

CPWF Research Agenda and Implementation Plan for Phase 2: An Update for the Science Council, 12 March 2008

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Chapter 1 Introduction

1.1 Context

The CPWF has been working intensively on plans for its phase 2 that take into account the external review process (April to August 2007), Science Council Commentary (September 2007), ExCo Recommendation (October 2007) and AGM Resolution (December 2007). In the CPWF Consortium Steering Committee (CSC) Meeting (20-21 February 2008) the CSC made major decisions about the shape of Phase 2. This paper gathers together all the material approved by the CSC so as to respond to the request in the September 2007 Science Council Commentary, which was *“In sum, subject to the development of a well-conceived and more tightly focussed strategy and implementation and monitoring plan for Phase 2, as well as a clear exit strategy and timeline, the SC endorses continuation of the CPWF. As a next step the SC looks forward to reviewing and endorsing a Phase 2 plan at the SC ‘09. The Plan should focus on the deficiencies as noted in the ER report and highlighted in the SC in this commentary.”*

Since the documents on which this information is based are recently developed and approved the information is spread among different chapters although we have attempted to reorganise it so as to make it more accessible. Please be aware that this is a plan some of whose details are still under development and that will be provided further in the Medium Term Plan due in June 2008.

The “well-conceived and more tightly focussed strategy” is presented in Chapter 2; the implementation plan is provided in Chapter 3; the monitoring plan is provided in Chapter 4. The exit strategy and timeline are explained at the end of Chapter 3 while the new governance arrangements agreed by the Steering Committee are outlined in Chapter 5.

1.2 Vision, mission and objectives of CPWF research

1.2.1 Vision

In Phase 1, CPWF learned that water and food problems are more complex than originally thought and that a ‘new way of doing science’ is needed. The CPWF is an institutional innovation that helps deal in an integrated fashion with multi-scale water problems and how they affect agricultural systems. It helps break down boundaries set up by institutional structures and mobilizes the efforts of a diverse group of stakeholders. It helps build a water dimension into on-going research on food, poverty, the environment and livelihoods. It has already raised the profile of water issues in crops and livestock research, for example in several CGIAR centers. It shows how integrated research can solve water and food problems – and in doing so, show how a large research alliance “does things differently”. As such, it contributes to CGIAR system institutional reform.

1.2.2 Mission statement

CPWF revisited its mission statement and discovered that it was the unrealistic objectives at Millennium Development Goal level, not the mission statement per se that were the problem. The mission statement is therefore left unchanged as:

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

In Phase 2, the terms “environmentally sustainable” and “socially acceptable” will be explored in the context of social and ecological resilience – a more specific and quantitative measure of a system’s ability to cope or adapt to rapid and/severe changes.

1.2.3 Modified objectives

Following advice from the external review and the Science Council, these have been revised so as to be more directly achievable by the CPWF itself, and more feasible to measure. They are:

- Contribute more effectively to the delivery of development outcomes (through partnerships with development institutions such as policymakers and NGOs)
- Produce more relevant and targeted scientific outputs for development
- Foster a more effective and integrated process of collaboration in research (among CG Centers and between Centers and other research partners)

The means – ends relationships are clear: while each of the above can be seen as an end in itself, the third (research collaboration) is a means of achieving the second (scientific outputs) which in turn is a means of achieving the first (development outcomes).

There is one caveat – the CPWF is only one player amongst many, and cannot on its own ensure the delivery of development outcomes. It can, however, engage more closely with those people and institutions – policymakers, NGOs, and others – with prime responsibility for fostering development. It can encourage and participate in social processes of innovation and it can help with capacity-building.

1.2.4 Criteria for CPWF research

Research must comply with three principles in order to qualify for inclusion in the CPWF agenda in Phase 2.

1. It must fit within the current research agenda for topics or basins
2. Beyond that, it must be interdisciplinary, include cross-scale analysis, and take into account resilience (social and ecological)
3. It must contribute to an improved understanding of the interrelationships among water, poverty, productivity and ecosystems in the context of global change.

Both (2) and (3) help ensure that all CPWF research produces international public goods (IPGs).

Chapter 2 CPWF Phase 2 Research Agenda

2.1 Principles guiding the research agenda

- Research will be focused in only the six poorest basins among the previous nine, all of which are multi-country. They include Limpopo, Volta and Nile in Africa, Mekong and Ganges in Asia and the Andean System in Latin America.
- Research will be focused on specific development challenges related to the work of CPWF Phase 1 and on major needs of each basin.
- Research will be focused on specific geographical parts of the basins but still with a basin-wide viewpoint – for example rain water management research in the Nile would concentrate in the Ethiopian highlands but would research and take account of downstream effects in Sudan and Egypt.
- International Public Goods will be focused through specific cross-basin topics whose evolution is driven by basin research.

2.2 Basin Selection for Phase 2

Basin selection for Phase 2 has been sharpened based on Program experience in Phase 1 and on recommendations from the 2007 External Review. These proposals aim to:

- Increase the emphasis on impacts to be achieved by the Program over the next ten years at basin level through a more coordinated portfolio of projects targeted at a limited number of key issues within a smaller number of basins

- Focus on basins that cover many low income countries, in line with requirements and preferences of the donors to CPWF

Research is expected to continue with full CPWF investment in six of the present benchmark basins: Andean system, Ganges, Limpopo, Nile, Mekong, and Volta. Scientists from existing CPWF basins in Brazil, China and Iran will be invited to continue contributing to the CPWF by helping strengthen research in the six named benchmark basins. It is hoped that they will also continue to work in their own basins in association with the CPWF providing they do so with their own financial resources (for example from national funds, or bilateral or multilateral loans) and thereby to contribute to research on global drivers and processes of change.

2.3 How the Phase 2 research agenda was developed

This agenda presents side by side two processes that are at different stages of development and that will be integrated by the end of Phase 1.

The first is the relatively new development of a strategy for the six benchmark basins that will continue into Phase 2. The second is the development of focused topics that provide the subject matter framework and support for work in basins. The history of these two processes is summarized in this section. Their results so far are summarized in Section 2.4 (topics) and Section 2.5 (basins).

2.3.1 Key issues in basins

The strategy for the six benchmark basins is the driving force behind CPWF plans for Phase 2, but the details are as yet relatively undeveloped for three reasons that are elaborated below.

The basin strategy concentrates on the idea that in each basin the CPWF should focus about 80% of its research investment to aim for impact in responding to key issues and challenges focusing first in specific geographical areas, with the possibility of later extrapolating further.

The basin strategy has six different sources:

1. The basin priorities developed at stakeholder meetings for each basin at the beginning of Phase 1; these (extensive) basin priorities were incorporated into the “concordance” that integrated the (very extensive) theme priorities developed by thematic advisory groups.
2. The results already available from “first call” projects that comprise over half of the research investment in Phase 1; truthfully these projects were selected mainly based on thematic priorities (and on the offers of research available) rather than on basin priorities, which had not been properly focused to guide research at the time of the first call.
3. The results of the Comprehensive Assessment on Water Management in Agriculture (CA) and the special report prepared jointly with the CPWF¹, although it is more focused on global priorities rather than those in specific basins.
4. A workshop among basin coordinators (in November 2007) where each was asked to define 1-2 key issues for their basin followed later by an interaction with theme leaders and CPWF management to develop their ideas further; naturally their opinions were influenced by (1), (2) and (3) above.
5. The results of basin focal projects (BFPs). One of the outputs of these in-depth analyses of the relationship between water productivity and poverty in each basin is the identification of challenges and opportunities to which the CPWF can respond.

¹ CGIAR Challenge Program on Water and Food (CPWF) and Comprehensive Assessment of Water Management in Agriculture (CA) Research Priorities, 2006

6. Further review and development of (4) by CPWF staff in each basin, particularly in interaction with a basin advisory committee of major stakeholders including researchers, development specialists, policymakers and farmer representatives.

BFP results (point 5) are becoming available after two years of research in two of the basins selected for Phase 2, the Mekong and the Volta, and have been used to refine the synthesis by BCs (point 3). Because of procurement interruptions, the BFPs in the other four basins (Andean System, Limpopo, Nile and Ganges) commenced only in December 2007; preliminary results with which to adjust their basin priorities will be available by the end of Phase 1 in December 2008; however, the content of BFP research proposals for those basins has already contributed to selecting and refining the research questions.

Point (6), which is the most important in order to refine the basin research questions, has not yet commenced. The basin advisory committees necessary for this task will be identified and will commence work in 2008 as part of the transition from CPWF Phase 1 to Phase 2.

Each key issue (perhaps more correctly described as a set of key issues) forms a development challenge that can be studied in a relatively compact area of each basin, for example, part of the Ethiopian highlands, or southern Burkina Faso. The chosen geographical area should be large enough to work with issues of scale but compact enough so as to provide focus and not attempt to work on all issues in a basin. CPWF's cross-scale approach requires that the downstream consequences of actions within the chosen area are studied. For example, in research on rainwater management the downstream consequences in Sudan and Egypt of changes in the Ethiopian highlands and in Ghana of changes in Burkina Faso. Although CPWF will often not be able to cover all countries within a basin, it will look for opportunities to work across boundaries. At the same time, it must maintain in view the entire basin picture so to understand key drivers, such as trans-boundary arrangements.

The focus on "key issues" provides a "basin platform" in several senses of the word. The CPWF basin platform would provide access to research sites, research partners working in the basins, development agencies including NGO and government programs, and policy makers. The platform it should provide an evolving framework of key research issues that can translate directly into development, and link together various CPWF projects (and those of other institutions). It should also provide a pathway for impact within the basins. The existence of such a platform would be a great benefit to many CPWF partners who cannot alone set up the facilities, networks nor outreach to policymakers in each and every place they work. CG centres, for example, could focus more on research, and less on setting up stakeholder dialogues, although they would be involved in those dialogues.

2.3.2 Focused topics

While identifying focused priorities for Phase 2, the theme leaders realized that all those areas of most interest (called "topics" to distinguish them) required input from many of the five themes used during the first phase. This was also illustrated by the fact that many Phase 1 projects covered two, three or even four themes; there was strong overlap among the themes in practice.

Work on identifying key priority areas of science for Phase 2 commenced in February 2007 and on integrating the themes in June 2007. The design and focusing of the topics has progressed through many iterations with some options tested and rejected. The four topics focus down to potentially 12 research questions compared to more than 90 research questions from the five thematic working groups that were contained in the 2002 proposal for Phase 1.

Since the topics are intended to support and serve the basins, the content of individual topics may be modified once the research questions have been more closely defined, and Phase 2 research is underway.

One of the ways that CPWF adds value is by cross-basin analysis, including how global change issues play out at basin level and below. The fourth topic is therefore dedicated especially to this (although it is relevant to all topics).

In this present plan, topics are developed to enrich and support the work done in the basins. Thus, the exact content of each topic will develop as the basin agendas

develop. The “headline topics” are however likely to remain broadly the same, even while the detail of research within each topic will be determined by the way the research agenda develops in each basin.

2.4 From Phase 1 Results to Phase 2 Topics

The objective of the CPWF is to identify sets of agricultural water-related interventions (technical, socio-economic, institutional) that will result in more resilient livelihoods and ecosystems. These interventions are expected to result in a major increase in water productivity to help meet what is now a global water and food crisis. The research undertaken in Phase 1 and the findings of the Comprehensive Assessment on Water and Food, taken together with priorities identified by each basin, has brought focus to four research topics for Phase 2 that will act in support of two or three key priorities identified in each basin. The topics are: **improving rainwater management, benefit sharing, multiple uses of water, and drivers and processes of change**. In each topic, the results from Phase 1 research are presented followed by the problem and research needs. As stated earlier, these topics – and particularly the content of each one -- will be continuously refined as the basin priorities are more clearly articulated.

2.4.1 Improving Rainwater Management

Research is needed to determine how to capitalize on the opportunities for increasing land and water productivity in rainfed² food production through improved rain water management, and approaches to achieve the institutional and behavioural changes needed to enable widespread adoption of the improved technologies. Research in this topic will aim to generate technologies and strategies that will increase food security and alleviate poverty through increasing the use of rainfall for food production and improved resilience in livelihoods and ecosystems in rainfed systems.

Building on Phase 1

Insights gained from the Comprehensive Assessment of Water Management in Agriculture (CA, 2007) and from research in Phase 1, primarily via the Basin Focal Projects, are that rainfed systems are under-productive across major parts of most CPWF basins. Consistent with these insights, Phase 1 projects showed that there are great opportunities for improvement using available technology. Further opportunities for improvement will also come from considering the water and food system in a more holistic manner, including crops, livestock, fisheries and socio-economic, political and institutional barriers.

In Sub-Saharan Africa, for example, 96% of the arable land is rainfed, and the productivity of rainfed cropping and mixed livestock-crop systems is a fraction of its potential (CA, 2007). Many projects from Phase 1³ identified technologies and participatory research approaches with great potential to increase land and water productivity of rainfed cropping in many locations subject to drought and/or salinity stress, through the integration of improved varieties with improved fertilizer management, in-field water harvesting and soil water conservation. The challenge is how to convert these opportunities into widespread change. The aerobic rice project⁴ introduced the possibility of converting high water demanding, traditional rice cultivation systems to rainfed with supplementary irrigations in water-short irrigation areas, such as in large parts of the Ganges and Yellow River Basins. It also introduced the possibility of substantial increases to land and water productivity in the more favourable but solely rainfed rice growing areas.

The problem and research needs

² The CA defined a continuum between purely rainfed, supplemental irrigation and full fledged irrigated systems. For the purposes of the work in this topic, it includes the part of the continuum from purely rainfed to supplemental irrigation.

³ PN1 Crop Water Technology and Markets: Mgonja, et al, 2006; PN2 Water Productivity Improvement in Eritrea: Ceccarelli and Grando, 2007; PN5 Rainwater and Nutrient Use Efficiency: Humphreys and Roth, 2006; PN7 Improving Productivity in Salt affected areas: Nguyen, 2006; PN10 Coastal Resource Management for Improving Livelihoods: Hoanh, et al. 2007; Alam et al. 2006; PN12 Yellow River Rainfed Conservation Agriculture: Changrong et al. 2006; PN15 Unraveling Mysteries of Quesungal System (QSMAS): Reynolds et al, 2007; PN17 IWRM for Improved Rural Livelihoods: Mupangwa et al. 2007; : Kahinda et al. 2007

⁴ PN16 Aerobic Rice System: Bouman et al. 2007; Bouman et al. 2006; Xiaoguang et al. 2005

Seventy-five per cent of the increased crop water use needed to achieve the 2015 MDG hunger reduction target will have to come from rainfed agriculture. The majority of poor people in the world are dependent on rainfed agriculture for food and livelihoods (Rockström et al. 2007). For example, in Sub-Saharan Africa, only 3.5% of the arable land is irrigated and the remainder is rainfed, and, more challenging still, most hungry people live in regions subject to high rainfall variability leading to frequent water stress and extreme water shocks such as droughts, floods and dry spells during critical crop growth stages. These stresses are likely to become increasingly pronounced as a result of climate change, and further exacerbate the impacts of abiotic stresses such as salinity. Productive capacity is further limited by inherently poor soil, or by human-induced soil degradation.

There is a high potential to increase the land and water productivity of smallholder rainfed food production. There is generally enough rainfall to double, and often even quadruple yields in rainfed cropping systems, except in the most arid regions, or equally important, to ensure a harvest where otherwise there would be none. In many areas, indeed, rainfall is adequate to meet agricultural demands, and yet droughts still frequently occur. This hints at the socio-political and economic problems that underpin many rainfed agricultural systems, and which will affect the adoption of any soil and water conservation and in-field water harvesting techniques and technologies. Both biophysical (poor or variable temporal distribution and access to some form of storage) and socio-political responses to in-field water harvesting are, however, variable and not well understood.

Supplemental irrigation can further bridge critical yield-reducing dry spells and stabilize yield in areas where external water harvesting is feasible. The ponds and small dams needed for supplementary irrigation have multiple uses in both domestic and income generating activities, such as watering homestead gardens and livestock, and raising ducks and fish. Between agricultural systems under 'full' irrigation and exclusively rainfed systems, the farmers' apply water to plants in different ways depending on the nature of the resource available (rain, water body, river, irrigation, drainage or sewage canal, groundwater table, etc.). For rainfed farmers, what prevents the use of supplemental irrigation water is more often the lack of access to water than the lack of irrigation infrastructure.

Significant gains from in-field and external water harvesting investments are, however, only achievable if other factors that limit production are improved simultaneously – such as an enabling institutional and policy environment (e.g. market access and control over water supplies), as well as crops/varieties, soil fertility, environmental flows and livestock management, and so on. By reducing risk, in-field and external water harvesting may provide the necessary incentives for investment in other production factors, and increased reliability of input demand and production, favouring the development of input/output markets.

Local institutions engaged in agricultural development and extension currently have limited capacity to promote rain water harvesting in an integrated approach to food production, and adaptation of these technologies needs to be accompanied by institutional and behavioural transformations. The cost effectiveness and likely impacts of wide scale adoption of water harvesting on downstream users and ecosystems, and their tradeoffs, also need to be assessed.

See also the following topic, Multiple Uses of Water, regarding the integration of livestock, fisheries and aquaculture with irrigation of crops.

2.4.2 Multiple Uses of Water

Research in this topic will focus on improving the ability of water storage and delivery systems (such as irrigation schemes and small reservoirs) to contribute to more resilient livelihoods and ecosystems in the developing world.

Building on Phase 1

A key difficulty in the design of much water management is that it tends to be sectoral, that is, the management of water for agriculture alone; or the management of water for urban use alone. These policies often neglect the multiplicity of water uses in rural areas, including for agriculture, livestock, aquaculture, or domestic use. This serious deficiency calls for the development of integrated approaches to assist poor rural people get better access and use their water resources, save labour, improve efficiency, and encourage the development of integrated water management institutions.

Phase 1 has shown the importance of diversification.⁵ When water is available for a variety of uses, it can be a key link to improve the resilience of the rural poor.⁶ Research on multiple use systems (PN28 Multiple Water Use: van Koppen et al. 2006) carried out in five river basins, has proved to have a high potential for increasing the incomes of the poor globally, including issues of gender, institutions and participation. For example, results of studies done at ICAR-RCER, Patna, indicate that integrated cropping systems featuring multiple water use practices are 3-4 times more profitable than traditional rice-wheat systems⁷. Research by Peden et al. 2007 found that income generation from multiple use activities varied from \$10 to greater than \$600 per capita per year depending on water service levels, access to land, livestock, credit and other enabling conditions and access to markets and institutional support, and in most cases is sufficient to cover maintenance and operations costs (Peden et al. 2007).

Key to MUS is understanding the bio-physical changes of various types of storage. For example, through careful measurement of evapotranspiration from small reservoirs in Northern Ghana, research has shown that previous estimates of evaporation greatly over-estimated (more than twice) the total evaporation⁸. This research could change the global understanding of the advantages and disadvantages of small reservoirs versus large reservoirs when planning for MUS.

Several projects have shown the importance of considering both fisheries and livestock when thinking about water productivity broadly⁹. It is important to factor in multiple uses when considering flood plains and areas where the boundaries of fresh and salt water shift over the course of the year¹⁰.

The problem and research needs

Much of the developing world receives low and variable annual or seasonal rainfall, a situation that is likely to worsen in many already vulnerable areas as a result of global climate change. Increasing the capacity of farmers and rural communities to store water will be essential for reducing poverty and enhancing resilience. To maximize their impact, water storage and delivery systems should be designed and managed for multiple uses, reflecting the multiple ways in which rural households use water in their diverse livelihoods strategies.

Improving the design and management of agricultural water storage and delivery systems to specifically take into consideration multiple uses and users is one of the major opportunities to increase water productivity (Molden et al, 2007), and at the same time to reduce poverty and enhance gender equity (Castillo et al, 2007). By explicitly recognizing the environment as a water user, multiple use systems can also have positive impacts on ecosystems (Falkenmark et al, 2007).

Rainfed agriculture is in a dynamic state of evolution driven by processes of degradation and intensification. In terms of agricultural water productivity, the CA puts particular emphasis on integrating livestock (Peden et al.), fisheries, and aquaculture into water management systems that are currently managed primarily for crop production. Livestock, ecosystems and crops are all highly interconnected. The increasing demand for food necessitates the transition from management focused either on livestock or crops, to “multiple uses of water” systems that accommodates both. Such integration can greatly improve economic productivity of water at a relatively low cost in terms of water consumed. Reducing environmental externalities, especially in the case of livestock, can also make an important contribution to human and ecosystem health. Explicit recognition of multiple uses may also raise incomes, food security and the social status of marginalized users such as women, fishers or the landless (Bruns and Meinzen-Dick, 2000).

Both technical and management innovations will be researched with a focus on catchment and sub-catchment scales. Incorporation of livestock, fish and aquaculture in systems traditionally managed for crop production are promising options from Phase 1 that will be further explored in Phase 2. Gender and water quality will be important cross-cutting themes, along with downstream impacts on

⁵ This has been found in research results from such projects as PN2, PN7, PN10, and PN12.

⁶ Humphreys et al 2006

⁷ Samra et al, 2003

⁸ PN46 Small Multi-Purpose Reservoir Ensemble Planning: Liebe et al. 2005; Liebe, 2008; Liebe, 2008.

⁹ PN30 Wetlands, Social Welfare & Environmental Security: Masiyandima et al. 2005; Morardet and Koukou-Tchamba, 2004; PN34 Improved Fisheries in Tropical Reservoirs: Kolding et al. 2006; PN37 Nile Basin Livestock Water Productivity: Bizuwork et al. 2007a; Bizuwork et al. 2007b).

¹⁰ PN 10 Coastal Resource Management for Improving Livelihoods: Hoanh, et al. 2006; PN 35 Community-based Fish Culture: Brummett, 2006.

communities and ecosystems. While our entry point will be the so-called “productive-plus” systems requiring management above the household scale, accommodation of domestic uses and users will continue to be a priority in Phase 2. In fact, in most rural areas, the distinction between domestic and productive does not exist since water sources are managed for multiple uses. The challenge for research and development is to maximize the benefits from all uses, while at the same time maintaining or enhancing social equity and environmental sustainability.

Off-site impacts across scales will be explored in the following topic, Benefit Sharing, as well as in the fourth topic on Drivers and Processes of Change.

2.4.3 Benefit Sharing

Research in this topic examines ways to expand and share the benefits (and costs) from water and related resources. In this context it is critical to understand the local culture and practices, as well as gender dynamics, against the background of national and international policies before any discussion on benefit sharing¹¹. Only through the allocation of water that provides for and prioritizes livelihood and ecosystem resilience will we address the global water and food crisis.

Building on Phase 1

There are substantial transfers of benefits and risks between people in different parts of the system that arise from change – from local to national to basin to global (Ringler and Sikka, 2007). The Companion Modeling and Water Dynamics project (PN25) used multi-agent systems (MAS), followed the companion modeling method, to facilitate water management negotiations in Bhutan, demonstrating that this methodology helped resolve a conflict over the sharing of water resources by establishing a concrete agreement and creating an institution for collective watershed management at community scale (Gurung et al. 2006). Research in Thailand has led to real changes in financial decision-making in communities, as well as transforming the ability of relatively poor farmers/groups to communicate effectively with their wealthier neighbours (Barnaud et al. 2006).

At catchment scale, the SCALES project¹² has profoundly changed the access and influence of poorer communities via the use of *conversatorios* in Colombia. Smaller scale communities are now able to communicate effectively – resulting in changes in land and water management that have empowered the poor – at higher scales of decision making. Practical methods of Payment for Environmental Services between upstream and downstream users were developed and effectively applied in communities in the Andes system of basins¹³. Livestock are a very important part of agriculture in the Nile Basin making up a significant fraction of the agricultural GDP of riparian countries (more than 40% in Sudan) and especially of the rainfed agricultural areas¹⁴. Sectoral tradeoffs are explored in the research on India’s National River Linking Project¹⁵, in the context of basins at the national scale. Research from Phase 1 has demonstrated both the phenomenon of risks shifting towards the already vulnerable and poor populations in the Mekong¹⁶ at the transnational basin scale, as well as the potential to change the balance in favor of the rural poor. For example, livestock have potentially important roles to play in terms of impacts on hydrology and trans-boundary trade.

The problem and research needs

As demand for water increases, so does the pressure to move water from lower to higher value uses. Water re-allocations can occur at multiple scales – between countries in trans-boundary basins, between sectors within countries, and between neighbours in catchments. In theory, such reallocations of water can increase the overall benefits of water use and can produce win-win situations where the share of the value of water in the new use is made available to more than compensate those who lose access (Fisher and Huber-Lee, 2005, 2006). In practice, past attempts to initiate reforms in water policies and institutions, especially those such as benefit-sharing that are inspired by market concepts,

¹¹ PN 47 African Models of Transboundary Governance: Earle et al. 2006; Lautze and Giordano, 2007; Lautze and Giordano, 2006.

¹² PN20: Sustaining Collective Action for Livelihoods and Ecosystems across Scales: Swallow et al. 2006; Johnson et al. 2007; Peralta et al. 2006.

¹³ PN22: Environmental Services Promoting Rural Development.

¹⁴ Peden et al. 2007

¹⁵ PN48 Strategic Analysis of River Linking: Amarasinghe et al. 2007.

¹⁶ PN50 Enhancing Multi-scale Mekong Water Governance: Lebel et al. 2007.

have not been successful in most countries and contexts (PN47 African Models of Transboundary Governance: Merrey et al, 2007). This poses a major challenge, particularly for research. In the context of growing water demands and limited supplies, there are few realistic alternatives to water reallocation, but if ways in which to practically and effectively implement benefit sharing cannot be identified, water-related conflict, inequity, and poverty may not only persist but increase.

This research will investigate the mechanisms by which benefits (and costs) from improvements in management produce win-win situations where the overall benefits of water use agricultural water (both rainfed and irrigated) (Bouman et al. 2007), can increase water productivity and at the same time enhance equity and sustainability¹⁷. The rationale of increasing water productivity is to increase the total net benefit, which can open possibilities of sharing additional benefits, not just existing benefits. Research will explore the potential for the emergence of market and non-market oriented approaches to water sharing; non-market approaches such as regulation and negotiation will, however, also be included.

Benefit sharing in water management holds great promise (Milewski et al. 1999; Mostert, 2003; Sadoff and Grey, 2005); it is crucial, however, to keep in mind that maximizing the economic returns from water is just one of many water management goals. There are benefits and costs not easily monetized but recognized by humans as equally important, such as the value of increasing the resilience of the poor and ecosystems (Molle et al. 2007; Castillo et al. 2007).

Based on the experience of Phase 1, the focus on this research will be at the basin and catchment scale. This intermediate scale is often overlooked as emphasis is placed either at the community scale or at the regional or national scale. This intermediate scale is very important for agricultural water management, especially in rainfed systems. Strengthening institutions at this scale may also be prerequisite for improving management at higher scales, especially in terms of increasing citizen participation and institutional accountability.

This topic will work closely with the fourth topic, Drivers and Processes of Change, in looking at how global scale drivers affect the poor and ecosystems in basins.

2.4.4 Drivers and Processes of Change

This research area builds on the knowledge generated by the three previous areas, by identifying higher scale opportunities and threats to peoples' livelihoods and ecosystems that arise from changes in the way they use water to produce food, including livestock and aquatic resources. This research topic is essential to understanding and characterizing scaling out and scaling up processes and developing methods to increase impact. Work in this topic will be linked closely with work in the other topics.

Building on Phase 1

Key drivers of change, including economic growth, population growth, technical change, land degradation, climate change, urban growth, political change, and trade liberalization will profoundly influence water development and water use decision making and the ability of the rural poor to improve their livelihoods. Phase 1 research has demonstrated the need to look beyond basin and national boundaries, as well as beyond water policy to increase the resilience of the rural poor¹⁸. It is critical to consider how multiple factors can indeed change the entire equation when considering water infrastructure. For example, research in India has demonstrated that consumptive water use may not increase depending on the government's decisions regarding food self-sufficiency choices and the increase in water productivity over time.

Another key research area – on the process of change itself – has demonstrated the value of considering impact pathways when conducting research. Two scientists on one project (PN38: Safer peri-urban vegetable production) realized after participating in an impact pathways workshop, that they could influence policy on safer use of wastewater, and demonstrating the value of its use to peri-urban poor farmers, and effectively modifying local policy around wastewater reuse (although safety issues remain

¹⁷ Including in the form of changes in the management of other watershed resources that impact on water quality and availability

¹⁸ Béné and Neiland, 2006; Bouman, 2007; Moreno and Renner, 2007; Wang et al. 2007; Smakhtin and Anputhas, 2006; PN53 Food and Water Security under Global Change: Deressa, 2008; Deressa et al. 2007; Nhemachena and Hassan. 2007

a major concern). Other research expanded the methodology of impact pathways to include an understanding of the role of power structures. Through the development of an influence network game, local policy makers in Northern Ghana have a much better understanding of how to influence decisions about water and other issues (PN40 Integrating Governance and Modeling; Berger et al. 2006).

The problem and research needs

Key drivers of change, including economic growth, population growth, technical change, land degradation, climate change, urban development, political change, and trade liberalization, will profoundly influence future progress of increasing the resilience of the rural poor and of ecosystems at the river basin level 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; and (4) managing conflicts over water use.

Because these changes occur at multiple levels – local, basin, national and global – identifying opportunities and threats requires understanding how changes at one scale affect changes at other scales (Bouman, 2007). With stakeholder engagement, research will identify and anticipate local threats and opportunities from global stresses on food and water systems and the implications for basin-level resilience and productivity. This research will inform institutional reform processes and lead to the design of policy and financial instruments to assure improved resilience of food and water systems (Block, 2007).

This research area therefore also aims to foster change towards more resilient food and water systems. This includes action research using impact pathways evaluation and ex-post impact assessment. Research will also include understanding institutional congruence and the role of partnerships in scaling up and out processes. Learning from projects' and the program's experiences will build the CPWF's capacity to carry out research for significant development impact in basins. Similar establishment of impact hypotheses and their testing at basin, topic and program level will help the CPWF develop IPGs that will help the CPWF and other research-for-development organizations to more effectively put research products into use.

2.5 Critical Challenges and Opportunities in each Basin

CPWF research in Phase 2 is focused on achieving impact on one or two sets of critical basin development challenges in specific geographical areas of each basin, as well as at the basin level. This section presents for each basin the priority research questions related to those challenges. Questions are presented in their current general state of development, along with the rationale and types of impact expected for each one.

Using the range of sources described in Section 2.3, CPWF Basin Focal Projects will refine the basin research questions presented here during 2008; CPWF will include them in a five-year Medium Term Plan for the years 2009-2013. It is anticipated that the research questions for each basin will fit together in a single impact pathway for each basin that will also be presented and discussed at the Second CPWF International Forum (November 2008). As in all medium-term plans, the research questions are expected to evolve as research proceeds over the years. A newly formed "basin advisory committee" in each basin will also contribute to the refinement of the research questions and the basin impact pathway. It is anticipated that CPWF will setup one research platform in each basin in 2009 and a second in 2010. The implementation arrangements are described in the document "CPWF Organization and Implementation in Phase 2".

2.5.1 Global change issues in all basins

All basins teams have expressed a need for better understanding of global scale processes, especially climate change, but others as well, in order to improve resilience for the poor and ecosystems. As such, this will be a cross-basin topic. In each basin, this issue was included in the priority concerns

expressed. This area of research is an important niche for CPWF. While the research questions will vary by basin and via the process described in Section 3, here are some of the issues currently raised in basins.

Research Question 1: Which key drivers of change, including climate change, biofuels and trade policies, are of most importance, and what complementary sets of policies and investments would be most effective to mitigate adverse and enhance positive impacts?

Global change processes are likely to have enormous consequences for agriculture, ecosystems and rural livelihoods, especially in the Limpopo, Nile and Volta basin. Much of the area in these basins is drought-prone, with a semi-arid climate. Many soils have a low moisture-holding capacity and much of the rain that does fall runs off. While this increases stream flow in the main reaches, it can also cause floods in the lower reaches of the basin, destroying lives and livelihoods in their wake. Improved management practices, above and beyond rainwater harvesting as discussed above, coupled with policies that would enhance coping mechanism for the communities in the basin could aid in the adaptation to these adverse effects.

Research Question 2: How does research achieve developmental outcomes and impacts (for different types of research output in different contexts) and what partners are necessary at different levels to achieve impact?

Research is needed to understand institutional congruence and the role of partnerships in scaling up and out processes. Learning from projects' and the Program's experiences will build the CPWF's capacity to carry out research for significant development impact in basins.

2.5.2 Andean System of Basins

Research Question 1: What kinds of benefit-sharing mechanisms, including cultural and social considerations, work best in different socio-economic, biophysical and institutional environments?

In many parts of the Andes, water is not particularly scarce, although quality is often an issue. Poor people frequently have limited access to water. Water management interventions can help reduce poverty by improving the access of poor people to water resources, by improving the productivity with which they use water – or, less conventionally, by providing them with financial compensation when they help increase the quantity and quality of water available for downstream communities.

This latter option – payment for environmental services or PES – is of special interest in the Andean system of basins. Research on PES has resulted in a greater appreciation of the potential for resource-conserving practices to reduce negative externalities. When farm-level, near-term benefits to farmers are high, spontaneous adoption of such practices can be anticipated. In other cases, however, social and environmental benefits may justify providing farmers with incentives to adopt. In a Phase 1 project in Fuquene, Colombia, a pilot PES scheme was used to provide incentives for farmers to adopt conservation agriculture in highland potato systems. This project aimed to improve farmer welfare while reducing agriculture's contribution to the eutrophication of the Lake Fuquene. Research on PES has also been conducted in parts of Ecuador and Peru.

Problems remain with regard to scaling up and out of PES schemes. Because of the nature of Andean geology, water generated upstream in one catchment may at times benefit downstream users in entirely different catchment. This may limit implementation of PES at smaller scales. Another reason to look beyond small scale PES programs is that many Andean cities are located in upstream headwaters, for example, Bogotá, Quito, Cali and Cuzco. These cities affect downstream water quality and quantity.

The effectiveness and sustainability of PES schemes may require that institutional boundaries be sorted out. In the Andes, it is not uncommon to find overlapping or conflicting mandates of institutions working on different aspects of water management. Provision of reliable shared information can help, for example, clarify tradeoffs between alternative uses of water. When decisions on water allocation must be made between competing uses, citizen participation is essential. Given power inequities, careful attention must be paid to giving voice to the poor.

Phase 2 research will build on the foundations laid by PN 20 and 22 in answering the following kinds of questions. How can sources of negative externalities (location and magnitude) be identified? How

can priority areas in watersheds be selected that have a relatively high potential to modify negative externalities and produce downstream social benefits? How can social benefits of farm-level interventions be measured at watershed and basin scales of analysis? What criteria should be used to disburse PES credits in order to achieve expected environmental and socioeconomic impacts? How can PES systems achieve political and institutional sustainability?

This research question is related to Topic 3 on benefit sharing.

Research Question 2: What are the implications of climate change for agriculture, livelihoods and the environment in vulnerable, marginal areas (very dry, very wet, steep slopes) and how will that affect water availability for hydropower, cities and other uses?

Climate change will have significant impacts in the Andes. The magnitude and distribution of these impacts is unclear, however. There is a similar lack of clarity as to whether they will be, on balance, positive or negative. Global models differ on these issues, and are not likely to converge soon. The implication is that land and water management will need to adapt to cope with unpredictability. This is especially important in the Andes in part because high altitude ecosystems such as páramo and nevados are critical for seasonal water flows. This research question is related to Topic 4 on drivers and processes of change.

2.5.3 Ganges Basin¹⁹

Research Question 1: How can productivity on sodic and saline soils be increased, and what is the potential for aerobic rice?

Sodicity and salinity are major problems in different parts of the Indus Ganges basin. The Indus, the western and eastern Ganges, and coastal areas are all affected in one way or another. In India alone 9.05 million hectares of farm land are affected by salinity and sodicity. Different research institutions in the basin have developed management strategies for these soils. Building on these strategies, the further development of salt tolerant crop varieties and improvements in management practices will result in productive utilization of otherwise barren soils, better resource use efficiency, and improved livelihoods for large numbers of rural poor. Research is needed on the longer-term consequences for soil quality of widespread use of such practices. Such research will carry forward the successful work of PN7 on introducing salt-tolerant germplasm and new management practices for salt-affected coastal areas in Orissa and sodic-soil affected areas of Uttar Pradesh.

Rice is a major crop in the Indo-Gangetic Basin. New water-efficient rice production technologies have the potential to save enormous amounts of water, in rainfed paddy areas as well as irrigated areas. Aerobic rice systems, studied in Phase 1 by project PN16, comprise one such technology. Research is needed on how to adapt aerobic rice germplasm to local environments; how to best manage aerobic rice under farmers' conditions (including their likely different strategies in "wet" and "dry" years); what are possible consequences over time for soil fertility, nutrient availability and soil biology; and what happens to downstream water availability and access when less water is used upstream.

This research question is related to Topic 1 on rainwater management.

Research Question 2: How can abundant groundwater resources in the eastern Ganges and scarce groundwater resources in the western Ganges be most effectively used?

Groundwater is critically important in agriculture in the IGB. In the eastern Ganges, there are enormous opportunities to sustainably improve livelihoods by using available and abundant groundwater resources for dry season cropping, as well as using flood waters in the monsoon season for community-level fisheries and other uses. In contrast, in the western Ganges, groundwater is relatively scarce and in many areas is being rapidly depleted through over-pumping. An emerging energy crisis, affecting urban and rural areas alike, is making pumping more expensive and energy supply less reliable. In these areas, farmers are shifting to water saving practices or high value crops, pushing staple food grain production into other regions, including the eastern Ganges. What changes in cropping patterns can be expected in east and west? How might more expensive and less reliable farm

¹⁹ It will be necessary to reduce to two the number of research questions requiring a geographical intervention platform in the Ganges basin

energy affect poor farmers? What can be done to help poor farmers participate more fully in a shift towards higher valued crops? What will be the consequences of these changes for groundwater use and aquifers? To what extent might scarce water resources be diverted to biofuel production? In both east and west, how can farm families best respond to these opportunities and threats? Responses may include varietal change, improved crop management, innovations in water and land management or changes in crop selection and cropping patterns. There are related opportunities for these responses to be supported and facilitated by suitable policy change. Finally, what might be the broader externalities – for ecosystem services or for downstream communities – of widespread adjustments in cropping patterns and farmers' practices?

This research question is related to Topic 1 on rainwater management.

Research Question 3: What will be the impact of climate change on vulnerability of food systems and their mitigation and adaptation strategies, particularly the deltaic regions?

An enormously important issue in the entire Ganges basin is the likely effect of climate change on food security. Climate change may lead to higher temperatures and greater variability and/ or reduced levels of rainfall. These will affect the yields of such crops as rice, wheat, maize and pulses, with unknown consequences for food prices and food security. Larger populations will require more food. Rapid economic growth is transforming the structure of demand for food, away from food grains and towards (relatively water-intensive) fruits, vegetables, dairy and other high value products. What are the likely impacts of climate change and market changes on food security and on the availability of surface water and groundwater? What are the current and future opportunities for virtual water trade in the basin? At the same time, energy security will become more of an issue – however, production of biofuels also requires water. How will policy responses to energy insecurity affect rural livelihoods and water use?

Even as water resources available for irrigation decline, inundation effects from rising sea levels will have catastrophic effects in coastal areas and in the delta. CPWF Phase 2 research will build on the successful link that has allowed movement of management strategies and institutional processes for coastal agro-ecosystems from the Mekong delta. It will also link to similar research in the Nile delta.

This research question is related to Topic 4 on drivers and processes of change.

2.5.4 Limpopo Basin

Research Question 1: How can rainwater management be improved?

Rainfed smallholder subsistence agriculture is important for the livelihoods of large numbers of rural poor in the Limpopo basin. Average annual rainfall in the basin ranges from 200 to 1,200 mm. It tends to be highly variable, unreliable, and inefficiently used. Many areas are routinely food deficient and rely on food aid. Large scale irrigation is restricted, with little scope for expansion. In dry years, water flows in the main reaches of the Limpopo for less than 40 days (Mgonja and Waddington 2006). Even in normal years, it does not flow throughout the year. The area developed for irrigation in South Africa (198,000 ha) already exceeds the estimated potential irrigable area (137,000 ha) (Louw and Liebenberg 2006), although many irrigation schemes are in disrepair.

Research is needed to further develop options for rainwater harvesting and conservation; identify where in the basin different options are most suitable; identify complementary farming practices (like soil fertility management) to accompany rainwater harvesting; foster institutional and policy changes to facilitate adoption; and evaluate the likely consequences for downstream water users and uses of increased rainwater harvesting upstream. Possible interventions include: rainwater harvesting, micro-irrigation, better land management, small scale irrigation, along with supporting policies. Such research in Phase 2 will build on the foundations laid by several Phase 1 projects, among them PN1 and PN 17. The research is likely to concentrate on southern Zimbabwe and/or northern South Africa (Limpopo province) and on the downstream effects in those countries and in Mozambique.

This research question relates to both Topic 1 on rainwater management and Topic 3 on benefit sharing.

Research Question 2: How can water and its benefits be more equitably shared?

A major water-related problem in the Limpopo basin is inequity in water allocation between sectors, for example, among mining, industry, commercial agriculture, smallholder agriculture and urban use and environmental uses. There are specific problems of water allocation between commercial farming and poor communities in South Africa and, to some degree, in Botswana and Zimbabwe. At a larger scale, there are issues of equitable distribution of water among riparian countries.

Questions of pollution and water quality are strongly linked to those of equitable water sharing. Principal sources of pollution include high density urban areas, and mining and other industrial uses. Different water users and uses (agriculture, livestock, fisheries, direct urban consumption, environmental flows) are affected in different ways by poor water quality.

Research is needed to evaluate the likely consequences of different intervention scenarios or policy options on water allocation and peoples' livelihoods. Modeling can be useful in this regard. Further research is needed on power relationships underlying inequity to identify potential intervention points, for example strengthening community rights vis-à-vis mining companies or assuring water allocations among countries. The results of such research will be used to inform policy debate and enhance dialogue in the basin.

This research question is related to Topic 3 on benefit sharing.

2.5.5 Mekong Basin

Research Question 1: What kinds of benefit-sharing work best, especially in the trade-off between water use for improved livelihoods and ecosystems with hydroelectricity and urban industrial uses, including hydropower?

Compared to many other river basins around the world, water in the Mekong basin is relatively abundant. Even here, however, competition for water is growing. Water demand for power generation and urban direct consumption is increasing. Meeting these demands through upstream investments will have consequences for downstream water quality and especially for fisheries that are of major importance to the livelihoods of the poor. One issue is the nature of upstream-downstream links: China sits upstream as the most powerful actor but does not suffer the downstream consequences when it alters river flows through dam construction. Among potential consequences is reduced fish production (Baran et al., 2007)²⁰. Another issue is the weakness of current governance (Hirsch et al., 2006)²¹. The Mekong River Agreement is neither enforceable nor conformable with national water policies.

For Hirsch et al. (2006), the solution lies in strengthening central institutions, but Lebel et al. (2005)²² argue that a more open and participatory model is required. Other solutions may involve a form of payment for ecosystem services (Ojendal et al., 2002)²³. Research can help develop institutional innovations for sharing the benefits of upstream developments (hydroelectric power, increased irrigation, improved navigation, changed land uses) with those negatively affected by them (such as fishing communities in the Tonle Sap). A key contribution of research is to develop tools and methods to quantify and monitor the costs and benefits of altered flows.

This research question is related to Topic 3, on benefit sharing.

²⁰ Baran E., Jantunen T. and Chong C. K. 2007 Values of inland fisheries in the Mekong River Basin. WorldFish Center, Phnom Penh, Cambodia. 76 pages.

²¹ Hirsch Philip, Kurt Mørck Jensen, Ben Boer, Naomi Carrard, Stephen FitzGerald, Rosemary Lyster, 2006, National Interests and Transboundary Water Governance in the Mekong. Australian Mekong Resource Centre, University of Sydney.

²² Lebel, L., P. Garden, and M. Imamura. 2005. The politics of scale, position, and place in the governance of water resources in the Mekong region. *Ecology and Society* 10(2): 18. [online] URL:

<http://www.ecologyandsociety.org/vol10/iss2/art18/>

²³ Ojendal, Joakim, Vikrom Mathur and Mak Sithirith, 2002. Environmental Governance in the Mekong: Hydropower Site Selection Processes in the Se San and Sre Pok Basins. SEI/REPSI Report Series No. 4. Stockholm Environment Institute, Stockholm.

Research Question 2: What local water governance models are most effective in multiple-use systems?

The first research question, above, explores water allocation and benefit sharing at the whole basin level. Similar questions may be posed, however, at the community level, where opportunities to introduce multiple-use systems can reduce competition for scarce water among different community members. Phase 1 research has shown that good local water governance can help improve coastal systems where salt water incursion from the sea is a major issue. Research in CPWF project PN10 has helped communities adapt to salt water incursions through a more accurate and reliable distribution of salt water to shrimp producing areas while conserving fresh water for rice producing areas. This requires a combination of improved community-level governance, better information systems, and improvements in water control infrastructure. Further research will build on this foundation to identify additional ways to manage salt-water incursions, and to bring this knowledge to bear in the deltas of other basins, especially the Ganges and the Nile. Phase 1 research also showed how improvements in local water governance can help introduce community-based aquaculture into flood prone areas where land is privately held and used by farmers for dry season cropping.

While the above examples of coastal systems provide models of governance and access, they do not necessarily translate to other food production systems and other cultures in Cambodia, Laos and Thailand. In Cambodia there are tensions over the use of the flooded forests around the Tonle Sap – should they be preserved for fish, where they are considered to be important fish nurseries, or should they be developed for rice? Rice-fish systems are also seen as the key to improving food security and diets in Laos (Meusch et al., 2007)²⁴, and an integrated approach including access and common property rights is required. Research is needed on models of local governance that take account of the multiple uses of water, particularly of rice-fish systems, and that are appropriate to the local cultures in areas of the basin upstream of the delta.

This research question is related to Topic 2 on multiple use systems.

2.5.6 Nile Basin

Research Question 1: How can rainwater management be improved?

Irrigated agriculture is the major water user in both Egypt and Sudan, with over 5.5 million hectares under irrigation. Ethiopia has a (largely unused) potential for 100,000 ha of perennial irrigation and 165,000 ha of small-scale seasonal irrigation. Water resource development is constrained, however, by the high cost of water storage and irrigation infrastructure and prior river water allocation in favor of Egypt and Sudan. The other riparian countries have little potential for irrigation in the basin and depend almost completely on rain-fed agriculture.

In all basin countries, with the exceptions of Egypt and Uganda, per capita food and agricultural production indexes have declined over past decades. In Rwanda, Sudan, Tanzania and Ethiopia, deterioration in food security is especially marked. Rainfed agriculture dominates both in high rainfall areas and the semiarid savannah belt. In both areas, research is needed to improve the productivity of rainfall, and to make farming systems more productive and profitable. Water harvesting practices, combined with the introduction of drought tolerant germplasm and improved soil fertility management, offer one set of solutions. Better integration of crops, fishing and livestock in farming systems offers another. Both of these were explored in CPWF Phase 1 through PN2 and PN37; the outputs of these projects serve as a foundation on which Phase 2 research can be built. The research is expected to focus on the Ethiopian highlands, studying downstream effects in Sudan and Egypt and thus developing further the work of project PN19 (Blue Nile upstream-downstream transboundary relationships).

At this transboundary level, countries are engaged in consultation on benefit sharing options associated with co-investment in water storage and hydropower infrastructure. Research can help (a) identify opportunities for enhancing and sharing benefits; (b) inform consultative processes and make explicit political choices involved designing and implementing instruments and mechanisms for benefit sharing; and (c) to identify those that offer most promise of 'win-win' solutions.

²⁴ Meusch, E., Yhoun-Aree, J., Friend, R. & Funge-Smith, S.J. 2003. The role and nutritional value of aquatic resources in the livelihoods of rural people – a participatory assessment in Attapeu Province, Lao PDR. FAO Regional Office Asia and the Pacific, Bangkok, Thailand, Publication No. 2003/11, pp. 34.

This research question relates to both Topic 1 on rainwater management and Topic 3 on benefit sharing.

Research Question 2: How can the effects of pollution, variable water supply and climate change be mitigated in the Nile delta?

Egypt's population, land-use, agriculture, and most of its economic activity are constrained to a narrow T-shaped strip of land along the Nile and the deltaic coast. Being the last to receive the water from the Nile, the delta is also subject to variable water availability; those fluctuations may increase due to climate change effects upstream. The delta also suffers pollution from upstream sources. The coastal zone around the Nile delta is already subsiding at approximately 3-5mm/year, affecting prime agricultural land in the Nile delta through inundation and salinization. Analysis of climate records reveals a warming trend in recent decades. Country average mean temperatures are projected to increase by 1.4°C and 2.5°C by 2050 and 2100, respectively. Of over-riding concern is the possibility that climate change could reduce upstream rainfall while increasing evaporative losses in semiarid regions, resulting in decreasing water availability in the Nile – even as water demands continue to climb. Research is needed on the consequences of climate change scenarios on coastal areas and on Nile water availability – and on the extent to which different strategies involving water management, agricultural and land management change, or policy or institutional could help mitigate projected negative impacts.

This research question is related to Topic 4 on drivers and processes of change.

2.5.7 Volta Basin

Research Question 1: How can rainwater management be improved?

The Volta basin is largely populated by resource-poor farmers who rely on rain-fed agriculture for their livelihoods. Less than one percent of cultivated area is irrigated. Crop yields are low: maize yields range from 0.8 to around 2.0 t/ha, according to rainfall level and soil quality. Even where average annual rainfall appears adequate for cropping, its uneven distribution leads to high risk of crop loss, which in turn discourages farmers from using fertilizers. During the past 30 years, rainfall has become more erratic and unreliable, and cropping seasons have become shorter.

The clear imperative for agriculture in the Volta basin is to increase the productivity of rainfed systems in the face of moderate to severe drought risks, low soil fertility and institutional obstacles. There are opportunities to achieve this: through the introduction and adaptation of conservation agriculture and in-field water harvesting accompanied by improved soil fertility management, and investment in water infrastructure such as dugouts and small reservoirs. These are particularly common in Burkina Faso and, increasingly, in northern Ghana. Phase 2 research on these topics can build on the achievements of Phase 1 projects in this basin, for example PN5, 6, and PN46.

Multiple-use crop-livestock systems dominate the northern part of the basin. At first sight, water productivity in these systems appears low. Research by Basin Focal Projects, however, found that water productivity can be surprisingly high when crop residues for livestock are taken into account. Feed and water transfers result in substantial productivity gains at relatively low levels of risk. Ways to sustainably improve the productivity of these systems must be sought. This will require that attention be paid to issues of land tenure, tensions between farmers and herders, and processes of land degradation.

This research question is related to Topic 1 and 3 on rainwater management.

Research Question 2: What kinds of benefit-sharing mechanisms, including cultural and social considerations, work best in different socio-economic, biophysical and institutional environments?

One of the most promising opportunities to improve livelihoods for the poor in the Volta basin is via the construction of small reservoirs. These can be used for small irrigation, aquaculture, watering of livestock and many other purposes. There are at present around 1,700 small dams. In Phase 1, however, Project PN6 showed that most of these are not maintained or managed so as to realize potential benefits. Important questions for research include: What is a suitable balance between storage (needed for fish, domestic use in dry season) vs. withdrawal for the peak irrigation season? How can water

quality issues best be managed? What infrastructure is needed (for example, separate livestock watering troughs) and how much extra does this cost?

Closely related to this is a concern that continued expansion in the number of small dams and reservoirs may affect water levels in Lake Volta and behind the Akosombo Dam. Lake Volta is the largest man-made lake in the world in terms of surface area and hydro-power from the Akosombo Dam is of paramount importance to development in Ghana. Analysis from the Basin Focal Project suggests that climate change poses as great a threat to hydropower as land use change and the construction of small dams. Benefit sharing in the context of the Volta is a transboundary issue that involves upstream farmers and downstream users of hydropower. Action research is required to accelerate the development of policy and financial instruments to accelerate benefit sharing.

This research question is related to Topic 1 on rainwater management and Topic 3 on benefit sharing.

2.6 Summary

The research agenda presented here represents a fundamental shift from Phase 1, placing much more of the decision making on research questions and implementation in the hands of collaborators in the basin. This research will be supported by the larger CPWF community via topic working groups. Table 1 illustrates, there are quite some commonalities among priorities across the basins. Figure 1 shows the research questions integrated into a very simple logic model for the CPWF.

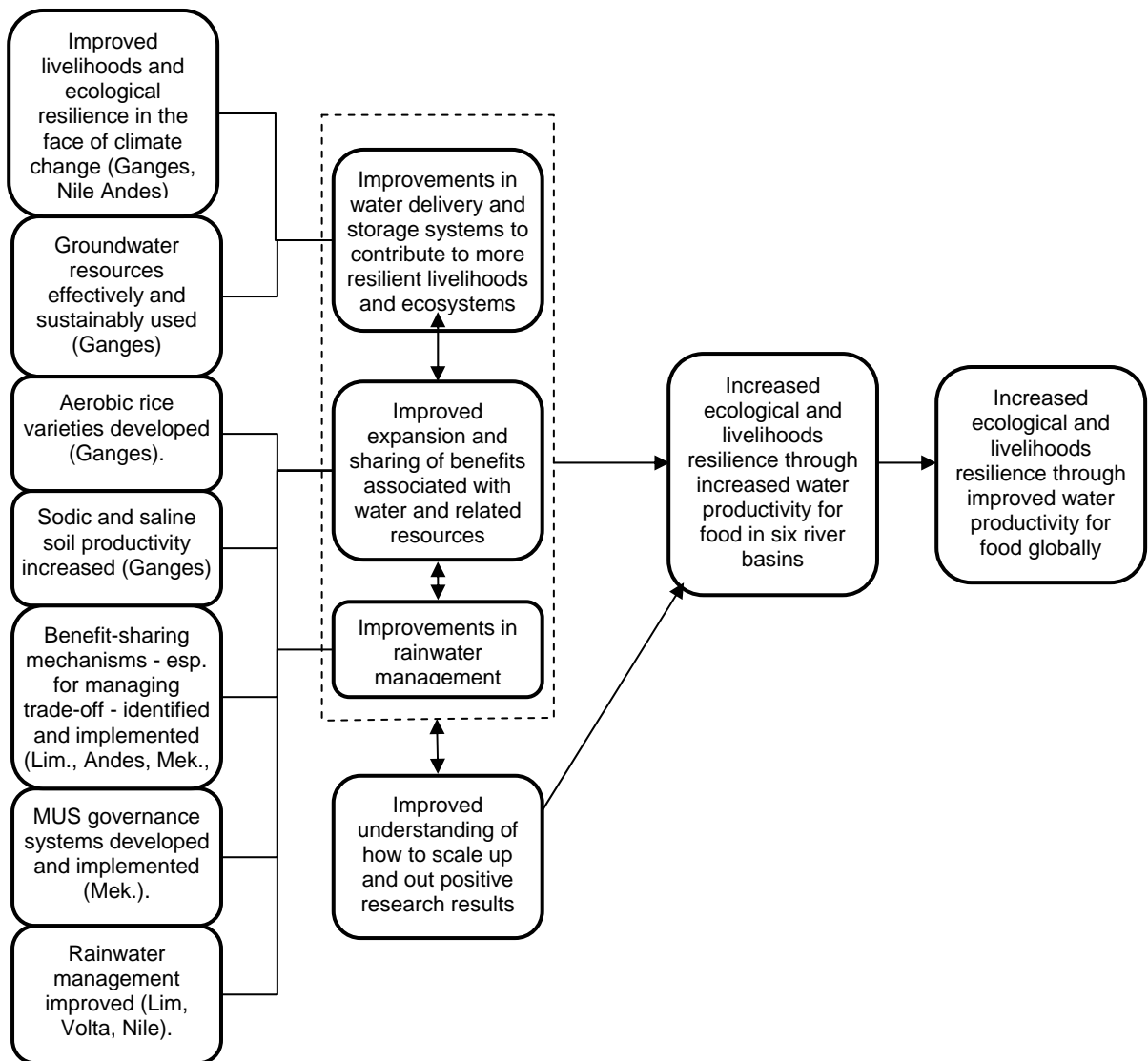


Figure 1. A Simple Program Logic Model for CPWF Phase 2

Table 1: Basin general research questions grouped according to similarity

ANDES	GANGES	LIMPOPO	NILE	MEKONG	VOLTA	ALL BASINS
	How can productivity on sodic and saline soils be increased, and what is the potential for aerobic rice?	How can rainwater management be improved?	How can rainwater management be improved?		How can rainwater management be improved?	
What kinds of benefit-sharing mechanisms, including cultural and social considerations, work best in different socio-economic, biophysical and institutional environments?		How can water and its benefits be more equitably shared?		What kinds of benefit-sharing work best, especially in the trade-off between water use for improved livelihoods and ecosystems with hydroelectricity and urban industrial uses, including hydropower?	What kinds of benefit-sharing mechanisms, including cultural and social considerations, work best in different socio-economic, biophysical and institutional environments?	
What are the implications of climate change for agriculture, livelihoods and the environment in vulnerable, marginal areas (very dry, very wet, steep slopes) and how will that affect water availability for hydropower, cities and other uses?	What will be the impact of climate change on vulnerability of food systems and their mitigation and adaptation strategies, particularly the deltaic regions?		How can the effects of pollution, variable water supply and climate change be mitigated in the Nile delta?			Which key drivers of change, including climate change, biofuels and trade policies, are of most importance, and what complementary sets of policies and investments would be most effective to mitigate adverse and enhance positive impacts?
	How can abundant groundwater resources in the eastern Ganges and scarce groundwater resources in the western Ganges be most effectively used?					

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ANDES	GANGES	LIMPOPO	NILE	MEKONG	VOLTA	ALL BASINS
				What local water governance models are most effective in multiple-use systems?		
						How does research achieve developmental outcomes and impacts (for different types of research output in different contexts) and what partners are necessary at different levels to achieve impact?

Chapter 3 CPWF Implementation in Phase 2

3.1 Basin Projects

The following changes in management for all six CPWF basins are proposed:

- To use a project format both to manage and guide research in the basin (one Basin Leadership Team per basin) and to implement CPWF research at the basin level (one or two integrated Basin Projects in each basin). Each Basin Project will correspond to a small set of related key issues in a geographically-focused part of the basin.
- To establish Basin Leadership Teams each composed of a Basin Science Leader and a Basin Impact Leader connected to analogous positions at Program level, so as to strengthen and integrate science and impact at the level of each basin.

A transition process will lead to the above through the following steps taking place in 2008.

1. **Identify the basin advisory committee** of researchers, development specialists, policymakers, end users and other stakeholders that will provide guidance and a “point-of-reference” for all the functions of each Basin Project in their basin, especially the development of the basin strategy.
2. **Refine the basin research questions.** The Basin Focal Projects and CPWF management together with the basin advisory committees will refine the presently formulated research questions into basin development challenges discussed at the Second CPWF International Forum (November 2008). Research questions are expected to evolve as research proceeds over the years.
3. **Establish the Basin Leadership Team in project mode,** through basin-tailored competitive or mixed competitive/commissioned processes such as (a) inviting offers from different institutions to provide both team members and their limited support staff and (b) a call for expressions of interest (EOI) from institutions and individuals²⁵, followed by the assembly of an integrated team by CPWF, to bring together the best people and elements of different EOI.

Once each Basin Leadership Team is established, it will have the following responsibilities.

1. **Develop a more detailed strategy** beyond the original proposal through workshops and other kinds of stakeholder consultation and based on the systematic description of impact pathways.
2. **Provide the “terms of reference” for calls for research projects**²⁶ based on the detailed basin strategy.
3. **Establish Basin Projects** (one for each development challenge, one or two per basin)²⁷, attempting to find the most capable and effective combination of people for the each task, including science, impact, project leadership and project management skills.
4. **Report** basin progress to CPWF management.
5. **Foster information sharing** between CPWF projects and complementary non-CPWF research.

²⁵ Those already experienced in the CPWF as theme leaders, participants in projects, especially Basin Focal Projects, and basin coordination could all be suitable candidates as well as those from outside the CPWF.

²⁶ Although part of the basin strategy, calls for projects are implemented by the CPWF Program Manager and Secretariat staff.

²⁷ This is likely to be done stepwise to gain experience in implementation of this new mode, starting (early 2009) with one project in 2-3 basins, then one project in the remaining 3-4 basins (late 2009), then adding (by 2010) a second project in those basins that have two sets of key issues.

6. *Develop capacity building activities* at basin level such as cohorts of young researchers and joint learning through mentoring by project researchers.
7. *Develop links between CPWF projects and “next users”*, i.e. institutions or individuals with an interest in applying research results to create impact amongst “end users” (scientific research institutes, international or local NGOs, development assistance agencies, community groups, or even private sector entities).
8. *Seek influential contacts for impact*, such as key high-level, influential local stakeholders.
9. *Synthesis of specific issues* by providing, on a recurring basis, a synthesis of CPWF achievements in the basin with regard to both science and impact.

3.2 Program level

A key team of Program Director, Science Director and Impact Director will be put in place during 2008 to strengthen the Program’s high-level abilities in science and impact. The exact shape of other program support to work in the basins (especially the management of the research topics) will be determined once basin research teams get under way. At present it is anticipated that the Science Director will need a leader of each Topic but it is not completely clear whether this support will be through revolving leaders of specific sub-topics or more permanent leaders with a broader purview. In a similar way it is not clear whether the Impact Leader’s need for key experts in M & E, Impact and Communications, should be covered by two or by three specialists.

3.2.1 Science Team (Program Level)

The science focus of the CPWF is led by the Science Director who will be an experienced scientist noted for his/her broad understanding, as well as depth in particular fields of endeavour, and who has an outstanding ability to integrate across disciplines and topics and to inspire quality science. In the overall structure, the Science Director supervises Basin Science Leaders and Topic Leaders and reports to the CPWF Program Director.

The Science Director has several tasks, among them: encouraging research integration across topics, basins and scales; ensuring that CPWF research adheres to agreed priorities, maintains a high level of quality and produces international public goods; supervising within-basin and cross-basin synthesis of scientific research findings; identifying desirable adjustments in research directions and priorities; leading the group of Basin Science Leaders in completing and adjusting basin-level work plans; identifying needs for topic leadership; overseeing cross-basin Topic Working Groups, participating in Topic Working Groups and the Impact Working Group (discussed below); and (in concert with the Impact Director) providing leadership in the suitable integration of gender, institutional and participation issues and approaches, and capacity-building into CPWF project planning and implementation.

3.2.2 Impact Team (Program Level)

The impact focus of the CPWF is led by the Impact Director who will be an experienced research scientist or development specialist with understanding and experience of both development and research and proven ability to achieve results “on the ground” for the benefit of poor communities. In the overall structure, the Impact Director supervises Basin Impact Leaders and Program-level specialists on monitoring, evaluation & impact assessment, and communication. Like the Science Director, the Impact Director reports to the CPWF Program Director.

The Impact Director has several tasks, among them: providing leadership in developing and updating impact pathways for the CPWF and individual basins; supervising “impact research” (on how research outputs move along impact pathways in different contexts, and the types of partnership required to transform research outputs to development outcomes); overseeing Program and basin-level work on monitoring and evaluation and impact assessment; overseeing the development and implementation of basin strategies as they are related to generating impacts; leading the group of Basin Impact Leaders in completing and adjusting basin-level work plans; leading the Impact Working Group; participating in Topic

Working Groups; and (in concert with the Science Director) providing leadership in the suitable integration of gender, institutional and participation issues and approaches, and capacity-building into CPWF project planning and implementation.

3.2.3 Challenge Program Management Team (CPMT)

The Program is led by the Program Director who is supported by the Challenge Program Management Team consisting of him/herself, the Program Manager, the Science Director, the Impact Director and one or two part-time external members, co-opted as and when needed, to ensure that the CPWF is in touch with the broader community and has access to skills of those who cannot dedicate themselves fulltime to Challenge Program management.

The CPWF Program Director is responsible for the overall quality of the Program, including its partnerships for science, for relations with donors and other outside institutions. Additionally he/she is a member of the Board and the primary point of contact with the Board Chair. Note that there is a relatively short line of responsibility designed to promote quality control of work at project level: Program Director – Science Director – Basin Science Leaders- Projects, with a parallel mutually reinforcing structure via the Impact Director and Basin Impact Leaders. Also note that the Basin Science Leaders and Basin Impact Leaders would usually be employees of the institutions contracted to provide the basin leadership team, and not employees of the CPWF.

The Program Manager is responsible for all administrative operations of the Program, including financial projections, project and project contracting and supervision, documentation, data storage and use and outsourced services such as Program accounting. The Program Manager will lead a Secretariat consisting of Executive Assistant, Project Manager, Financial Administrator, Data Expert, Administrative Officer and Communications Assistant that will continue into Phase 2 based in Colombo, Sri Lanka.

3.3 Working Groups for Value Added

CPWF achieves some of its International Public Goods (IPGs) within each basin and across basins by comparing, contrasting and integrating in-basin IPGs. Organizationally, cross-basin experiences are obtained through several working groups.

There will be Working Groups for each topic and one for Impact. Each could meet on a regular schedule of virtual meetings, with occasional in-person interactions of the whole group.

3.3.1 Topic Working Groups

Topic working groups are expected to be the main mechanism to develop ideas, research papers, synthesis and communication and outreach material on each topic. The issues covered by the working group (and therefore its membership too) are likely to evolve as the challenges and research questions within the Basin projects also evolve. One working group will be constituted for each topic, coordinated by the Topic Leader, with membership of the Basin Science Leaders and project researchers working within that topic. The Science Director, Impact Director, Basin Impact Leaders and other topic leaders will participate at their discretion.

3.3.2 Impact Working Group

The Impact Working Group will meet to gather cross-basin learning in all areas related to impact (capacity building, M&E and impact, communications, and partnership development). This Working Group will include the Impact Director, the Monitoring, Evaluation & Impact specialist, the Science Director and Basin Impact Leaders. Others, including Project Science Leaders, may participate at their discretion.

3.4 Timeline

A timeline for Phase 2 of the CPWF, including transition actions in 2008 at the end of Phase 1, is shown in Table 2.

3.5 Exit strategy

The exit strategy of the CPWF depends on the strong focus on basin research needs and questions. By 2018, CPWF will have established partnerships in each of its six basins in research for development that are sufficiently robust so that CPWF as a Program is no longer needed. The CPWF will have given the platform for the CGIAR centres to build their role in working in water for food, together with each other and with ARIs, NARES, NGOs and river basin organisations in the basin. Basin by basin the institutional nodes of this collaboration will vary according to local circumstances. As part of their work, CPWF basin focal projects will already by 2009 have provided the first analysis of the institutional networks and have noted the institutions that at present are best able to act as nodes in the network to involve other institutions in the research facilitated by CPWF.

In legal terms, CPWF's withdrawal by 2018 will present no problems because all service agreements with institutions and personnel are based on time bound contracts.

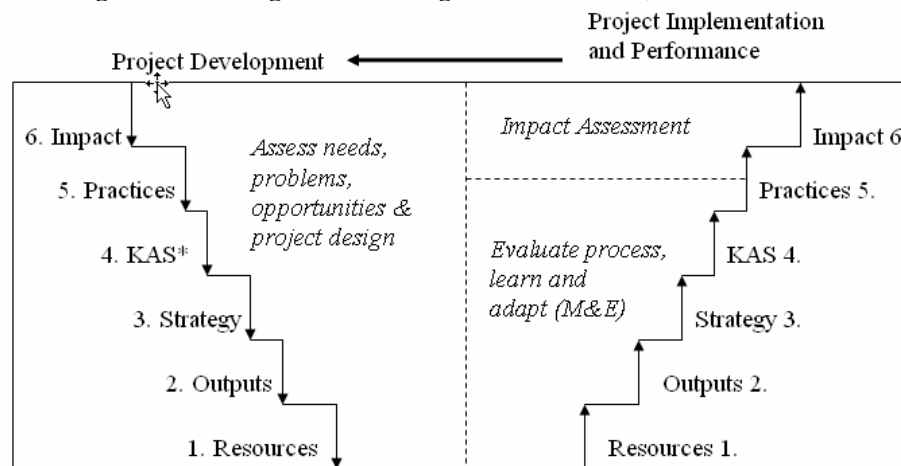
Chapter 4 Monitoring and Evaluation in Phase 2

4.1 The CPWF Integrated Planning and Evaluation Tool

Planning and monitoring and evaluation (M&E) in the CPWF is based on program theory evaluation used extensively in the US and Europe, and recommended as good practice by the Network of Networks on Impact Evaluation (NONIE)²⁸ and EIARD²⁹. Fundamental to good planning and evaluation is making program theory explicit – that is, developing cause-and-effect models that link project activities to outcomes to eventual impact. For the CPWF it is equally important to show the partnerships required for the type of research the program undertakes and to promote the development mandate of the program. The CPWF calls these models ‘impact pathways’ (IPs). Impact pathways models include a logical framework and network maps (showing partnerships).

The CPWF’s generic logic model is outlined in Figure 1. CPWF is a research-for-development program which aims to achieve social, economic and environmental impacts in basins. The program identifies needs, problems and opportunities, which when solved or exploited, can contribute to achieving impact. Basin and project teams develop impact pathways that describe who needs to do what differently (change of practices) to achieve the desired impacts and how the use of research outputs will help bring these changes about (left-hand-side of Figure 1). The validity of these hypotheses is tested during project implementation (through monitoring and evaluation) and impact assessment (right-hand-side of Figure 2).

Figure 2: CPWF Logic Model: Integrated Planning and Evaluation (based on Bennett’s Hierarchy³⁰)



*KAS = Knowledge, Attitudes and Skills

The CPWF constructs three levels of impact pathways: cross-basin, the basin and the project level. These are interdependent: hence it is possible to track adjustments to expected outcomes through the different levels. For instance, if an unexpected result or new opportunity presented itself at the project level, there is a mechanism by which, depending on the severity of the change, an adjustment at the project level could be

²⁸ NONIE draws its membership from three official development evaluation networks – the DAC Evaluation Network, the UN Evaluation Group and the Evaluation Cooperation Group of the Multilateral Development Banks

²⁹ Task Force on Impact Assessment and Evaluation, European Initiative for Agricultural Research for Development

³⁰ See Bennett, C. F. and Rockwell C. (2000) ‘Targeting outcomes of program (TOP)’, available at citnews.unl.edu/TOP/english/

reflected at the basin and cross basin levels in the impact pathways. These changes are documented as explained later in this chapter.

Cross-basin and basin IPs are prescriptive, in that the research questions they address and the impacts they seek to generate are identified before projects are implemented at the basin level. This also assists with identifying the potential international public goods that the research will provide. However, while the IPs are prescriptive, this does not mean they are inflexible. Currently CPWF is in transition between phase 1 and 2 with focussed research questions being refined in basins in the areas that the CPWF intends to address.

4.2 Who implements the planning, monitoring and evaluation tools?

An important practical aspect of basin level monitoring, evaluation and promotion of impact is the contracting of 'Basin Leadership Teams', that are themselves projects, and accountable to (a) implement basin-level IPs; and (b) contribute to the fulfilment of the cross-basin IP. Each team consists of a Science and an Impact Leader with complementary roles. They are responsible for the progress of projects within their basin, as well as taking part in cross basin working groups to share their experiences and contribute to the synthesis of results (IPGs). As the titles suggest, the Science Leader is primarily responsible for evaluating the quality and relevance of the science, while the focus of the Impact Leader is also relevance as it applies to out and upscaling of the results. They are therefore a key link between achieving the outcomes of the cross basin IPs, and project level IPs, while being responsible to deliver on the basin level IP through contract obligations.

The basin teams do not work in isolation however. Program level Science and Impact Directors oversee the basin level teams and are accountable for cross basin IPs. They lead the cross basin working groups and take on the broader global picture as their counterparts at the basin level.

While the program and basin level teams focus on evaluation and impact, monitoring of project progress is led by the CPWF Secretariat. The CPWF considers monitoring to be tracking the quantitative contract obligations of research teams. This includes financial accountability, accordance with milestones, and delivery of outputs in the form of tangible products. This compliments the evaluation and impact role that fosters learning and adaptive management and addresses matters of quality (scientific publications and rigour, partnerships and their maintenance and utility, adoption on outcomes – out and up scaling – and resultant impact and its measurement).

4.3 Implementing and using the tools

Reporting responsibilities across the CPWF structure therefore comprises three parts: science implementation, impact and partnerships, and contract obligations.

The process commences with the identification, through the current transition period, of research questions at the basin scale, and sets of hypothesis at the project scale. As noted elsewhere in this chapter, this process will result in program and basin level impact pathways, with timelines and milestones identified alongside the level of investment required. The first attempt at this will be available in the 2009-13 Medium Term Plan.

Basin Leadership Teams will be contracted based on ability to deliver on the impact pathways and supporting planning tools already devised. These teams may differ within basins depending on investment level, transboundary nature, and social and biophysical diversity but the team must embrace innovation and flexibility linked with sound management experience.

Research projects will be contracted by the CPWF Secretariat through commissioned or competitive calls, and submissions will be required to include a rudimentary impact pathway and network model. Once

contracted these will be further refined, and timelines and milestones constructed as well as monitoring tools for administrative aspects of contract management. Project Leaders will work with the Basin Leadership Team to develop these tools and to establish that the project leaders are accountable to the basin team to deliver on their component of the basin impact pathway.

Subsequently, six month project reports will be submitted on line and evaluated by the Basin Impact and Science Leaders from their complementary perspectives. They will draw on key indicators described in the projects' logical frameworks to assist them in this process. While progress is measured against project-level milestones and outputs, it is also measured in terms of the project's progress along the basin IP. It will be clear to projects that they do not work in isolation. A web based project management system (PMS) is currently being adopted and adapted by the CPWF that enables access by dispersed participants to input, review and provide comments to other personnel. As in phase one, contracts will clearly define the result of project reviews, with the potential to continue, adjust, or terminate the research depending on the progress along the impact pathway.

The PMS enables monitoring by the Secretariat that project contract obligations are met, and by the program level Science and Impact Directors who track the progress of basin level IPs along the program level IP and supporting tools. Basin Leadership Teams are responsible to the program Science and Impact Directors for progress at the basin scale, and also provide six month reports of progress, and attend cross basin workshops to share their experiences.

Another important aspect of monitoring and evaluation is the adoption of Participatory Impact Pathway Analysis (PIPA³¹). This chapter has already referred to elements of PIPA, but a key feature following workshops to develop IPs are subsequent six month or yearly 'Reflection Workshops'. As the name suggests, these workshops are focused on teams reflecting on progress to date and plans for the future, and is the point at which formal documentation is devised to show where impact pathways, networks, milestones, timelines and key indicators are adjusted to take into account the unexpected, opportunities, and failures of research to date. Basin Leadership Teams will be trained in the use of PIPA, and it is through this process that program level Science and Impact Directors will evaluate basin progress.

Program Level Science and Impact Directors are responsible to the CPWF Board, through the CPWF Management Team, to deliver on the program level impact pathways. These will be contained in the Medium Term Plans, together with other tools resulting from the PIPA process at the program level. While the 2009-13 Medium Term Plan will describe the current level of knowledge and research gaps, including those that the CPWF is mandated to address, subsequent Medium Term Plans will reflect the ongoing process of research results, adjustments, new lines of enquiry and development achievements through the uptake of the outcomes of the program. It will be possible to explore further how and why adjustments are made in the research strategy through the linkages explained above, particularly through the PIPA process and subsequent actions.

This process is supported by a clearly formulated set of reporting and management lines, report formats and timelines, as well as many communications product options that support the impact orientation of the program. This support will be provided by the CPWF Secretariat to the basin teams.

The connection between the CPWF Secretariat and the basin teams is through the Science Group and the Impact Group. The Science Group is led by the program level Science Director, and several 'topic leaders' whose number and expertise will depend on the final set of research topics that the program intends to address. The Impact Group is lead by the program level Impact Director, and includes the monitoring, evaluation, impact assessment, capacity building, and communications program of the CPWF. Basin teams will be supported and back-stopped by these groups, who provide advice, guidance, training and other knowledge with which to improve the implementation, research and impact processes. Basin teams will receive frequent visits with members of these teams, and will be expected to maintain regular email and telephone contact with them.

³¹ See "Participatory Impact Pathways Analysis: a practical method for project planning and evaluation" B. Douthwaite; S. Alvarez; G. Thiele, R. Mackay. January 2008. <http://impactpathways.pbwiki.com>.

Chapter 5 Proposed Changes in CPWF Governance

The external review indicated the need for an independent, smaller governing body with more frequent meetings and specific new expertise that maintains representation of different types of CPWF partners while avoiding conflict of interest. Other CPs either already use that type of model (Harvest Plus) or have decided to move to it (Generation, decision taken in December 2007).

The changes proposed in this chapter respond in general to the principles expressed by the ER, but not to the sequence of actions proposed. The proposals here are more transparent in terms of how members are selected, and can be implemented more rapidly and smoothly. This paper describes the principal ideas; the annexed draft resolution includes more detail.

5.1 CPWF Consortium Steering Committee

The present steering committee of 18 members will change functions while maintaining its name and legal status through the Joint Venture Agreement. It will undertake limited but vital functions that it will exercise in meetings every second year, or more frequently *ad hoc* if specific issues arise that require its decision:

- Selection of the Board.
- Responsibility for high-level stakeholder consultation (a CSC committee is presently preparing a proposal for this)
- In general, responsibility for the content of, and any changes to, the CPWF Joint Venture Agreement, including the contractual rights and obligations of the signatories, such as:
 - Responsibility for policies governing the intellectual property generated by the CPWF
 - Decisions, if any, to admit new members to the Consortium

The CSC is responsible for selecting the Board and providing strategic advice to the Board. Once the Board is selected it is not formally accountable to the CSC. The Board is accountable however to donors and other stakeholders for legal reasons.

5.2 CPWF Board

The newly created Board will be responsible for programmatic and budgetary decisions and the related accountability. These include all those decisions that require independent judgment and/or regular interaction with the program staff.³² These include most of the responsibilities exercised by the CSC in the past and some new ones.

There will be nine Board members as follows:

One representative of the Alliance of fifteen CGIAR Centres

One representative of IWMI, as the lead centre that carries legal responsibility for the CPWF

One representative of the non-CGIAR members of the Consortium

Five independent members, none of whom would be a representative of a Consortium member

The CPWF Program Director (ex-officio)

All members would be required to have expertise in one or more of: science for development, finance and corporate governance.

- One member should have professional expertise in audit and finance and would be the Chair of the CPWF Audit committee. Experience of at least one other Board member in finance is highly desirable.

³² “Staff” means all personnel directly employed by the CPWF or through other institutions and with functions in the CPWF, whether full- or part-time.

- At least one member should be selected primarily for his/her experience in corporate governance of international development organisations, including those connected to research.
- At least four members should have expertise, complementary to each other, in science for development, including research.

Each member should cover one or more areas of expertise. The science expertise that should be covered among the members should include: Policy and Institutions; Hydrology and Water Management; Agricultural Science including Livestock and Aquaculture; Economics; Social Sciences and Collective Action; Natural Resource Management and the Environment; Development³³

The primary selection criterion for the five independent members will be their professional expertise, seeking a balance of expertise among all nine Board members. The secondary criterion will be to seek among all nine members, as far as possible, a balance in each of the following:

- type of institution (both present affiliation and previous institutional experience);
- experience in developing countries of Africa, Asia and Latin America;
- national origin;
- gender.

None of the independent members should have been an employee nor a recipient of compensation from any consortium member for a period of at least two years before the appointment.³⁴

Independent members of the Board will serve for a period of three years, renewable once, as a consecutive appointment. The representative of the CGIAR Alliance will be selected by the Alliance and will also serve for a period of three years, renewable once. The IWMI representative to the Board is appointed at IWMI's discretion, but IWMI is requested to inform the Selection Committee with two months notice about any changes proposed. For continuity and staggered rotation of the 'founding Board', two independent members will be up for reselection (three year period) or replacement after two years, one after three years and two after four years. Replacement members may not necessarily have to provide the same expertise as the departing member, but the balance of expertise required in the Board should be retained.

5.3 Selection Committee for the Board

The independent members of the Board will be selected from among qualified candidates by a Selection Committee after an international call for nominations; the Selection Committee will be formed with representatives selected from each group of the CSC by those members themselves:

- One representative of the CG members of the Consortium
- One representative of the NARES and the one RBO member of the Consortium
- One representative of the ARI members of the Consortium
- One representative of the NGO members of the Consortium
- One representative elected from amongst all CSC members (who shall Chair the Selection Committee)

Members of the Selection Committee shall serve for three years. Upon occurrence of a vacancy, the same group of the CSC will identify a representative from among themselves or that type of institution outside the Consortium members.

³³ The need for the present "Expert Panel on Scientific Quality" in phase 1 and the "Scientific Advisory Panel" recommended by the ER are obviated by the strong science presence and frequent meetings of the new Executive Board, thus reducing transaction costs and complexity.

³⁴ Receipt of compensation from the CPWF for short term consultancy (less than 20 days total in the two previous years) is permitted, since this is not considered to create a conflict of interest in favour of any particular Consortium member.

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The Selection Committee should carry out its work attending to the need for balance of expertise, type of institution, geographical experience in developing countries, nationality and gender as described above, taking into account the evolving nature of the CPWF.

The Selection Committee will at the same time select a Chair of the Board from among those independent candidates who in their nomination indicated interest, experience and expertise in fulfilling that role. The Chair should be a person with the personal abilities to lead and moderate the Board of this diverse program, taking different points of view into account.

The Board should meet at least four times a year, of which at least two should be in person.

Decisions will be reached by a simple majority vote where this is needed, while seeking consensus when possible. A quorum of five is required for regular meetings. If the Chair is not one of the five, the quorum will nominate an 'acting chair' for the meeting.

This proposal is being implemented by amending the CPWF Consortium Joint Venture Agreement. The amendment has been accepted by the CSC in principle, has been checked legally and will be presented to the IWMI Board, given its legal responsibility for the CPWF.

5.4 Responsibilities of management, Board, Steering committee and lead centre

Table 3 summarises the division of responsibilities among different levels based both on governance and implementation proposals approved by the CSC.

Table 3: IWMI, CSC, Board and Management (CPMT) Functions

Function	IWMI	CSC	Board	CPMT
Legal basis for operating through non incorporated JVA	Full legal responsibility taken by IWMI Board.	Content and changes to the JVA, including membership . Communicate any Modification or elimination of governance structure to others.	Bring to the attention of the CSC any issues beyond the TOR of the board.	Advises IWMI on legal issues affecting the governance and procedures of the CPWF.
Membership and Chair of CSC.		CSC consists of one representative of JVA members, and may invite new members. Chair appointed from members on majority vote.		
Membership, selection and performance of Governing Board (9 members)	One Board member nominated by IWMI.	Selection committee formed of CSC members to appoint 5 external board members. Identify Chair from these members. No objection by all CSC to the recommendations of the Selection Committee. Remove all board members. One board member nominated by non CGIAR members.		Program Director an ex officio member. Nominates board members for consideration by Selection Committee.
CSC and Board interaction.		One member may observe board meetings. CSC responds to board on matters requiring approval.	One member may observe at CSC meetings.	Facilitates sharing of information, including meeting minutes. Provides board and CSC secretary.
Program strategic direction.		Provide strategic advice to the Board.	Determine the strategic directions, set overall goals and approve program strategies that result.	Propose design of strategic directions for Board consideration
Accountability and liability	Purchase errors and omissions liability insurance applicable to board members activities as a member on behalf of the CPWF.	CSC is not accountable to the IWMI Board. CSC is accountable to donors on decisions made by the board.	Board not liable to any CSC member unless through gross negligence. Board is not accountable to the CSC, but is accountable to donors and other stakeholders for legal reasons constituted under IWMI establishment.	CPMT is accountable to the Board.
Quality control			Of CPWF work in general	Of the quality of science in research on specific topics
Risk Management			Establishes a policy, and monitors implementation.	Proposes risk policies for Board approval. Implements policy.
Conflict of Interest			Monitors and manages potential conflict of interest of Board, CPWF staff and consultants.	Alerts board to potential conflict situations.
Competitive and commissioned selection processes			Approve broad policies. Approve independent review panel members.	Propose suggested policies for Board feedback and approval; implement approved policies
Contracting of commissioned and			Approve broad policies governing contracting. Award research grants.	Full responsibility, within policies approved by Board.

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competitive research				
Monitoring, evaluation and impact assessment		Forum for discussion on impact (through working groups)	Approve broad policies for M&E and impact assessment.	Propose M&E policies for Board approval; implement approved policies
Intellectual Property	Holds IP in trust on behalf of CSC members.		Apply policies pertaining to intellectual property in CPWF contracts. Negotiate and implement decisions of the CSC.	Advise on policy interpretation and revision. Implement decisions of the board.
Work plan development and monitoring for staff				Full responsibility
Hiring and firing Program Director			Full responsibility lead by the Chair.	
Hiring and firing staff	Establishes secretariat.		Approve broad HR policies, including staff recruitment and management	Full responsibility, within policies approved by Board
Performance evaluation			For Program Director (Board Chair is supervisor; rest of Board would be consulted if Director and Board Chair do not agree about the Director's evaluation)	For all other staff. Note that some staff will be directly hired by the CPWF but others will be seconded, or provided through project contracts with their home institutions. In these cases the CPWF and the home institution will have joint responsibility for performance evaluation. 360 degree methods will be used as part of all evaluations.
Managing day to day challenges and management.	Support services to Secretariat agreed under Service Agreement.		Oversee, guide and provide advice and support on key issues to CPMT.	Full responsibility
Public awareness and communications		Information flow to CPWF from global W&F community. Builds connections to policy and high level decision makers.	Promote CPWF in RandD community.	Full responsibility
Data Base (IDIS)	Organize and coordinate data held and generated.		Make decisions on distribution of shared data sets in consultation with IWMI for 6b JVA.	Full responsibility
Budget approval and expenditure control			CP-level budget. Board establishes an audit committee to report to the Board.	Program-level budgets
Compliance with CGIAR administrative and bureaucratic requirements	Financial accountability provided by IWMI to the CGIAR.		Audit sub committee comply with CGIAR audit requirements on advice from IWMI. Ensures integrity of accounting and financial reporting systems.	Full responsibility, other than specialist CGIAR financial reporting and audit requirements.
Fund-raising and resource mobilization		Be alert to fund raising opportunities from donors and other non traditional sources.	Facilitate contacts, identify opportunities for management follow-up, and in other ways assist in fund-raising as per agreement with management.	Primary responsibility

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