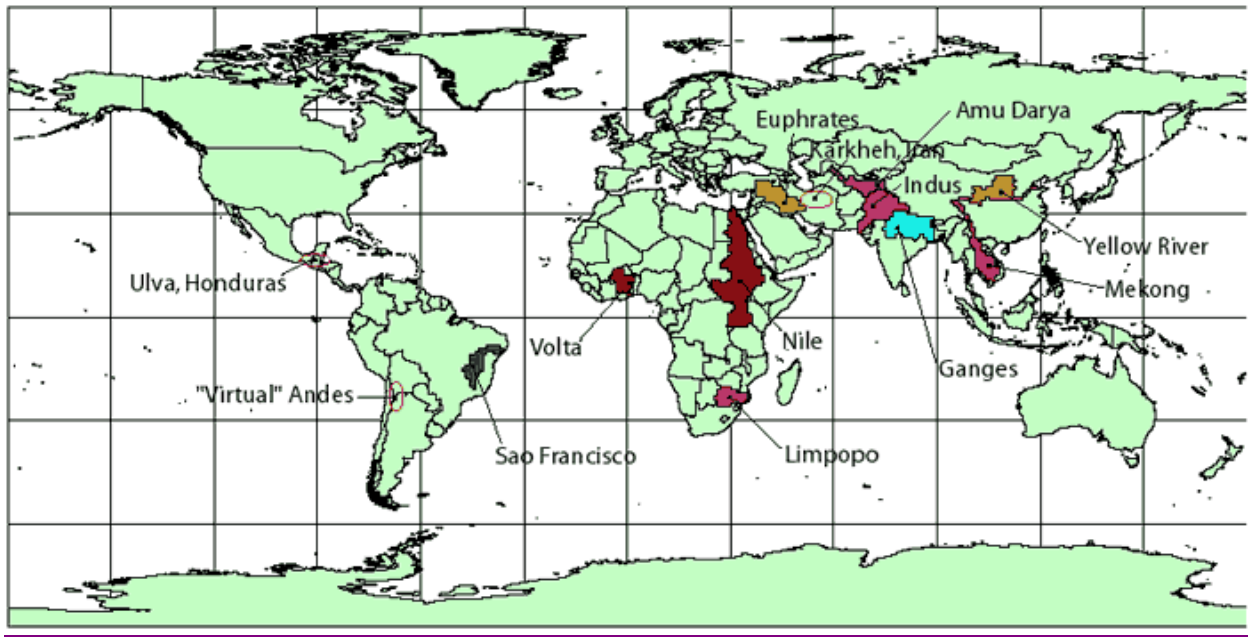

Euphrates
Amu Darya
Karkheh, Iran
Indus
Yellow River
Mekong
Ulva, Honduras
Volta
Nile
Ganges
"Virtual" Andes
Sao Francisco
Limpopo

Table 3. Initial set of CP Water and Food Benchmark Basins.

Asia	Africa	CWANA	LAC
Yellow River	Limpopo	Amu Dariya	Sao Fancisco, Brazil
Mekong	Volta	Karkheh, Iran	Andean Basin (s)
Indus-Gangetic	Nile Basin	Euphrates	Ulua, Honduras

6.2 Dialogue and Comprehensive Assessment Linkages

In most of the planned CP Benchmark Basins the Dialogue on Water, Food and Environment is either active, or planning to start dialogue activities. The Dialogue and the CP will mutually reinforce each other. The CP will encourage and support the Dialogue activities, where possible, and work with the Dialogue groups as stakeholder representatives that can help to identify priorities and later act as a conduit to disseminate and implement research results. The Dialogue groups will participate in the kick-off workshops for the CP Benchmark Basins. The CP also intends to use the Scientific and Technical Advisory Panel (STAP) of senior international experts that has been set up by the Dialogue on Water, Food and Environment, to establish ad-hoc evaluation panels to review proposals made for competitive grant funding.

The Comprehensive Assessment on Water Management for Agriculture is a System-Wide Program of the CGIAR that brings together 11 CGIAR/Future Harvest Centers. It is currently undertaking a series of basin studies in some of the CP Benchmark Basins as well as in other basins around the world. These basin studies will provide an assessment of the potential to increase water productivity and the key innovations that are most promising – both in the CP Benchmark Basins, and in a larger set of basins that can act as comparator basins. At the basin level there will be integration of activities in all basins where both research programs are active. The major distinction between the two is that the Comprehensive Assessment has neither the mandate nor the funds to implement its research results in the basins.

Dialogue on Water, Food and Environment.

Ten key stakeholders in the water, agriculture and environment areas have joined hands to form a strategic alliance – known as the Dialogue on Water, Food and the Environment – to help bridge the chasm between agriculture and environmental communities over the way water should be managed and developed. These organizations range from UN agencies (FAO, UNEP, WHO) to associations of farmers (IFAP), irrigation engineers (ICID), environmental organizations (IUCN, WWF), water umbrella organizations (GWP, WWC) and water research (IWMI, representing the CGIAR). The Dialogue is organized around three main (groups of) activities:

1. *cross-sectoral dialogues at national and basin levels, aimed at developing shared values related to water for food and environmental security;*
2. *a "knowledge-base" of credible and authoritative information – acceptable to both agricultural and environmental communities; and*
3. *local-action activities that aim to provide an information exchange and best-practice identification, platform, linking thousands of local, NGO and bilateral projects and activities into the formal knowledge base(s).*

The goal of the Dialogue is provide a multi-stakeholder learning framework that will generate a body of knowledge to help answer the question, at river basin level, how to manage and develop water resources to achieve food security as well as environmental security (www.iwmi.org/dialogue).

Hence, the knowledge base generated in the Comprehensive Assessment can usefully be applied by the Challenge Program. Through the CP's partnerships with ARIs, NARES and NGOs in the basins, a multiplier effect will be created which will maximize the impact of the research results of both programs.

B. Business Plan

1. Overview of the business model

The Challenge Program (CP) on Water and Food is one of the pilot programs designed to re-invent the business model for the CGIAR. The following five key points characterize the new proposed business model approach that the CP on Water and Food proposes.

1. **Consortium**: Truly shared decision-making on strategic management and quality control through the CP Water and Food Consortium of 18 IARC, NARES, ARI and NGO partners.
2. **Thematic Groups**: Setting research agendas through communities of practice (thematic groups) in five key, linked research themes coordinated primarily by CGIAR centers.
3. **Benchmark basins**: Providing geographical focus, regional/local priorities and emphasis on impacts through benchmark basins coordinated primarily by NARES partners.
4. **Competitive grants**: Driving the research agenda forward through competitive grants made from CP core funds of the CP Water and Food, with grant awards based on independent and anonymous peer review mechanisms to determine merit and alignment with thematic and basin priorities.
5. **Global Change agenda**: Linking to the global change research agenda to both build on, and s well as contribute to, the water-related global change research agenda, primarily through ARI partners.

The CP Water and Food consortium

Effective research for development requires new partnerships that take into account the changing strengths of research organizations in developed countries, ARIs[11], research and extension organizations in developing countries, NARES[12], and international research centers such as the Future Harvest Centers supported by the CGIAR.

On the one hand, ARIs have access to a wealth of knowledge and technologies in advanced research areas such as functional genomics, or global water cycle change modeling. Research in some of these areas requires major investments and large consortia that lead to the necessity of increased scales of research projects. On the other hand, the increasing number of highly trained scientists in many parts of the developing world, and major research systems in some large developing countries has considerably increased the potential of many – but not all – developing countries to carry out high quality research independently. The relevant research systems in large countries in the South now have larger budgets and larger numbers of capable scientists than the complete CGIAR system put together.

In this changing world, the role of the Future Harvest Centers shifts from being international research organizations that initiate and have primary responsibility for doing research in the developing world, to becoming organizations that derive their added value primarily from brokering and facilitating international research networks. The international research centers link

[11]Advanced Research Institutes, generally interpreted as research institutes in OECD countries.

[12] National Agricultural Research and Extension Systems – NARES, that, in a broad definition used here includes both the national research system ***and*** the institutes in the system (also referred to as NARIS), that is, including the universities and all other research organizations relevant for the water and food research agenda – e.g. agricultural, environmental, water, or fisheries research organizations.

ARIs and NARES in complex multi-disciplinary research programs with a strong focus on poverty alleviation and capacity building. The brokering role is a substantive role that does require the maintenance of high-quality research capacity within the system of international centers. The nature of the role of the Future Harvest Ccenters should, however, adapt itself to playing different roles: from (1) providing a two-way international window on the world for large, high-capacity countries such as Brazil, India or China, to (2) playing a major role in building capacity for research in countries with severely restricted internal capacities.

The key innovation in terms of partnership proposed for the CP Water and Food is that primary ownership of the program, and its strategic management, is proposed as a shared responsibility of an 18-member Consortium. The Consortium has decision-making responsibility for key strategic decisions and provides oversight for operational management in the program. Consortia, or joint ventures of a group of partners linked together by an agreement for a specific purpose, are used widely in the business world, and have a well-defined legal meaning. The CP Water and Food Consortium has agreed on a Joint-Venture agreement in its first meeting on June 13-14 2002, that is attached to this proposal (Annex 1).

The CP Consortium bears the strategic management responsibility for the proposed CP Water and Food, within the confines of the oversight mechanisms agreed with the CGIAR, which exercises a "shareholder" role with respect to the CP. The CP Consortium, as a group of partners, shares responsibility for the business model, and for the funds provided directly to the Consortium. It does not bear direct responsibility for the potentially much larger flows of funds that are directed by a large array of partners to implement the research in line with the research agenda developed through the CP. The Consortium oversees a process of calling for proposals and awarding research grants in line with the CP research agenda and is responsible for setting up and running the various CP-internal processes of independent review that are crucial to CP implementation and quality control, i.e. review of proposals, review of (scientific) outputs and review of projects. A model for the competitive grants process, development of consortia and independent review mechanisms that is considered valuable for the CP Water and Food is that developed by the European Commission for the EU Framework Research programs. Other valuable experience -- from which the CP Water and Food intends to learn -- has been gained recently by competitive research grant schemes set up by the World Bank and countries in the Caucasus and Central Asia.

In addition to the limited number of members of the CP Consortium, which will act as a Steering Committee for the CP, a much larger number of organizations will participate in CP Water and Food research projects. Participating organizations are defined as all those organizations that participate in CP Water and Food research projects.

Setting the Thematic Research Agenda

Thematic groups of scientists and researchers – including, but not limited to, representatives of all participating organizations – develop the thematic research agenda. The goal is that these thematic groups represent the best science available, globally, for each of the themes and that the impact of the research agenda developed by these groups goes considerably beyond the directly funded CP research. Successful examples in other fields, e.g. the global change research agenda in general and the ICSU Geosphere-Biosphere program, or the Intergovernmental Panel on Climate change (IPCC) in particular, show that the research agendas developed by authoritative groups of top-level researchers can have a major agenda-setting impact on the research (funds) directed or allocated by national and international research funding agencies. The ambition of the CP Water and Food is to become the primary international effort that sets and evolves the research agenda

related to water and food – at least in the developing world but quite possibly globally.

To ascertain that a significant portion of the research agenda developed by the CP Thematic Groups is implemented, a significant amount of core CP funding should be allocated to projects that aim to implement the agenda through a process of competitive research grants. The research agendas developed by the Thematic Groups will form the basis for the calls for research proposals. Crucial in this process will be the competitive (i.e. open to all, within the rules of the game) research grants process, with an independent review process. That is, independent experts and stakeholder representatives that are neither involved in the Working Groups nor in the proposals should evaluate the research proposals in order to leave thematic group researcher and research organizations free to be included in proposals.

After a number of years of operation, however, the indirect impact of the CP in developing research agendas that influence the budget allocations of research funding organizations in developed and developing countries may, if the CP is successful, well outweigh the impact of the directly funded research alone. Independent review within the program, at project and theme level is organized and overseen by the Consortium. The evaluation of impact and organization of the CP as a program will however be carried out under the auspices of the Science Council of the CGIAR.

The second role of the Thematic Groups will be to achieve synthesis of the results of the projects carried out in the theme. This will involve: (a) development of methodology for the thematic areas early on in the process; (b) interaction and coordination across thematic areas with the other Groups; (c) synthesis of the results within the thematic area through commissioned research and overview or synthesis papers. This second role of the Thematic Group implies that in addition to the funds for competitive grants, funds should be reserved for the synthesis work of the Thematic Groups. The objective is that the CP Water and Food would periodically bring out major synthesis documents that have undergone extensive review and that indicate the state of the art, new developments in research and their realized as well as potential impact on food security, poverty alleviation, public health and environmental quality. The model that may be used as an example is the IPCC reporting on climate change scenarios, impacts and response options.

Achieving Impacts through Benchmark Basins

The five CP research themes have been selected to focus on priority research issues, rather than to provide (eco)-regional focus. The CP on Water and Food will prioritize, however, rural and peri-urban areas in river basins with low average incomes and high physical, economic or environmental water scarcity or water stress, with a particular focus on low-income groups within these areas.

The eco-regional focus is achieved through the selection of a limited number of (relatively large-scale) Benchmark Basins in which at least seventy-five percent of the CP competitive research grant funding is concentrated. The Benchmark Basins would serve several purposes:

- Provide (eco-)regional focus on high priority areas.
- Develop research priorities from a regional/local/basin perspective.
- Bring together research projects that are part of different research themes in a single, coherent setting (and within nested scales from field to basin).
- Monitor impact at realistic / large scales that make a significant contribution to achieving the CP objectives.
- Field-test interventions that can be disseminated in other basins.

Whereas the international centers have a comparative advantage in coordination of thematic areas across regional boundaries, the NARES have a comparative advantage in coordination of research within the Benchmark Basins that are within their geographic mandate. NARES partners will provide primary leadership and coordination for the Benchmark Basins for all but possibly several cases where, for international basins, other partners are better positioned to fulfill this role. In addition to the NARES members in the Consortium (that all act as Benchmark Basin lead organizations), other partners can lead additional Benchmark Basins.

One of the first priorities of the CP will be to develop the research priorities for each basin and establish a research platform and a baseline, in each of the Benchmark Basins selected. The Benchmark Basin Coordinators will be responsible for establishment of a baseline, development of a platform that can accommodate research projects from each of the 5 CP themes in that area, and monitoring and synthesis of results or research and impacts on water productivity, livelihoods, health and environmental quality.

Competitive grants

The direct, unrestricted funding for the CP would be primarily used for financing research projects awarded through a competitive bidding process that is open to the Consortium Members as well as other research organizations. In addition, the core funds will be used for CP management and synthesis activities, as well as research activities that ensure the coherence and integration of the program as a whole thematically and by basin.

Bidding for projects, in response to calls for proposals to implement the research agenda developed by the Thematic Groups, will be open to all research organizations within the following proposed rules for grants awarded from CP core funds[13]:

1. Each proposed research project needs to include at least two NARES (or NARIS) partners and the contribution from the CP to the combined NARES partners in each project shall be at least 33%.
2. NARES partners from middle-income developing countries *[as defined by a WB or UN list]* will contribute 33% of their total proposed share in project proposals in matching funds (i.e. will provide 1:2 matching funds). NARES partners from low-income countries may be reimbursed up to 100%.
3. Each proposed project shall involve at least one of the five Future Harvest Center Consortium members.
4. Future Harvest Centers may be reimbursed up to 100% of their proposed share in project proposals, but are encouraged to demonstrate matching for their proposed involvement.
5. ARI partners, that is, research organizations from OECD countries, public and private, will demonstrate a 2:1 match for all project funds received from the CP (i.e. will fund two-thirds of their activities in each proposal from other sources than the CP, which may include research funded through other sources relevant to the CP agenda).
6. NGO, or other non-research partners may participate and have up to 100% of their costs reimbursed if their activities contribute directly to dissemination and uptake of CP research results or to capacity building.

[13] In addition to projects paid for out of CP core funds, partners may submit proposals to donors for **restricted** projects that contribute to the CP. Donors may ask the CP to review such project proposals, but such review would be based on donor demand, not mandatory. Partners may also **contribute** projects that are already funded though other sources. For all such projects – core, restricted and contributed – the CP will review the quality of the results, outputs and impacts before the results are incorporated into CP (synthesis) output documents or other products such as databases. The output review process could be comparable to that organized by, for example, the IPCC.

Any research organization can be a partner in a project proposal, and if a proposal in which it participates is granted funding, the organization automatically becomes a CP Water and Food participating organization. Research proposals do not have to be led by Consortium members, i.e., within the above rules any research organization can lead a CP research proposal. Private sector research organizations in developed or developing countries can participate in CP research projects, but have to underwrite the public goods nature of the CP outputs. Non-research organizations in developing countries, or international non-profit organizations, can participate in CP research projects if they play a role in the dissemination and uptake of research results, or associated capacity building in research organizations or stakeholders to carry out research or use the knowledge generated, respectively.

Ad-hoc panels of outside, world-class experts established for this purpose will evaluate proposals submitted to the CP in response to calls for proposals on substantive merit and their contribution to thematic and basin priorities. In case the funding required by the proposals that are evaluated as (1) excellent on merit and (2) strategic in regard to the priorities, exceeds the budget available, the CP Consortium selects the projects that will be funded through majority voting on recommendations prepared by the CP Coordinator (based on criteria to be developed during the Inception Phase) from among the proposals that have been reviewed positively.

The envisaged evaluation process is similar to that used by the European Commission for its grant applications. Other examples on competitive grants schemes are, for instance, the agricultural research competitive grants schemes developed and implemented in recent years by the World Bank in cooperation with countries in the Caucasus and Central Asia. The CP competitive grants process will be further refined during the CP inception phase. It is proposed to have two major calls for proposals during the first 5-year phase of the CP, in the first and third year, and subsequent calls in later phases.

Linking to the Global Agenda

There are at least two agendas at global level that the CP Water and Food should link to, i.e. the global sustainable development agenda and the global change research agenda. In addition, the CP Water and Food is closely linked with two related initiatives: the Dialogue on Water, Food and Environment (the Dialogue) and the Comprehensive Assessment on Water Management for Agriculture. Finally, the CP on Water and Food has agreed a division of labor – and in fact a close cooperation – with the proposed Challenge Program on Genetic Resources. The CP Water and Food is also keen to develop appropriate linkages to other possible CGIAR challenge programs, e.g. regional programs for Africa or the CAC region, or the proposed programs on climate change and desertification. These linkages will be developed as the proposals for those programs develop further.

First, the preparation for the World Summit on Sustainable Development (WSSD) in Johannesburg in August 2002 includes the discussion of relevant targets and actions to which the international community should commit. On water the Millennium Summit, in 2000, adopted a target to halve the population without access to safe drinking water by 2015. Related to water for agriculture, the Secretary General of the UN called for a Blue Revolution in agriculture, that increases the "crop per drop" – but a specific target was not yet adopted. The current preparation of targets for WSSD related to productive water use includes a target to achieve the targeted decreases in malnutrition and rural poverty without increasing the water withdrawn for agriculture (globally) beyond the 2000 level.

If such a target, and associated actions, are gets adopted at WSSD or a later international

forum, the CP on Water and Food would propose to take on the challenge to implement the research necessary to achieve such a target.

Second, there is a very active global change research community linked to water and food issues that the CP Water and Food needs to collaborate with for mutual greater effectiveness and increased impact. For water, it is recognized in the global change research community that the primary drivers of global change over the next 25 years will be demographic and economic (i.e. globalization, trade and economic growth), rather than climate change – even though the latter does play a key role and cannot be ignored. Three cycles have been identified that are changing and have key impacts: water, carbon and food and fiber cycles. There are a number of key international research programs[14] dealing with these changes that are dominated by research organizations in OECD countries and have their research sites primarily in OECD countries as well. The CP Water and Food can build on these programs, e.g. use of methodology, global datasets and global and regional modeling tools, but can also contribute to these programs through its much greater understanding of water and food cycles in the developing world and its focus of research sites in developing country river basins.

Close collaboration with the research in the global change community related to the global water and food cycles will ensure the frontier science character of the CP Water and Food in areas dealing with modeling the global water and food cycles, and in the development of Remote Sensing and GIS related tools and data platforms. Linkages with the global change research community will also ensure that research outputs of the CP Water and Food will be global public goods in at least three categories: (1) technologies related to drought and salt tolerant plant varieties; (2) modeling tools, common sampling protocols and global datasets; (3) policies and institutions dealing with sustainable management of land and water resources - from model laws to models for basin management and water user groups.

Third, the CP Water and Food is closely related to (1) the Dialogue and (2) the Comprehensive Assessment. The objective of the Dialogue on Water, Food and the Environment is to help bridge the chasm between agriculture and environmental communities over the way water should be managed and developed. The core objective of the Comprehensive Assessment is to assess the potential to grow more food with less water in ways that alleviate poverty and sustain or improve human and environmental health. The three initiatives are organized to be interdependent, decentralized processes. They are expected to reinforce and support each other significantly, as outlined above in section A.6.2. The primary roles of the Dialogue and Comprehensive Assessment in the CP can be defined as follows:

- ✓ The Dialogue on Water, Food and Environment (www.iwmi.org/dialogue) opens opportunities for the CGIAR to:
  - Involve more stakeholders, and coordinate with external partners.
  - Help in ddetermining priorities for research from stakeholder perspectives.
  - Provide a delivery channel for public goods research
- ✓ The Comprehensive Assessment of Water Management in Agriculture, a CGIAR system-wide initiative (www.iwmi.org/assessmentCA) provides:
  - Scoping potential for innovations in water and agriculture
  - Research priorities for CP research from a research perspective

[14] The GEWEX project of the World Climate Research Program (WCRP). The Joint Water Project of IGBP, IHDP, WCRP and Diversitas. The Hydrology for Environment Life and Policy (HELP) program of UNESCO. The Global International Waters Assessment (GIWA) of UNEP. The World Water Assessment Program (WWAP) of the UN system. The Global Environmental Change and Food Systems (GECAFS) project of IGBP, IHDP and WCRP.

- Analysis of how much water is really needed for agriculture.

Finally, the proponents of the CP Water and Food have discussed the interface with the proposed CP on Genetic Resources with respect to breeding of drought, salt and submergence tolerant plants. A common scheme has been agreed that divides the breeding of plants for abiotic stresses in 6 steps that start with identifying desirable traits and end with field-testing new varieties. It has been agreed that the CP on Genetic Resources will deal with the "upstream" part of the process that can be summarized as identification of genes and pre-breeding, while the CP on Water and Food would deal with the downstream part from pre-breeding to field-testing. Certain steps in the process, e.g. identification of the desired traits, would be undertaken jointly by the two proposed CPs (Table 4).

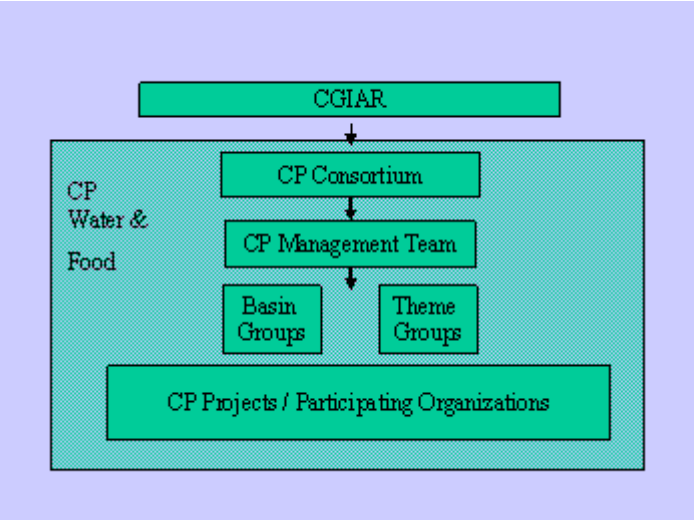
Table 4. Links to CP on Genetic Resources.

1. Identifying desired straits	Joint Activity – CP Genetic, CP Water + Food
2. Discovery of relevant genes	CP Genetics
3. Bringing the desirable genes into plant varieties	CP Genetics
4. Pre-breeding	Joint Activity – CP Genetics, CP Water + Food
5. Breeding	CP Water + Food
6. Dissemination	CP Water + Food

2. Roles and responsibilities

The roles of key actors in the CP Water and Food are described in this section; with emphasis on four key functions, i.e. oversight, strategic management, day-to-day management and implementation of the research. An overview of the management and governance structure is provided in Figure 3 below.

Figure 3. Management and governance structure of the CP Water and Food



Oversight

Oversight for the CP Water and Food as a whole is carried out by the CGIAR AGM, Executive Council and Science Council in a role that is to be further defined by the CGIAR. Based on our discussions with the interim Science Council, we anticipate that there will be an independent body set up for the external monitoring of the progress of all the Challenge Programs of the CGIAR.

Strategic management

The CP Consortium is jointly responsible for strategic management and quality control of the CP, and accountable to the CGIAR. The ultimate responsibility for the implementation of the CP Water and Food rests with the Consortium Steering Committee. The Consortium Steering Committee consists of one representative from each Consortium member, appointed by each member. Decision making in the Consortium Steering Committee is by simple majority voting[15]. The CP Consortium Leading Member chairs the Consortium, is the legal entity representing the Consortium and acts on behalf of the Consortium for tasks delegated to it by the Consortium.

The Consortium appoints a Coordinator nominated by the Leading Member, Lead Researchers nominated by the Future Harvest Centers responsible for each Theme and Benchmark Basin Coordinators nominated by the NARES partners responsible for each Benchmark Basin. The CP Coordinator reports to the Consortium. The CP Management Team, chaired by the CP Coordinator and consisting of the Theme Lead Researchers and Benchmark Basin Coordinators, is responsible for day-to-day management within annual budgets and workplans approved by the Consortium. These roles and duties are clearly laid out in detail in the Joint Venture Agreement for the Consortium that was

[15] Majority voting will be used for all decisions except the submission of the CP proposal (that requires unanimity) and changes to the Consortium Agreement (that require a two-thirds majority).

signed by all Consortium Partners in June 2002 (see Annex 1).

The Consortium of the CP Water and Food will be responsible for:

Submitting the proposal for the first and subsequent phases of the CP Water and Food.

- ✓ Appointing the Coordinator, Theme Lead Researchers and Benchmark Basin Coordinators.
- ✓ Setting up the government and management structure for the CP, developing the various review mechanisms and review criteria and supervising the day-to-day management of the CP, reporting directly to the CGIAR.
- ✓ Approving the annual budgets and work plans for the core activities, thematic groups and benchmark basin coordination.
- ✓ Awarding the grants for research projects following a competitive bid structure and independent review.
- ✓ Quality control through the establishment of adequate independent and peer review mechanisms as further outlined below.

There will be three primary forms of review internal to the CP Water and Food for which the Consortium will be responsible, and a fourth one, at the level of the CP as a whole, that is the responsibility of the CGIAR. The three forms or levels of review within CP are:

1. **proposals** for research grants in response to calls for proposals published by the CP Water and Food through ad-hoc panels of experts and stakeholders unrelated to either the thematic groups or the proposals that are submitted;
2. **research products** that are produced by the CP, ranging from publications to databases to tools or models and to synthesis publications produced at the level or themes, benchmark basins and the CP as a whole, primarily through peer review mechanisms; and
3. **projects** to which CP Water and Food grants are made, and all activities that receive CP funding from central budgets, will need to report in a pre-determined format and will need to be reviewed or audited to determine their effectiveness in meeting their stated objectives, and fulfilling the reporting requirements – this form of review could potentially be contracted out to auditing firms.

Operational management

The CP Management Team is led by the CP Coordinator and consists of the Coordinator, the Theme Lead Researchers and the Benchmark Basin Coordinators. The CP Coordinator, Dr Ania Grobicki of South Africa, appointed by the CP Water and Food Consortium on June 14, has been recruited from outside the CGIAR, contracted by the Lead Member and will be seconded to the CP Water and Food Secretariat. The CP Coordinator leads the CP Management Team, manages the CP Secretariat and central budget, and is responsible for developing and managing the CP processes, as well as for external representation and fundraising. The CP Coordinator reports to the Consortium.

All CP Management Team members have, or will have, the CP Water and Food as their primary responsibility (i.e. are full time or at least spend the majority of their time on the CP). An overview of the CP Management Team Members appointed by the Consortium at its first meeting on June 14, 2002, is provided in Table 5 and their CVs attached to this proposal (Annex 3). The CP Management Team is responsible for operational or day-to-day management for the CP, including CP outreach and communication activities, and the monitoring of impacts.

Table 5. Overview of the CP Water and Food Management Team[16]

CP team role	Name	Nationality / affiliation
CP Coordinator	Dr Ania Grobicki	South Africa, private consultant
Lead Researcher Theme 1	Dr To Phuc Tuong	Vietnam, IRRI
Lead Researcher Theme 2	Dr Simon Cook	Australia, CIAT
Lead Researcher Theme 3	Dr Patrick Dugan, a.i.[17]	Ireland, ICLARM
Lead Researcher Theme 4	Dr Francis Gichuki	Kenya, University of Nairobi[18]
Lead Researcher Theme 5	Dr Mark Rosegrant	USA, IFPRI
Coordinator Yellow River BB	Ms Liu Xiaoyan	China, YRCC
Coordinator Indo-Gangetic BB	Vacancy	
Coordinator Limpopo BB	Vacancy	
Coordinator Nile BB	Dr Mahmoud Moustafa	Egypt, NWRC
Coordinator Karghe BB	Dr Shahram Ashrafi	Iran, AREEO
Coordinator San Francisco BB	Dr Ricardo Brito	Brazil, EMBRAPA

The Lead Researchers lead the five Thematic Groups. The five Future Harvest Centers manage the research in the theme that they lead (i.e. bear legal and accounting responsibility for the work in the theme). This implies that the core CP funding for the research carried out in each theme "flows through" the books of the Future Harvest Center responsible for it, or in other words, contracts for grants awarded by the Consortium in each theme are written and administered by the CG Center that coordinates the theme (under responsibility of the Lead Researcher leading the theme). To prevent conflicts of interest, the review process for calls for proposals is managed by the CP Coordinator, and the decisions on projects allocated on each call is made by the Consortium, not the individual Future Harvest center managing the theme (since each of the centers will also participate in the theme they coordinate and manage). The Lead Researchers are responsible for facilitating and chairing the Thematic Groups that develop the research agenda, for the Thematic Group budgets and for the synthesis of work in their thematic area.

The Benchmark Basin Coordinators are responsible for developing benchmark basin research priorities, a baseline, data and modeling framework and general research platform for their benchmark basin. They will facilitate a stakeholder group for each basin and be responsible for the Benchmark Basins budgets. The Benchmark Basin Coordinators also will be coordinating the synthesis of research results for their basin.

[16] The Benchmark Basin Coordinators are those for the six "minimum" basins - additional Coordinators will be added to the team once the inclusion of additional basins in the program has been determined.

[17] Dr Dugan has led Theme 3 during the proposal preparation, but will be replaced by a person to be recruited by ICLARM.

[18] Dr Gichuki is currently working for the University of Nairobi, but has been recruited by IWMI to lead theme 4.

The CP Management Team is jointly responsible for coordination and integration across themes and basins. The 5 Lead Researchers are individually responsible for managing the portfolio of research in their theme and development of an evolving thematic research agenda with their Thematic Group, as well as the synthesis of research results in their theme area. The Benchmark Basin Coordinators are individually responsible for managing the portfolio of research in their basin and development of an evolving basin research agenda with their basin stakeholder group, as well as the synthesis of research results in their basin.

Research implementation

All CP Water and Food research is implemented through projects. All organizations that implement CP Water and Food projects are by definition CP Water and Food participating organizations. After awarding the grants from the first call for proposal, by mid-2003, this is expected to be a group of at least 50-100 research organizations. All project leaders and key researchers of CP Water and Food projects are expected to join the Thematic Groups related to their field of interest.

The CP will develop a CP project management system under the responsibility of the CP Coordinator that tracks the implementation of all projects that have received core funding, containing at least the logical frameworks, plans and budgets, progress reports and copies of all outputs.

The primary responsibility for project implementation will be with the project leader for each project. Project Leaders can be any researcher – from the CP Coordinator to the leader of a project that was awarded a CP grant, to the leader of contributed projects.

The involvement of the CP in project management will depend on the sources and responsibilities of the funding of the projects. For all core CP Water and Food Funds for which the Consortium is responsible to the CGIAR, project management info will be maintained in the CP Secretariat. The primary project management for the core-funded projects in each of the five themes is the responsibility of the coordinating Future Harvest Center and its Quality Management System applies. The five centers will harmonize their forms for logframes, plans, budgets and progress reports so that CP Secretariat can integrate their information at CP level.

For restricted and contributed projects the primary responsibility for project management lies with the organization holding the contracts. The CP will develop minimum reporting and associated formats, so that those that wish to include their projects as Associated CP Projects can agree to provide this information for inclusion in CP reporting.

Capacity Building, Uptake and Impact

An important objective of the CP Water and Food is to increase the capacity for research in the relevant domains in areas where this is low. The NARES members in the CP Water and Food Consortium have deliberately been selected from countries that have strong research systems in the water and food area. Direct South-South exchanges and capacity building among these NARES and with NARES from third countries will be a key characteristic of the CP Water and Food. The first six Benchmark Basins have been selected in areas where there is strong ongoing research, so that the CP Water and Food can build on existing scientific infrastructure and show impact at relatively short notice.

At the same time it is recognized that there is a great need for capacity building in basins where there is less current capacity and scientific infrastructure, but considerable need for this type of research. Particularly in areas where there are high levels of poverty and particularly in Sub-Saharan Africa. For this reason the capacity building within the CP Water and Food will

primarily focus on Sub-Saharan Africa. One objective is to enable, through capacity building, the CP Water and Food to expand to additional Benchmark Basins, such as the Zambezi and the Niger in Sub-Saharan Africa.

Primary capacity building mechanisms, that prioritize (individuals and institutions from) low-income developing countries, particularly in Sub-Saharan Africa, will include but not be limited to:

1. Research development workshops where partners have an opportunity to form linkages with strong partners from South and North and receive training on development of competitive research proposals;
2. PhD Fellowships for students, preferably through sandwich constructions, from targeted countries in the Benchmark Basins where the research capacity is relatively low to do their PhD as part of the CP Water and Food;
3. PostDoc positions for nationals from targeted countries in the Benchmark Basins who have recently completed their PhDs and are offered an opportunity to participate in the CP Water and Food (in addition to the PostDoc positions that would be part of the proposed research projects anyway);
4. Certificate training programs for mid-level researchers at research institutes with a competitive advantage in the South, at CG centers, or with ARI partners.
5. Sabbatical leave positions for researchers from targeted countries to work for one-year periods at strong research institutes (NARES, IARCs or ARIs).

The NARES partners in the benchmark basins are the primary partners to achieve impact through the CP Water and Food. In addition, the CP Water and Food will also explore innovative partnerships to achieve impact. These will range from policy roundtable dialogues at ministerial level to direct partnerships with NGO and Community-based organization partners that have a much greater capacity to reach large numbers of direct beneficiaries (farmers, villagers) than do research organizations.

The CP Water and Food will develop, early on in the Inception Phase, a strong monitoring system based upon a set of indicators to measure and monitor impact, particularly in the Benchmark Basins.

3. Funding

The total funding of research that is directed to implement the CP Water and Food research agenda – and therefore to achieve its objectives – goes well beyond the direct core funding provided to the program. Three funding types or sources of funds can be distinguished:

1. **Contributed projects and matching funds** are contributed by Challenge Program participating organizations. They benefit from cooperation in the overall Challenge Program, its shared objectives, methodology, interaction with partners and the impact of coordinated dissemination of results. Participating organizations will be encouraged to adhere to the framework and methodological guidelines developed for the CP Water and Food. If contributed funds are provided as matching funds for CP core funds, then they will be subject to well-defined reporting requirements.
2. **Restricted Projects** (directly funded projects) are those that an organization or collaborating partners specify, make proposals, and obtain project specific CP-related funding for. The outputs of these projects should fit into the overall frame of the Challenge Program.
3. **Core funds** are those funds made available by the CGIAR and other donors to the CP

Consortium to implement the CP Water and Food. Core funds will be required for:

- CP level coordination and synthesis activities (directly managed by the Consortium through the CP Coordinator);
- competitive grants through calls per Thematic Group organized by the Consortium, with independent peer review;
- thematic group budgets: to fund the Theme Lead Researcher, thematic group meetings and preparatory and synthesis work for each theme; and
- benchmark basin budgets: to fund the Benchmark Basin Coordinator, stakeholder groups and preparatory and synthesis work for each Benchmark Basin.

Core funds for the CP Water and Food will be sought from the CGIAR as well as other donors – some from the same donors that are also members of the CGIAR, but from other "windows" than the CGIAR contribution, e.g. water, environment, or health windows – and also from non-traditional (non-CGIAR) donors. Initial discussions have been started with several private sector organizations to explore how they may partner with, or contribute to the program.

The initial target for CP core funding is $82 Million US$, or $16 Million US$ (average) for the first 5-year phase (2003-2007). While this may seem a large amount to most individual participants, it is in fact modest compared to many of the national budgets of large NARES, or to the budgets of large research programs that aim to achieve major advances through research and development in industry or private sector research. A first commitment of the order of $82Million US$ in late 2002 will enable the CP Water and Food program to kick off along the lines developed in this proposal. To achieve the ambitions of this challenge program, however, to significantly raise the productivity of water in food production globally, it is clear that much larger amounts will need to be allocated as the confidence in the CP Water and Food grows. This could either be later during the first phase, or during a second phase of the program. The minimum core funds (scenario 1) and a more ambitious scenario (scenario 2) are outlined in Table 7, that indicates the distribution of funds over key activities.

If additional funds can be raised, this will increase the funds available for the calls for proposals for competitive research grants, as well as the funds available for capacity building. It would also enable the program to expand to additional basins.

At this point in time the funding of the initial $82 Million US$ in core funding is sought from the following (and there are early expressions of interest from the parties involved that these funds are likely to be available):

1. the Netherlands: 25 Million Euro grant for 5 years (these are funds from the "water window" which are additional to the Netherlands CGIAR contribution)
2. the World Bank Funding: US$25-30 Million grant for 5-years
3. other CGIAR Members: jointly at least US$25-30 Million for 5 years – given that there are at least 10 CGIAR members that have expressed interest in funding a potential CP Water and Food this appears to be a conservative target that could possibly be increased to $50 Million US$ if the program is successful.

It is expected that there will be considerable opportunities to raise matching funds through, specifically, middle-income NARES and ARI partners. An early, conservative estimate of this is that the $82 Million US$ in core funds would raise at least another $50 Million US$ in matching funds.

As the program becomes known and successful in formulating the research agenda and driving the agenda forward through significant research grant funding, the objective is to organize the program in such a way that other partners will be encouraged to align their

(national) research budgets with the CP Water and Food research agenda – through a process analogous to that followed for global change research.

Following submission of the CP Water and Food Full Proposal to the CGIAR, fund raising will start. This includes a major event at the WSSD on 30 August 2002 in Johannesburg at the Water Dome, as well as presentations of the CP Water and Food to individual donors during the period July-October 2002. In addition, first contacts are made with private sector partners to explore how their research activities could potentially fit the CP Water and Food, as well as with non-traditional donors.

4. Budget

Achieving a Blue Revolution in agriculture in the field is unlikely to be possible within 5 years. It is expected that achieving the objectives of the CP Water and Food will require at least 10 to 15 years, but that funding will initially be committed for no longer than 5 years – or Phase 1. A second phase would depend on progress achieved in the fourth and fifth years -- based on external reviews of progress achieved by that time.

While all projects in the Thematic Groups will be based on competitive research grants, some of the synthesis work, both at the CP and thematic group level may be necessary to prepare methodologies and set up baselines in the Benchmark Basins (in cooperation with others already working in those basins, obviously). For each Benchmark Basin a kick-off workshop will need to be organized to prioritize research questions for each basin, and to as well as establish baselines and a research platform. For each of the Benchmark Basins, the NARES of the countries in which the Benchmark Basins are located will play a key role. For the international basins, where there are international river basin organizations such as the Mekong River Commission and the Nile Basin Initiative, these will be key partners.

A more detailed budget for the first five years, based upon Scenario 1, is provided in Annex 7. The budgets for the central activities, thematic groups and Benchmark Basins are averages and first estimates. Actual budgets, within the overall envelopes provided in the table, will be based on annual workplans and budgets that are prepared by the CP Management Team and will be approved by the CP Consortium. This implies that some of the Thematic Groups may have higher or lower budgets that indicated in the table (depending on need and merit), and similarly that some Benchmark Basins may need more or less funding than the average. In addition the budgets are an average over time for the first five years, while annual budgets for components need not be constant in each year.

Table 7. Budget overview of Phase 1 CP Water and Food core funding.

Expenditure components	**Scenario 1: 82 M US$ (Million US$ for**	**Scenario 2: 125 M US$ (Million US$ for 5**

	5 years)	years)
1. **Central funding** (Coordinator, Secretariat, Consortium meetings, review processes, program level conferences, fundraising and publicity)	**5**	**5**
2. **Working group funding** (Lead Researcher, thematic group meetings, methodological and synthesis work), for 5 groups/themes	**10**	**10**
3. Benchmark Basin funding (Coordinator, stakeholder groups, baseline data), for 10 Benchmark Basins	**12**	**15**
4. Competitive funding I: for 5 themes and focused on 10 basins – first call in 2003	**35**	**35**
5. Competitive funding II: for 5 themes and focused on 12 basins – second call in 2005	**17**	**50**
6 Capacity Building (PhD Fellowships; PostDoc positions; Sabbatical positions	**3**	**10**

C. Process Framework

1. Overview

This Process Framework sets out the process by which the Challenge Program will be initiated and developed over time. An overview of the dates and duration of the major tasks and activities to be undertaken during the first phase of the Challenge Program, through to 2008, is given in figure 4.

The first crucial activity once the CP becomes operational is the 1-year Inception Phase, which will run from November 2002 to October 2003. The CP Water and Food Coordinator will develop the processes and set up mechanisms for the smooth running of the program, including review and measurement of activities, project management, etc. During this phase all operational details of the CP will take shape. Thematic Groups will develop an Analytical Framework to define their activities. Kick-off workshops will be held in the Benchmark Basins.

The activities during Phase 1 of the Challenge Program, through to 2008, cover the following broad areas:

- Selection and award of competitively funded research projects (Cycles 1 and 2) addressing the issues as set out in the Research Agenda
- Management of research within the Thematic Groups
- Coordination of activities in the Benchmark Basins, and basin monitoring programs
- Development of linkages and cross-learning between the Benchmark Basins, both globally and on a regional basis
- Capacity-building within the basins, among researchers and stakeholder groups and in additional basins
- Linkages with associated basins and contributed research projects
- Strategic evaluation and assessment of impact, implementation of research and technology transfer through linkages with stakeholder groups, NGOs and other organisations
- Enhancement of communication, sharing the vision, and dissemination of information via the Internet, print and other media
- Linkages with the Dialogue on Water, Food and Environment, the Comprehensive Assessment of Water Management in Agriculture, other CGIAR Challenge Programs and various relevant global initiatives
- Oversight, coordination and management of the Challenge Program

These tasks and activities have been organised within a Detailed Action Plan for the Challenge Program (not shown due to space constraints).

2. Milestones

Three major Milestone Conferences are envisaged for the first phase of the Challenge Program, namely the Baseline Conference, to be held once the Benchmark Basins have been established and the competitive research grants awarded; the Synthesis Conference, midway through the first phase; and the Targets Conference, assessing and evaluating the impact of the Challenge Program at the end of the first phase, drawing lessons and setting out the agenda for the future. The timing of the milestones is shown in the Gantt chart below.

2.1 The baselines

The first milestone for the Challenge Program will be to establish and publicise our baselines: *Where are we now, at the start of the Challenge? How do key stakeholders see the Challenge? What is the situation in the Benchmark Basins with regard to key indicators? What are the crucial gaps in*

knowledge that we need to address in order to tackle the Challenge?

These questions will be addressed at the Baseline Conference in **November 2003**. This conference, held in the UN's International Year of Freshwater 2003, is an opportunity to raise awareness worldwide about the objectives of the Challenge. Having the baseline information with regard to certain key indicators, Challenge targets will be discussed for those indicators, in each Benchmark Basin. The research projects which have been awarded will be presented, their strategic importance highlighted, and outputs and potential impacts discussed.

The Baseline Conference will be held in one of the Benchmark Basins. Real and/or virtual tours of the basin and of the major research sites within the basin will be organised for participants. A wide range of stakeholders and sponsors of the Challenge Program will be invited, together with the communities of practice formed within the Challenge Program itself: the Challenge Program researchers and Benchmark Basin stakeholders; CP Consortium Members, and the CP Management Team. The conference will also be attended by, among others: representatives of the CGIAR Science Council; colleagues from other programs including the Comprehensive Assessment of Water Management in Agriculture and Dialogue on Water, Food and Environment; initiatives and people working on global change research programs; science and environmental journalists and general media.

2.2 The synthesis

Midway through the first phase of the Challenge Program, the task of synthesising the knowledge generated through the activities of the CP will be tackled. The Synthesis Reports produced will become the global touchstones, state-of-the-art documents for integrated river basin management, and improving water productivity in agriculture. The reports will be made available in print, and in user-friendly form on the Internet.

At this point in the CP, the focus will start to shift towards producing and disseminating guidelines, Best Management Practices, and developing the large-scale mechanisms through which the CP can make an impact on the ground, in the Benchmark Basins. The Synthesis Conference in **May 2006** will present the Synthesis Reports, and provide an opportunity to take stock of the current effectiveness and future potential of the Challenge Programme in meeting its targets.

Certain Cycle 1 research projects will have been completed, Cycle 2 research projects will have been selected and awarded, and the Comprehensive Assessment will have been completed for presentation at the World Water Forum in 2006. All of these will be discussed at the Synthesis Conference, and once again a wide range of stakeholders and sponsors will be invited, together with the CP communities of practice, and the global media. The Synthesis Conference will be held in one of the CP Benchmark Basins. Real and/or virtual tours of the basin and of the major research sites within the basin will be organised for participants.

2.3 The targets

The third milestone for the Challenge Program will be the completion of the first phase, marked by the Targets Conference in **October 2008**. Five years on from the Baseline Conference, this will be a high-profile media occasion, and a showcase for the achievements of the Challenge Program in the first phase. The evaluation of results of research projects, and the assessment of impacts via the basin monitoring programs will tackle the questions : Are *we meeting the Challenge ? Are we moving closer to our targets? What are the constraints, and what are the valuable lessons that can be learned, as we move into the next phase of the Challenge?*

3. Development of Indicators

The concept of "target indicators" is necessary to pose a real, physical challenge. It is important for public understanding, to have numbers that people everywhere can grasp and remember, that they can perhaps apply to their own situation. These sorts of numbers also provide sound bites for the media, which is helpful in developing and maintaining a high media profile for the CP. It is very important for donors to see some positive results, in numbers, as part of the deliverables of the CP. Finally, having defined targets will ensure that much of the research done within the CP stays close to the realities of implementation.

Having targets is risky. There is a high probability of many possible targets not being reached within 5 years, and perhaps not even within 10 or 15 years, if we consider subsequent phases of the CP. Hence it is important to select targets that are not only worthwhile, but also offer a reasonable chance of success. If a target is not met within 5 years, at least there may be some measurable progress towards it, to show that water management within a given basin is moving in the right direction. Subsequent phases of the CP would then specifically address the issues related to the target, and show further improvement.

The overall target of the CP is:

To retain global diversions of water to agriculture at the level of the year 2000, while increasing food production, to achieve internationally adopted targets for decreasing malnourishment and rural poverty by the year 2015.

This overall target necessitates the tracking of key indicators such as diversion of water to agriculture, food production, malnourishment and rural poverty. For the purposes of interbasin and interregional comparisons, and cross-learning, certain more specific target indicators can also be selected, such as crop water productivity for a range of crops, and fish productivity. All of these target indicators need to be measured at the baseline, when the CP begins, and then to be tracked over time.

In order to have a full picture of each Benchmark Basin, and to understand the processes taking place in the basin, it is also necessary to measure a much larger number of baseline indicators. There are many possible indicators of interest, which may be physical, ecological, socio-economic, or institutional indicators.

Physical and ecological indicators need to be:

- Easily measurable without excessive cost implications.
- Adjustable for seasonal variation and year-on-year rainfall variation; alternatively should be tracked continually.
- Standardised for local instrumentation and local methods of measurement/analysis.

A limited number or subset of these baseline indicators will be selected to have agreed targets, as part of the Challenge. Some indicators may need to be the subject of specific research projects and the development of models, while others can be monitored as part of the baseline-monitoring program for each Benchmark Basin. It is recognised that indicators may have instabilities, or that levels may be highly unevenly distributed within a sub-basin, where e.g. "hotspots" of poverty may need to be specifically tracked. A preliminary list of indicators has been included in the logical framework for the CP (Annex 2).

The CP Coordinator together with the CP Management Team (i.e. the Theme Leaders and the Benchmark Basin Co-ordinators) will develop a full list of baseline indicators to be monitored in each Benchmark Basin. This list will be developed together with the research team of the Comprehensive Assessment of Water Management in Agriculture, taking into account the work on indicators done through the UN's World Water Assessment Program. The final list of indicators will be reviewed in a workshop and agreed with the Scientific and Technical Advisory Panel of the Dialogue on Water, Food and Environment, prior to the initiation of basin monitoring programs.

4. Inception Phase

The Inception Phase of the CP will take place between November 2002 and October 2003. It will have three main components: Benchmark Basin kick-off workshops; development of processes for the CP; and development of analytical and conceptual frameworks by the Thematic Groups.

4.1 Kick-off workshops

Kick-off workshops in all the Benchmark Basins will be held as soon as possible in the first year, prior to the Baseline Conference. These workshops will bring together representatives of a range of stakeholders, across sectors, and at different levels within the basin (basin level, sub-basin level, and at farm and eco-system level). The development of a stakeholder database will be managed by the Benchmark Basin Coordinator together with an inventory of existing basin-wide initiatives, key basin stakeholders, and any Dialogue projects currently underway in the river basin. The kick-off workshop will include:

- Information exchange and consultation on the Challenge Program
- Setting of priorities
- Development of stakeholder dialogues
- Discussion of baseline and target indicators for the basin
- Organisation of basin-wide monitoring programs and information gathering
- Issues of access to information and data

From this point on, basin-wide monitoring programs for the key basin indicators, and other information gathering activities, will be managed and coordinated by the Benchmark Basin Coordinator in each basin.

4.2 Development of processes for the CP

The processes for the sound management and operation of the CP Water and Food will be developed by the CP Management Team in cooperation with all partners. Priorities for the first year of the program will be the establishment of the Secretariat and development of the key management processes. These are specified further, together with their timing during the Inception Phase, in section 5 below.

The CP Water and Food management team is led by the CP Coordinator and consists of the Coordinator, the Thematic Group Lead Researchers and the Benchmark Basin Coordinators. All CP Management Team members have, or will have, the CP Water and Food as their primary responsibility (i.e. are full time or at least spend the majority of their time on the CP).

The Team is responsible for operational or day-to-day management for the CP, including CP outreach and communication activities, and including the monitoring of impacts.

4.3 Development of Thematic Groups' Analytical and Conceptual Framework

As the CP moves into its operational phase, a further priority for the Inception Phase is to develop a coherent analytical framework that allows integration across all research projects. The framework will work through the Thematic Groups and through the Benchmark Basins. During the Inception Phase, time will be set aside for methodology development led by the Thematic Groups and stakeholder groups in the Benchmark Basins.

Sound research methodology, coupled with an analytical framework, is a pre-requisite for synthesizing and extrapolating the results of the research and for driving impact and uptake of the findings. These will lead to guidelines and criteria for the actual research projects and become part of the Call for Proposals.

5. Key management processes for the Challenge Program

This section describes in some detail the key management processes, tasks and activities which will be put into place during the Inception Phase.

5.1 Competitive Funding Cycle 1

5.1.1 Timing

- call for pre-proposals/concept notes : Monday 2 December 2002
- contracting Independent Reviewers for each theme Jan – March 2003
- submission of concept notes by end of March 2003
- selection of projects to go to full proposal April – May 2003
- proposal preparation phase May – August 2003
- full proposal submissions : Friday 3 August 2003
- independent review processes and final project selection Sept – Oct 2003
- award of 2-year and 5-year project funding
- research projects commence : 1 November 2003

~~5.1.2.~~ Appointment of independent evaluators for peer review

Independent evaluators will be contracted to review the concept notes, and remunerated accordingly. The contract will include a clause stating that the evaluator has had no direct involvement in any of the proposals, and is not employed by an institution which is involved in any of the proposals. Potential evaluators will be identified through databases held by the CGIAR Secretariat, the CG centres, the Dialogue, Comprehensive Assessment, and the CP Consortium partners, and their completed reviews will be kept anonymous.

5.1.3 Preparation of guidelines for proponents of research projects

These will be made available on 2 December 2002 on the CP web-site, together with the call for proposals, for downloading by anyone who wishes to put forward a concept note for consideration in Competitive Funding Cycle 1.

5.1.4 Preparation of guidelines for evaluators

These will be posted on the CP web-site on 2 December 2002, together with the call for proposals and guidelines for proponents. They will also be sent to the reviewers together with the concept notes that they are required to review.

5.1.5 Process for selection of concept notes for development of full proposals

Each concept note will be reviewed by at least 2 independent reviewers, who will give as total score based upon quality of science, relevance, and likelihood of success. The CP Management Team will then assign ratings to the concept notes. Proposals will be rated α, β or γ, where alpha projects are recommended for development into full research proposals, beta projects are recommended for further development and capacity building, so as to be ready for submission in Competitive Funding Cycle 2, and gamma projects recommended for rejection. These recommendations will be put forward to the CP Consortium, who will make the final decision on projects to go to full proposal at the meeting on 15 May 2002.

Met opmaak: opsommingstekens en nummering

5.1.6 Expanded guidelines for proponents and evaluators of full proposals

These will be made available on the CP web-site as early as possible during the Inception Phase, so that the process is transparent to all interested parties.

5.1.7 Ensuring scientific excellence in the research projects and the CP as a whole

This will be achieved through the appointment of ad-hoc Advisory Panels, as necessary, on various aspects of the research.

5.1.8 Preparation of contracts

In our interactions with our grantholders we will specify, inter alia :

(1) Contractual obligation on grantholders to list intellectual property (IP) assets in a specific way based upon the expected research outputs (IP asset management table); grantholders must complete an invention disclosure form as well as an IP asset management table as part of the contract.

(2) The Central Advisory Service of the CGIAR (CAS) will be contracted to provide IP asset management services to the CP, in terms of carrying out IP audits of all research projects which are funded by the CP. Each project will be obliged to comply with one full IP audit. In the case of 5-year projects, this audit will be carried out in the 3rd year, and an update audit will be carried out 3 months prior to completion. These obligations will be placed on grantholders to ensure that the CGIAR and its partner organisations continue to have access to these IP assets after the completion of the research projects, in order to be consistent with the mission of the CG system.

(3) A financial audit of each research project will be required to be conducted annually, for the year running from 1 November to 31 October, and to be submitted by 1 February of the following year. This will be a contractual requirement on the grantholders. In addition, grantholders will be required to provide financial information to the CG centre through which their grant money flows, at the time and in the form in which it is required by the centre. By this means, donors can be assured that the financial management of this new entity, the Challenge Program, will be of the same high standard as that of the CGIAR itself.

The research project contract will be reviewed by an international lawyer. Each successful project leader will then be required to sign the contract on behalf of his or her institution.

5.1.9 Process of final selection of research projects

Each of the full proposals will be reviewed by at least 2 independent reviewers. The CP Co-ordinator, together with the Research Advisors, will then rate the proposals, and submit the proposed ratings to the CP Consortium for consideration. The preferences of the Theme Leaders and Benchmark Basin Co-ordinators would be noted, but as they would all be involved in the projects themselves they cannot in any way be involved in the final rating. As before, proposals will be rated α, β or γ, with all alpha projects recommended for funding (subject to funds being available), beta projects recommended for funding in Competitive Funding Cycle 2, subject to the proposal being substantially revised and updated at that stage, and gamma projects recommended for rejection.

5.2 Consortium Steering Committee meetings

Consortium Steering Committee meetings will be held on a 6-monthly basis, in mid-November 2002 and in mid-May 2003. In November 2002, the Consortium Steering Committee will review the call for concept notes, the guidelines for proponents and evaluators, and the financial management plan for the CP.

At the meeting in May 2003, the Consortium Steering Committee will select the concept notes which will proceed to development into full proposals. It will approve the financial management plan for the next 6-month period, and it will consider the progress made in planning for the Baseline Conference. It will also consider the mechanisms proposed by the CP Co-ordinator for measuring the progress of the CP in both Themes and Basins.

The Consortium Steering Committee will hold a virtual meeting (tele- or video-conference) in October 2003, in order to approve the final selection of the Competitive Cycle 1 grants to be awarded.

5.3 CP Management Team meetings

CP Management Team meetings of the CP Co-ordinator, the Theme Leaders and the Benchmark Basin Co-ordinators, will be held at least every 3 months, or when necessary, usually by tele- or video-conference.

5.4 Definition of mechanisms to measure progress in both Themes and Basins

During the Inception Phase, the mechanisms to measure progress in both Themes and Basins will be put in place. For the Basins, this will necessitate the development of a list of indicators. Baseline indicators will then be measured and monitored in each Basin, or where necessary the capacity will be built to enable the baseline monitoring to be done.

A smaller subset of the baseline indicators, called target indicators, will then be used in order to measure progress in the Benchmark Basins.

During the Inception Phase, a proposal for mechanisms to measure progress in the Themes will be developed and put forward to the Consortium Steering Committee for consideration at the meeting in mid-May 2003. This mechanism will then be put in place prior to the start of the research projects in November 2003.

5.5 Intellectual Property (IP) asset management

It will be very important to describe and catalogue IP assets created by the CP, and to track the IP inputs provided by the various institutions and partners. Technology transfer departments within the organisations of many of our Consortium partners have a mandate to maximise the value of the IP owned by their institution. It is important therefore to be very clear from the outset about the IP assets involved in the CP, whether they are international public goods or not, and to carry out responsible IP asset management for the CP as a whole.

During the Inception Phase a detailed IP asset management plan for the CP will be developed, through the CP Secretariat. This is an overall plan for the CP as a whole, separate from the individual IP plans which will be required from each of the research projects. IP asset management for the CP will incorporate the IP assets from individual research projects, but will also include :

- synthesis work for the Themes
- IP assets developed in the Benchmark Basins
- and the various papers, guidelines, protocols, standards, databases and contracts created within the CP Secretariat in the course of managing the Challenge Program.

Finally, IP asset management of the CP will cover the development of a technology transfer plan, which will focus on those IP assets (generally research outputs) which the CP is mandated to share as widely as possible. The technology transfer plan will codify the IP assets, the target users, and mechanisms to implement the transfer.

5.6 Financial management

A budget for the Inception Phase will be put forward by the CP Co-ordinator to the CP Consortium at the meeting in November 2002. Financial management of the Challenge Program will be carried out through the existing mechanisms of the 5 CG centres, namely IWMI, IRRI, CIAT, ICLARM and IFPRI. In addition to the funding of Theme 4 grants, IWMI as the Leading Member of the Consortium will be responsible for the funding of the Secretariat and the Benchmark Basins. Every 6 months a consolidated financial management plan will be prepared by the CP Co-ordinator and presented to the Consortium, reflecting commitments from

donors, actual income and expenditure over the previous 6 month period, and a consolidated budget for the following 6 months.

5.7 Development of Website and links

The Challenge Program web-site will showcase all the activities taking place within the Challenge Program. During the Inception Phase, Benchmark Basins will be encouraged to set up their own web-sites, and as they do the links will be added to the CP web-site. Funding will be set aside for translation of key CP documents into French, Spanish, Portuguese, and Chinese, and these will also be made available for downloading from the web-site.

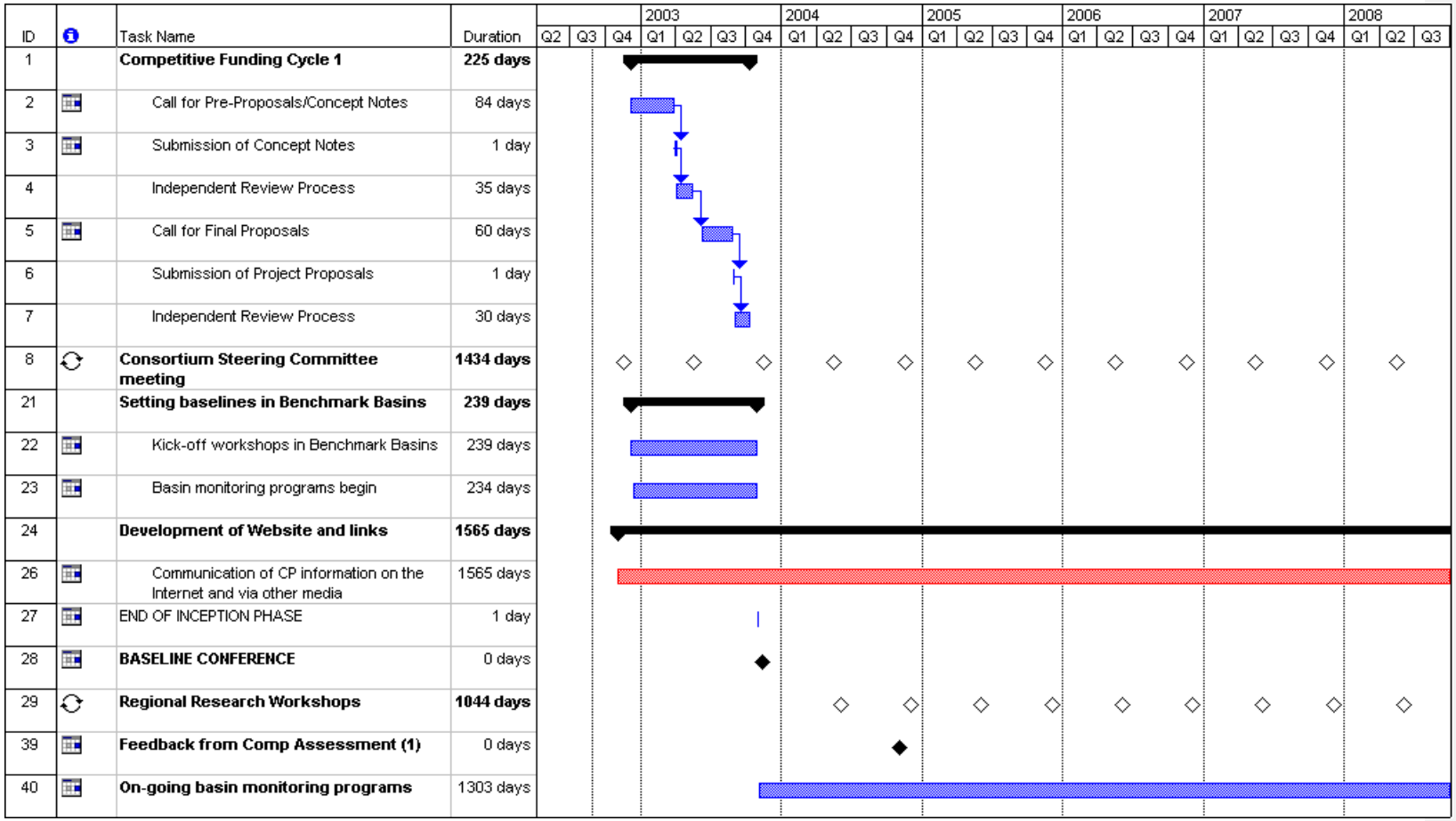
5.8 Planning of Baseline Conference

The Baseline Conference will be held in mid-November 2003. Preparations for this major milestone conference, which will be held in one of the Benchmark Basins, will be ongoing throughout the Inception Phase.

5.9 Gantt chart showing time-lines

The Gantt chart showing activities and time-lines for the Inception Phase of the Challenge Program is shown below.

Figure 4. Tasks and Activities



ID	Task Name	Duration
1	**Competitive Funding Cycle 1**	**225 days**
2	Call for Pre-Proposals/Concept Notes	84 days
3	Submission of Concept Notes	1 day
4	Independent Review Process	35 days
5	Call for Final Proposals	60 days
6	Submission of Project Proposals	1 day
7	Independent Review Process	30 days
8	**Consortium Steering Committee meeting**	**1434 days**
21	**Setting baselines in Benchmark Basins**	**239 days**
22	Kick-off workshops in Benchmark Basins	239 days
23	Basin monitoring programs begin	234 days
24	**Development of Website and links**	**1565 days**
26	Communication of CP information on the Internet and via other media	1565 days
27	END OF INCEPTION PHASE	1 day
28	**BASELINE CONFERENCE**	0 days
29	**Regional Research Workshops**	**1044 days**
39	**Feedback from Comp Assessment (1)**	0 days
40	**On-going basin monitoring programs**	1303 days