



## PROPOSAL for a Basin Focal Project

**Proposal Number: 63**

**River Basin: Andean**

**Project Duration: Target Commence Date: Finish Date:**

**Validity Period:** the proposal is valid for implementation until a starting date of (month/year). 1/1/2010

**Opening of Financial submissions:** Do you wish to be present at the public opening of the financial submissions (this will be undertaken in Sri Lanka) NO

**1. PROJECT TEAM See Attachment 1**

## 2 METHODOLOGY FOR THE 6 WORKPACKAGES

**2.1 Project Overview (500 words)** *(describe how your proposed work plan achieves the outputs required by the BFP methodology guidelines. This section will be lifted onto the CPWF web page if your proposal is approved for support.*

Our workplan incorporates the recommendations of the methodological guidelines. We developed for a synergistic and complementary approach between packages. In addition to the study process suggested, we produced a conceptual framework that integrates the work packages as depicted by Figure 1 (included in Figures attachment). WP1, WP2, WP3 and WP4 provide the diagnoses of current status of the CPWF main interests: water poverty, water productivity, environmental security and the institutions context. A preliminary review of basins characteristics was advanced in order to keep in mind the distinct and common challenges in the Andean region. After the detailed work of WP1-4 is advanced, the project will conduct a joint scenario and synthesis workshop to identify a subset of intervention alternatives. A second scenario and synthesis workshop will advance discussions and analysis with diverse basin stakeholders, where they prioritize the proposed interventions. During all these stages, WP6 will manage knowledge sharing. The last project stage is a revised scenario analysis that accounts for stakeholder contributions and synthesis of the project outputs and processes.

### 2.2 Work packages

**Please note that the questions appearing against each work package activity are tentative questions to orient you to the key BFP issues. You are free to add other comments that may cover any innovative aspects of your proposal.**

#### Work Package 1: Water Poverty Analysis

- Approach and activities to review of literature – What approach to literature review, and other measures, do you intend to use to determine the past and present status of poverty in different parts of the basin? What data will you use to determine the extent to which water availability and use and agricultural production the main determinants of poverty in different parts of the basin?

Numerous published, national-level studies on Andean poverty are available (Farrow et al., 2007; Sushchny and Gallopin, 2004; UDAPE, 2003, World Bank, 2004). Other published case studies (e.g. Bebbington and Perrault, 1999; Hentschel and Waters, 2002; and Grootaert and Narayan, 2004) will be acquired through bibliographic searches. Gray literature will also provide information, especially Spanish language reports and university theses. These studies will be acquired through the CIAT gray literature search services (CATIE, 2007; CGIAR, 2007). The Andes research and development consortium CONDESAN also provides a wide range of information and data.

Spatial and temporal data from poverty mapping initiatives, agricultural and population censuses and household surveys will be acquired from public domain data sources (Table 1). Poverty maps, generated from data aggregated to the municipio level, include the Foster-Greer-Thorbecke consumption (Foster et al, 1984) and unsatisfied basic needs (Feres and Mancero, 2001) approaches. Agricultural and population censuses also produced data at municipal or district levels (DANE, 2005; INE, 2001; INEC, 2001; INEI, 2005;). Household poverty data, including measures of household consumption, will be acquired from the Living Standards Measurement Study (LSMS) of the World Bank (2007). Anthropometric measures indicating nutrition and poverty levels will be acquired from Demographic and Health Surveys (MEASURE DHS, 2007).

Biophysical data will be acquired from research conducted in other WPs, from public domain data, and from ongoing Generation Challenge Program (GCP) research (Hyman et al., 2007). The GCP data includes a drought probability map, based on WFCP research in the Limpopo basin (Jones et al., 2006) and production data for 20 crops (You and Wood, 2006). These will be aggregated to spatial units of the socioeconomic and poverty data. For example, pixels can be averaged or summed in a municipality, permitting comparisons of biophysical and socioeconomic information.

- Approach and activities to analysis of methodology – What conceptual framework will be used to assess poverty at community, sub-basin and basin levels? What primary and secondary data will be needed, how will it be obtained and analyzed?

We base our analysis of water-poverty linkages on the consensus arrived at the Water-Poverty Mapping workshop (Accra, March 2007). Agricultural livelihoods are improved to differing extents by water use and productivity and by reducing production losses from climate variability (Cook and Guchuki, 2007). Other factors constraining production include labour, technology, capital, and soil nutrients. Transportation quality and organizational capacities are important determinant of community abilities to market products and enhance their livelihoods.

Conventional poverty assessment and reporting restricts wide-scale data analysis to the

resolution of municipality. We will therefore conduct our analysis at two levels: (1) the entire Andes physiographic region within Colombia, Ecuador, Peru and Bolivia, and (2) intra-basin level with data from rapid field assessments and secondary sources, especially CONDESAN.

Our framework consists of three principles and their corresponding activities:

1) Descriptive analysis of poverty in the Andes: Different measures of poverty provide a comparative approach to understanding of poverty and the effects of water (Hyman et al., 2005). Poverty is analyzed in three ways: a monetary indicator; the presence or absence of basic needs in the household, and; nutritional status.

2) Novel and traditional multivariate statistical approaches can identify the correlations (and perhaps drivers) of poverty. Multivariate analysis will be conducted for the Andean municipalities or districts for the four countries. Qualitative expert knowledge garnered in the rapid basin appraisal will be built into our models of water-poverty interactions using Bayesian networks, and will build on the progress made in the water-poverty mapping workshop.

3) Link climate variability - agricultural production – poverty analyses. In conjunction with the other WPs, effective interventions can be identified that enable improved farmer livelihoods. Possible interventions will be matched with the severity and type of water-related constraint to agricultural production and the vulnerability of the population.

- Approach and activities to information packages – How will the information generated be packaged into specific outputs? How will it be disseminated and/or used in the other work packages?

This activity will be coordinated closely with WP6. Our approach will be to generate insights on water and poverty for the full range of users. Information products include: databases, detailed reports, interactive mapping services, summary maps, and policy briefs. Data for use in statistical packages and geographic information systems will be available for those users who want to download the data and work with their own specialized software. These users are likely to be scientists, professionals and analysts with advanced technical skills. For less experienced analysts, our poverty maps will be available within online interactive mapping systems – such as map servers and virtual globes (e.g., Google Earth). These users might be university students and local officials in government departments. Some users will want pre-packaged information that includes our interpretations and can be used directly for policy- and decision-making and advocacy. We will produce information and policy briefs for these users.

- Comments on the expected effectiveness of your approaches to reach the required outputs.

We expect the variability of the Andean region and the study sites to shed light on poverty characteristics that are general and broad-scale versus those that are local and specific. Working across the entire Andean region of Colombia, Ecuador, Peru and

Bolivia, our analysis will give users of WFCP outputs a broad scale assessment of water and poverty in the Andes. Our field assessment of the seven basins will allow us to assess unique characteristics of local areas, and to link the broader assessment to local conditions. We will be able to verify and validate our data analysis with expert assessments from the field, and qualitative information on the relationships between water and poverty.

Specifically our diagnosis of the Andean region using various definitions of poverty will show where the poor are, and whether their relative location within the basin has an impact on their levels of poverty. Our team has the experience to build on past work in the basin and apply methods tested in other focus basins, in particular our combination of qualitative and quantitative, socio-economic and biophysical data in one methodological framework will give insights into the relationship between water availability and poverty and account for current coping strategies in water stressed households or communities.

Our approach will be strengthened by cross cutting and multi-dimensional analysis, and by linking these analyses to possible interventions or pathways out of poverty (Dixon et al., 2001).

## **Work Package 2: Analysis of Water Availability and Access**

- Approach and activities to review of literature – Based on the available literature how will you analyze whether water availability and access vary temporally and spatially in different parts of the basin? How will you analyze which are the water scarce areas and what are the factors contributing to water scarcity in these areas?

We will first review pantropical and global water resource assessments such as SHI/UNESCO and move forward to previous regional analyses from International NGOs and development organisations (DfID, CARE, World Bank), followed by analysis of previous work by the national hydrological institutes, the CG system and NARS. Finally water resource assessments of the regional governments and autonomous corporations will be reviewed. These will provide the context for a data-based analysis of availability and access.

We have previously carried out pantropical analysis of water availability at 1km resolution for UK DfID using the best available spatial data from remote sensing and ground based sources : see <http://www.ambiotek.com/tropicalhydrology> (Mulligan and Burke, 2005). This involved modelling (wind-driven) rainfall inputs minus (climate and land cover dependent) modelled actual evapotranspiration and cumulating the resulting water balance downstream over the hydrological networks. Pan-tropical spatially explicit scenarios for historic and projected climate change and historic land use change were also generated and applied to examining the water resource sensitivity to climate and land use change i.e. the change in available resources per unit change in land use or climate. Such an approach can be used to identify areas in which water resources are

highly sensitive to change and target these for priority study. The datasets used include a number developed and made available by the applicants including some of those at the KCL geodata portal (<http://www.kcl.ac.uk/geodata>) including 1km mean monthly and annual rainfall totals, intensities and seasonality generated from the entire TRMM (Tropical Rainfall Monitoring Mission) rainfall radar record (1998-2006), and the 3-hourly TRMM/GOES point rainfall time series (1998-2006), and solar radiation and PET products based on SRTM (<http://srtm.ciat.cigar.org>) and MODIS cloud frequency (<http://www.kcl.ac.uk/geodata>) products.

The intention here would be to apply similar approaches to evaluate water availability at a higher spatial resolution (1 Ha) across the entire Andes (defined as elevations >500m) to assess annual mean and seasonal variation. These data will be combined with developed databases on tropical dams ([www.ambiotek.com/dams](http://www.ambiotek.com/dams), Mulligan et al. (2007)) and populations and infrastructure in order to assess accessibility and access to these resources. More detailed analysis and validation will take place for the CPWF basins.

- Approach and activities to rapid assessment of status and trends – How will you carry out a rapid assessment of the status and trends of water availability and access in different parts of the basin? Do you know what data is available for such an analysis, and how will you access it? What hydrological modeling tools do you propose to use in assessing water availability for parts of the basin where data is not available?

Water resources are accessed directly from rainfall harvesting, from rivers and reservoirs and, less-commonly in the Andes, from groundwater sources. The status and trends in available water must reflect changes in the quantity and seasonality but also the quality of available water and the changing methods of storage and access to it, including physical and socio-economic constraints.

Rapid assessment of status can be carried out as described in the previous answer. Trends as defined by climate variability and change can be ascertained using the same modelling approach with some datasets developed by the group including the 8 year time series of 3 hourly rainfall data (and trends) previously mentioned and made available at <http://www.ambiotek.com/1kmrainfall>. This can be corroborated for many basins with runoff trends data from the Global Runoff Data Centre (GRDC) records and the national hydrological institutes rainfall and flow records as well as those held in the CIAT database. Further validation efforts for the largest basins will be attempted using the satellite altimetry approach of UNAL (Leon et al, 2006).

Trends according to land use effects can be defined by using the USGS 1991/2 and TREES 2000 1km land cover datasets coupled with 2000-2005 annual 250m MODIS land cover change ([www.ambiotek.com/trees](http://www.ambiotek.com/trees)) to run hydrological scenarios for the impact of historic land use change on water resource availability at 1 Ha. resolution (as was carried out pan-tropically at 1km resolution, Mulligan and Burke, 2005).

Trends according to change in access can be defined partly through an analysis of water 'quality' trends coupling models of sediment production and delivery with analyses of total upstream population growth as a surrogate for water quality. Moreover an

historical analysis of the dams database and of irrigation trends from the IMWI GIAM (Global Irrigated Areas Mapping) data will provide the necessary information on storage supply and agricultural demand, spatially throughout the Andes. Since these databases cover the entire area, the budget modelling approach outlined will be possible throughout.

For intensively studied areas where more data are available, the more sophisticated FIESTA water delivery model ([www.ambiotek.com/fiesta](http://www.ambiotek.com/fiesta), Mulligan and Burke, 2005b) will be parameterised allowing the detailed examination of water resource availability and change and climate/land use scenario analyses. This will be particularly important for the defined CPWF basins in some of which the CSIRO team have already carried out detailed analyses. Such an approach has been used recently (Saenz and Mulligan, 2007) to assess the economic impact of land cover change on water resource input to Bogota's system of HEP and water supply dams)

- Approach and activities to water assessment and accounting at basin level – What water assessment and accounting framework do you propose to use at local, sub-basin and basin levels? How will you take into account the temporal variability? What data and analytical tools will be used?

Much of this is covered in previous answers but in fact we will use two accounting frameworks. As a starting point we will use the framework developed by the CSIRO group to provide water accounting for the Andean CPWF basins, making use of data already gathered. This framework has already been applied in the Mekong and other basins for the CPWF. We will then scale-out from these basins with a methodology that could potentially be applied to any basin using pantropical datasets developed and archived by CIAT and King's College London ([srtm.ciat.cigar.org](http://srtm.ciat.cigar.org) and [www.kcl.ac.uk/geodata](http://www.kcl.ac.uk/geodata)). This methodology, outlined in the previous answers, uses two 1km to 1 Ha cellular models, a simple climate and land cover sensitive grid-based water balance (applied pantropically in previous efforts) and a much more sophisticated dynamic modelling (the FIESTA water delivery model) which is one of very few developed specifically for tropical montane environments and which has been applied to the whole of central America, Colombia and Ecuador at 1km resolution, the entire Amazon at 1km resolution, the whole of Costa Rica and 90m resolution, the Volta at 1km resolution and the catchments supplying water to Bogota at 90m resolution, in previous projects.

- Approach and activities to information on water availability – What information on water availability and access will be generated? How will it be packaged for use in other work packages and for dissemination?

Maps of water resource sensitivity to historic and projected land use and climate change will be prepared at 90m spatial resolution for the entire Andes. Maps of long term average water availability (mm/month water balance) and trends (change per year) will also be produced. All maps will be made available online - visualisable through Google Earth and downloadable in georeferenced common formats (in the same way as existing datasets at [www.kcl.ac.uk/geodata](http://www.kcl.ac.uk/geodata)). Maps will only be made available after the validation process using runoff records, local data and expert opinion as well as cross-

referencing with other data sources has been completed. A geowiki will be made available to allow local experts to add comment to particular spatial locations on particular maps (see [www.ambiotek.com/terrascope](http://www.ambiotek.com/terrascope) for an example). On the basis of the validation results maps will grey-out in areas with greater uncertainty so that data can still be visualised but interpreted with caution. A similar approach will be adopted for basin specific results from the CSIRO water accounting.

The FIESTA delivery model which runs in the freely-available PCRASTER GIS, will be modified to run in the freely available IDL virtual machine, facilitating the use of a better GUI and its connection seamlessly to the databases at [www.kcl.ac.uk/geodata](http://www.kcl.ac.uk/geodata) in order to self-parameterise for application to other catchments (see [www.ambiotek.com/desurvey](http://www.ambiotek.com/desurvey) for a similar system) . If users have access to more detailed local data then this could be added but the model would essentially be operable anywhere from around 40N to 40S without significant data collection/assimilation overheads. In this way the FIESTA delivery model will be developed into a more user friendly but sophisticated decision support system for water availability which is capable of being run for any basin. This will become the major CPWF output (public good) of this WP.

- Comments on the expected effectiveness of your approaches to reach the required outputs.

The modelling and decision support approaches outlined here have been very successful in delivering scientifically based, yet sophisticated and detailed information on water resource availability in previous projects throughout the Mediterranean, in North and west Africa, Central America and the Andes/Amazon in a range of previous projects. Moving away from oversimplistic approaches to a focus on physically based spatial modelling coupled with spatially detailed remotely sensed datasets provides the ability to not only provide a validatable assessment of current status but also investigate recent and likely future changes. but more importantly, the sensitivity of the hydrological system to a range of changes.

This provides a hotspotting tool which, when combined with spatially detailed information of water-poverty (WP1) and agricultural water productivity can be used to analyse the implications of scenarios for institutional (WP4) change, the application of policy levers or interventions (WP5) in silico before such changes are made in vivo. The team has a long history in the development of such support systems. Moreover such systems are not such scenario testing tools but assist in understanding basin function and performance, and linking to economic and social data. This type of linkage has already been seen in the CSIRO work in the Murray-Darling basin (economic assessments), and in the Mekong basin (social and poverty assessments).

The interactivity and output sophistication of the FIESTA water delivery model especially with the modifications outlined here will ensure that the database delivery for WP5 is both scientifically robust but also intuitive to a wide range of users to whom this information is aimed.

### Work Package 3: Analysis of Agricultural Water Productivity

- Approach and activities to review of literature – What approach to literature review, and other measures, do you intend to use to determine the main agricultural production systems in the basins? What data is available to determine yields of producers and how water limits the attainment of higher yields? How will you determine what is known about agricultural water productivity in different parts of the basin?

Information exists on main production systems and yields in a variety of forms, including national statistics at an aggregate level, and research reports from organizations such as CONDESAN, CIAT and local universities. Modeled crop surfaces include data on tons produced, area planted and yields (You and Wood, 2001). Local grey literature or anecdotal evidence from sources such NGOs farmer groups will be used to confirm wide scale analyses.

While the work package is called agricultural water productivity, we consider water in the context of food generally, since nutrition and food is important to resource-poor people. Livestock is important throughout the Andes. The literature review and data gathering will generally focus on agriculture and livestock.

Water productivity analysis is fairly straightforward for agriculture. We will use several means of determining water use, as well as defining it in several different ways. Productivity is, by definition, an output divided by an input, such as yield divided by volume of water used. For irrigation volume of water used, we will use either field-level water use or the volume diverted from the river (the latter being greater than the former because of losses). For rain fed systems total rain will be used, or rain during the growing season, or rain minus runoff. We will also use modeled inputs from WP2 on water availability.

Water productivity estimates will enable assessment of the change in food production as result of change in water availability, whether due to an external factors such as climate change, or a local factors such as land use change (e.g. crop diversification, variety improvement) or river management change.

- Approach and activities to rapid assessment of status and trends – How do you propose to carry out a rapid assessment of the status and trends of water productivity of the main agricultural production systems in the basin? What indicators of water productivity will you generate and why? What data and analytical tools will you use?

A rapid assessment of status and trends is accomplished as indicated above via literature and local knowledge survey for systems and yields (mostly), and for water use, modeling, and destinations such as remote sensing evapotranspiration (ET) estimation.

The indicators of water productivity are food yield per unit of water used for most

systems. Other key indicators include the opportunities to increase food production per unit of water (for example, in a case where crop yield is substantially below potential for an identifiable and treatable reason), and the vulnerabilities of systems to impacts that might reduce the food production per unit of water. For example, WP1 will estimate expected losses to production from climate variability. Similarly, we will use outputs from WP2 on climate change and land use change to assess impacts on water productivity.

The data used includes land use types, crop or other agricultural and natural systems, cropping or other food yield calendars, crop or other food yield, trends in these over recent years, climate data (especially rain / snow and potential evapotranspiration (PET), also taking account of snowmelt), water use in the different systems from vegetation, modeled water use and remote sensing ET estimates. Spatial and temporal variability will be included.

We will also develop scenarios of likely impacts, and generate data for these. These will include: drought probability, climate change, likely land use change, and projected trends in diet and international food trade.

The analytical tools will include: a water use account or hydrological mode, crop water use, and other agricultural production models. All of these will be set in a spatial modeling framework, and use the spatial data on land use, water availability, etc.

- Approach and activities to identification of areas – How will you select the areas to carry out detailed analysis – i.e. sub-basins within a basin and study communities within a sub-basin?

The Andean basins are already small enough to treat in their entirety. Nevertheless, for some of the very small basins in close proximity to one another, it may be sufficient to analyze a few as examples for others. The choice of basins will then be primarily driven by data availability, local knowledge and contacts. Detailed analyses will be coordinated with the needs and activities of the other work packages.

- Approach and activities to identification of impacts – How will you assess the impacts (a) of water availability and access on water productivity; (b) of agricultural production system on water productivity; and (c) of water productivity on water availability for non-agricultural uses?

Impact identification is accomplished by coupling the water use accounting or other hydrological information to the food production information. As an example, a crop water use model will use the spatial rainfall and PET from the water use accounting to predict yield; changes to rainfall (hence water availability) will lead to predicted changes to yield. Discussion with local stakeholder in selected basins will confirm/refute results from large-scale analyses.

Access is a social issue, and depends on the results of the water poverty work (WP1) and institutional analysis (WP4). There are several approaches to linking access to water availability and food production. One that has been successfully used in the Mekong is

local surveys of poverty (in which water access is one key element surveyed), leading to Bayesian belief network modeling of the likely poverty outcomes of changes to access (and, of course, a range of other constraints and opportunities). WP1 will be developing this information from standardized household surveys and local workshops. This will be a joint activity with this work package.

Models and information as specified above will estimate the impact of the agricultural production system on water productivity. Importantly, we will examine through the modeling the opportunities for increasing food production that would result from changing elements of the production system.

The impact of the water productivity on water availability for non-agricultural uses will be accomplished through the water use accounts or other hydrological modeling. These models are designed for such analysis, and are an easy and natural application.

- Approach and activities to information packages - How will water productivity information generated be packaged into specific outputs and how will it be disseminated and/or used in the other work packages?

The water productivity information will be packaged into several kinds of outputs:

- maps and datasets to be lodged with the IDIS data management team;
- reports and papers;
- policy briefs for governments and other organisations such as aid agencies;
- seminars and workshops for governments and NGOs;
- reports and workshops for interaction with other parts of the CPWF community of practice.

The water productivity information will be used in the water poverty work package to examine the links between poverty and food production, and hence between that and water availability. The information will also be used as part of the intervention analysis (WP5), in which interventions will be tested for their impact on water availability and agricultural productivity, hence on food security and poverty. The information will be delivered partly through the knowledge base work package (WP6).

Models will be used to examine the impact of different interventions, such as land use change, economic incentives, new variety adoption, crop diversification, as well as external impacts such as climate change and drought. These models take into account the relations and risks between water availability (i.e., water use accounts), food production and poverty impacts (the latter using the Bayesian belief networks approach successfully being used in the Mekong, as describe in WP1).

- Comments on the expected effectiveness of your approaches to reach the required outputs.

The WP3 approaches are proving very effective in the Mekong basin. To illustrate, Mac Kirby received an informal comment from a senior official in the Mekong River

Commission that the Mekong basin focal project had achieved more in two years with \$800,000 than one Mekong River Commission program had achieved over several years with 10 times that amount of money. The approaches have also provided a leading example in this area for the basin focal projects generally. The water use accounting approach and its use is now being applied to all basins in the CPWF.

#### **Work Package 4: Institutional Analysis**

- Approach and activities to review of literature – What approach to literature review, and other measures, do you intend to use to determine the main institutional factors that shape the way water is developed, allocated and used in different parts of the basin? How will you identify the main organizations that address water, food and environment issues and which ones will play different roles in the generation, dissemination and applications of the study findings?

Institutions are social structures and mechanisms. Institutions include formal regulations, laws, and policies, and informal, customs and traditions. In the northern Andean countries, an array of institutions crosses society both vertically and horizontally. At national level, environmental, energy and agricultural ministries typically guide policies and formulate regulations and sectoral development plans. Organizations operate at distinct political levels (national, departmental, municipal) and rarely coordinate efforts. Despite the existence of formal institutions, the distinct objectives of such organizations (e.g. hydrology, economic, social, environment) can cause policies to conflict. Moreover, insufficient financial and human resources often limit the enforcement of regulations. Consequently, informal institutions affect how water resources are used.

In order to obtain a thorough understanding of the influences affecting present and future conditions of water resources, a multi-scale and systemic analysis is necessary. We will review the literature produced at different levels of the system, focusing on documentation related to the specific basins while also considering the literature embracing a wider Andean context. Given the magnitude of the documentation, specialized software tools will be used to analyze extensive documents.

To assure the creation of a comprehensive institutional database, work will be conducted in conjunction with WP6. To identify the informal institutions, the project will (1) coordinate with water-related projects working in the area and (2) interview experts and stakeholders within the CONDESAN network via phone or email.

- Approach and activities to rapid assessment of status and trends – How do you propose to carry out a rapid assessment of status and trends of policy and institutional changes and their influence on water development, allocation, use and productivity in different parts of the basin?

Although the BFPs expect to base their findings on secondary data and existing documentation, knowledge of the current status and trends of policy and institutions

requires information gathered from primary sources. Rapid political, social and economic change in the region affects water institutions throughout the Andes. Given the diversity of the Andean system of basins, a sample of 3 basins will be examined in detail. Users and local decision makers will identify the recent institutional changes and the internal and external drivers.

The CONDESAN network will provide access to additional water institution experts and user associations, thereby providing connections between the local institutions and others outside the basins. Published literature such as economic and policy journals will be consulted and tracked to the update news sources. Government documentation in three countries will be reviewed and analyzed. In coordination with WP6, a database of water-related projects will be developed that identify priority objectives (e.g. hydrology, economic, social, environmental) receiving funding and the type of human capacities involved.

- Approach and activities to detailed assessments – How do you propose to carry out the detailed assessment? What primary and secondary data will be assembled and how will they be analyzed?

A detailed assessment requires documentation and measurement of institutional change processes and responses. The detailed assessment will combine the recent advances of influence mapping of social networks (IMSN) with the established disparate stakeholder management approach (DSMA). IMSN is a technique that identifies main actors, their relationships (dependencies or dominances), who influences whom, and characterizes their goals and strategies (Schiffer, 2007).

The DSMA combines decision analysis, political and institutional analysis, and public choice economics as a framework to examine stakeholder preferences, their potential influence over decision-making processes, and likely policy/management outcomes (Koontz and Hoag, 2005). Decision analysis tools, such as Analytical Hierarchy Process (AHP), help policy facilitators discern the nuanced priorities of stakeholders. Although a preference of a stakeholder involves disparate social, political, technical and economic factors, AHP engages stakeholders in separating complex alternatives into smaller manageable parts. Respondents rank their choice according to a qualitative score. AHP calculates preference measures, synthesizes results, identifies preferred outcomes, and provides a clear rationale of the prioritization process (Saaty, 1995, Expert Choice, 2003).

Institutional analysis provides a framework of legal, political and administrative processes (Ingram, et al., 1984). The Legal Institutional Analysis Model (LIAM) characterizes organizational rules of behavior and institutional boundaries that guide management decisions (Lamb, et al., 1998; Lamb, et al., 1999). Questions determine stakeholder perceptions about three types of power of their stakeholder group: (a) political access, (b) legal or usufruct resource rights, and (c) group cohesion. A second AHP analysis examines stakeholders about their current power level and the level perceived as necessary to influence decision-making processes.

This institutional research will be conducted in three of the seven basins. To facilitate scaling processes, stakeholders from the other four basins will participate in workshops.

- Approach and activities to identification of institutional changes – How do you propose to find out what policies and institutional changes would be required to increase water productivity in ways that alleviate poverty and release water from agriculture for use by the environment and other sectors of the economy?

Considering that the objectives related to increases in water productivity, environmental security and poverty reduction are already stated, a main concern is to identify the potential paths to achieve effective institutional reform and other interventions. Public choice analytical approaches (PCAA) forecast probable responses of stakeholder groups to different scenarios and a likely negotiated outcome. PCAA estimate the possibility and potential success of influential stakeholder groups investing time and money to alter the negotiated policy outcome (Becker, 1983). Prior knowledge of such rent-seeking behavior enables policy makers to be better prepared during negotiations. Moreover, rent-seeking has important welfare implications. The combined transactions costs of individualized stakeholders attempting to improve their own position can generate social waste (Buchanan, et al., 1980). Transparent assessment of the negotiation process can help build consensus. PCAA can also identify viable ways for weaker stakeholder groups to increase their level of influence. Alliances and partnerships with other organizations that share similar objectives are one means of enhancing power.

Improved intra-group interaction and communication can also increase power of an organization. As preferences for water use are explicitly examined and discussed, members within stakeholder groups gain a more complete understanding of fellow member perspectives. In some cases, tacit understandings may be mistaken (Caughlan and Hoag, 2002). Identifying internal rifts and improving group cohesion before the negotiation process can increase stakeholder group influence (Carnevale and Pruitt, 1992). Such proactive efforts can be accomplished in little time, so as not hinder the negotiation process.

- Approach and activities to information packages – What institutional information will be generated and how will it be packaged and disseminated and/or used in the other work packages?

Institutional information about organizations working in the area is commonly found together with their data produced and analyzed. Such information includes legal frameworks, institutional arrangements and governance processes. The creation of systematic institutional databases enables the management of collected information, results generated, and facilitates quick integration with the WPs.

WP6 will immediately share this info, whether about water poverty, productivity or about their role in food security and environmental security. Summary information (e.g. scenario documentation and policy briefs) will be developed amongst WP teams. An internal review process of documents will ensure that technical jargon is minimized. Accessible information is central to the scenario analysis and synthesis stages of the project (Figure 1).

- Comments on the expected effectiveness of your approaches to reach the required outputs.

IMSN and DSMA will document and analyze policy objectives, policy instruments and policy actions where these affect the access to and productivity of water, poverty alleviation, food security and environmental security. Literature searches and interviews will provide documentation of legal frameworks, institutional arrangements and governance processes. Scenario analyses and synthesis workshops using DSMA will identify institutional change needed to alleviate poverty and enhance food and environmental security through improved water distribution and use.

### **Work Package 5: Intervention Analysis**

- Approach and activities to review of literature – What approach to literature review and other measure are you intending to use to determine the high potential interventions for increasing water productivity for poverty alleviation in different parts of the basin? How will you identify what has been tried in the basin and why it succeeded or failed?

The literature, databases and experience of CONDESAN provide an excellent start to determine potential interventions. CONDESAN manages InfoAndina – an information and communication network – with more than 1000 members from universities (northern and southern), the private sector, NGOs, governmental organizations and inter-governmental bodies. Access to such a broad range of individuals and organizations enhances the likelihood of identifying interventions that have both succeeded and failed, along with the reasons for such outcomes. Interventions include technological and management changes, infrastructure investments, benefit sharing mechanisms, institutional reforms and knowledge/capacity building. Additional discussions/interviews with associated researchers and project personnel can identify: (1) the conditions and actions that led to outcomes, and (2) how future efforts can be improved and adjusted according to different Andean contexts.

The approach of the WP5 goes beyond evaluating interventions realized in the Andes. Experiences with water interventions abound in the general literature and within the CPWF. Bibliographic searches and discussion groups with other BFP efforts will facilitate knowledge sharing (WP6).

A database of intervention experiences will provide a solid foundation from which to categorize interventions according to costs and likely beneficiaries. This summary information will provide stakeholders a menu of options from which to prioritize further analysis and investment. Given that interventions may benefit some parts of the basins more than others, analyses of likely outcomes via an impact pathway approach (Douthwaite, 2007) improves the transparency of decision-making processes.

- Approach and activities to detailed assessments – How do you propose to carry out detailed assessment of potential interventions? How will the feasible options for

different parts of the basin be arrived at? What qualitative and quantitative assessments will be carried out? What are the sources of secondary data and what primary data will be collected and at what resolution? How will the data be analyzed?

The WP5 assessment is based upon the biophysical and socio-economic contextual analyses (WP1, WP2, WP3, WP4). To different degrees, these four WPs provide quantitative information of biophysical and socioeconomic relationships of water availability, productivity and poverty. To all extents possible, qualitative information will be made quantitative. The WP4 analytical framework of institutions produces quantitative estimates of qualitative stakeholder perceptions and priorities.

Results from these analyses provide descriptive information and prescriptive interventions for water policy and management. The objective of WP5 is to synthesize these results by examining the likely outcomes of interventions. Four summary evaluation criteria will be used: hydrologic, social, economic and environmental, with specific criteria (and weighting) to be determined by stakeholder engagements (as linked with WP4). Prescriptive interventions will be examined with analyses of scenarios. The Disparate Stakeholder Management Approach (Kootnz and Hoag, 2005) will be used to involve stakeholders in the evaluation of interventions. This process will also generate quantitative information on stakeholder group preferences, their organizational power, and levels perceived as being required to influence the policy-making process.

Data analysis and resolution will differ according to WP. Data resolution of WP5 activities will depend on available data and aggregation level required for accurate analysis and minimizing unnecessary complexity. Such a summary approach facilitates discussion amongst laypersons; detailed information will be shared where needed in order to substantiate reports and results.

- Approach and activities to assessment of high potential intervention scenarios – What level of stake holder consultation is envisaged and how will it be undertaken? How will the potential (hydrologic, social, economic and environmental) impacts of the high potential interventions for different parts of the basin assessed? What interventions scenarios will be assessed and how?

The project assesses high potential intervention scenarios twice (see Figure 1). After the detailed work of WP1-4 specialists is advanced, the project will conduct a joint scenario and synthesis workshop to identify a subset of intervention alternatives. A second scenario and synthesis workshop will advance discussions and analysis with diverse basin stakeholders, where they prioritize the proposed interventions. During all these stages, WP6 will manage knowledge sharing. The last project stage is a revised scenario analysis that accounts for stakeholder contributions and synthesis of the project outputs and processes.

The WP5 intervention analysis is closely linked with all work packages. Nevertheless, WP5 is most closely associated with WP4 and is an extension of the institutional analysis. Details of stages preceding and including WP5 are:

<ol style="list-style-type: none"> <li>1. Summarize current stakeholder, institutional and policy contexts (WP1-4). <ol style="list-style-type: none"> <li>a. Characterize the range of water uses and policies,</li> <li>b. Identify stakeholder interests and objectives,</li> <li>c. Identify promising interventions.</li> </ol> </li> <li>2. Provide an institutional analysis framework (WP4). <ol style="list-style-type: none"> <li>a. Identify the power types (e.g. political access, property rights, and group cohesion) that influence the decision processes,</li> <li>b. Estimate the power of each stakeholder group with respect to the three power types,</li> <li>c. Predict the likely negotiated water policy outcome according to stakeholder preferences and associated influence levels.</li> </ol> </li> <li>3. Forecast likely stakeholder responses (WP4, WP5). <ol style="list-style-type: none"> <li>a. Calculate stakeholder levels of support and dissent for the different water policy and management strategies,</li> <li>b. Share research results with stakeholders before meetings occur,</li> <li>c. Estimate the potential success of a stakeholder group altering the negotiated outcome (i.e. rent-seeking behavior),</li> <li>d. Facilitate response strategies of less-organized groups in order to improve their capacity to influence interventions,</li> </ol> </li> <li>4. Estimate likely intervention outcomes (WP4, WP5) <ol style="list-style-type: none"> <li>a. Summarize changes of stakeholder capabilities to influence interventions,</li> <li>b. Develop survey instruments that facilitate longer-term impact assessment.</li> </ol> </li> </ol>
<ul style="list-style-type: none"> <li>• Approach and activities to description of impact pathways – How will the problem and objective trees be generated? How will the problem and objective tree be used to assess which organizations should be involved and what role they should play? What strategies will be used to increase the chances of having an early impact?</li> </ul>
<p>The project will coordinate with B. Douthwaite at CIAT, leader of the impact analysis of CPWF projects and member of the project team. Documentation is currently in draft form for the Andean basins and member of the (Douthwaite, 2007).</p>
<ul style="list-style-type: none"> <li>• Comments on the expected effectiveness of your approaches to reach the required outputs.</li> </ul> <p>The two-stage approach of scenario analysis and synthesis will generate a short-list of potential significant interventions in different parts of the basins. Diverse stakeholders using the DSMA will qualitatively evaluate likely impacts on water use and agricultural water productivity. Quantitative scores will enable comparative analysis of stakeholder preferences, types of organizational power, and their ability to influence decision-making processes.</p> <p>Scenarios will identify tradeoffs amongst objectives and help participants discuss and negotiate optimal interventions according to likely outcomes. Strategic plans of the basins will identify promising interventions, for specific situations identified for different parts of the basin. Scenario analysis and synthesis workshops increase awareness of high potential interventions and participation the key actors (e.g. agricultural producers, ministries, donors, research and development agencies, urban consumers).</p>

## Work Package 6: Development and application of the knowledge base

- Approach and activities to spatial data base development – What datasets will be needed and how will the data be acquired?

Data will be needed on all aspects of water resources use and management in the selected basins and the larger Andean region. These needs include information on biophysical aspects of the basins, poverty and socioeconomic issues and on institutional and policy matters.

In the initial phase of the project, special datasets will be acquired amongst the collaborating institutions, international and local partners and from the IDIS database, including the CGIAR elevation data (SRTM - <http://srtm.csi.cgiar.org>) and Mark Mulligan broad range of hydrological data ([www.ambiotek.com](http://www.ambiotek.com)).

The other five work packages will contribute data to the knowledge base developed in this part of the project. We will develop mechanisms to manage the different data types. Large volumes of environmental data, often in raster GIS formats, will be developed in the water availability (WP2) and water productivity (WP3) work packages. The poverty work package (WP1) will develop spatial data as well as tabular data. The institutional (WP4) and interventions (WP5) work packages will develop information in documents, graphs and tables. We will tailor dissemination mechanisms to each type of data.

All data will be organized in a central database – using IDIS technology. In addition to spatial data, descriptive data about the project's catchments, and the institutional and policy issues related to them, will be collected and centrally stored. If property rights allow, this data will be available to the public. In case of restrictions, only project members will have access. All data will be indexed and where applicable tagged using a comprehensive keywords dictionary. The keywords should enable the linkage of information to content in other BFPs and the Internet.

- Approach and activities to discussion and exchange of data – What valuable data sets does your team offer based on the past work in the basin?

The participation of team members in diverse projects on terrain and hydrological analysis and on poverty assessment will allow us to bring a large amount of processed information to analysts and users of water-related data. These projects include the CGIAR's effort to process 90-meter digital elevation data and their derivatives. Mark Mulligan's work on tropical hydrology will allow us to tailor data specifically to the WFCP community of researchers ([www.ambiotek.com](http://www.ambiotek.com)). This experience also includes CIAT's involvement in a poverty mapping study in Ecuador (Farrow et al., 2007) and other initiatives to map human welfare at the finest possible spatial resolution. Jorge Rubiano has developed a comprehensive spatial data set for the Fuquene basin, include a full range of biophysical and socioeconomic data.

- Approach and activities to knowledge sharing processes – How do you propose to share knowledge and experiences among the members of your team and among basin focal projects?

Efficient knowledge sharing is based on the interchange of personal experiences and interpretations of information amongst the BFP team members. Modern technology can help to enable information flow beyond physical barriers. Technology also supports the structuring and discovering of information and permits pattern-based, intelligent, rapid analysis of huge amount of datasets.

Forums, blogs and e-mail lists provide quick and easy information exchange as well as the opportunity to analyze all communication between the BFP team members. The content is stored in a structured format for later analysis and search.

A central document and content repository system, or content management system (CMS) will enable easy and dependable information exchange between project members. Powerful and intelligent search functionality and information structuring methods give the project team access to relevant information. We will employ advanced search algorithms to allow intelligent data mining, helping to discover information in a user-centered approach.

Where property rights allow, this information is shared with all BFP's. Selected and aggregated information is uploaded to the ISID system periodically to enable broader use. WP6 will collaborate in the development of policy briefs and scenario reports.

- Approach and activities to engagement with the CPWF community of practice – To what extent do you expect to engage the community of practice and what are they likely to contribute and how will this contribute to achieving the desired outcomes earlier.

To publish and announce the work in the Andean BFP, we plan presentations (oral and posters), workshops and online newsletters. This is to get attention from the community of practice. Once this first contact is established and there is interest in joint activities, we offer access to the projects knowledge base, a web based information systems (e.g. IDIS) including classifications and providing comprehensive search functionality.

A new dynamic in the data/information/knowledge exchange can be established by integrating the community's questions and findings into a new system (working with existing data management tools like IDIS), which helps identifying homogenous needs and problems among institutions. This approach intelligently links all participant's data and finds clusters with similar activities/needs/problems.

- Approach and activities to processes and tools to support investment – What processes, tools and information do you propose to make available to basin stakeholders to support their investment decisions?

Our approach will focus on online access to compiled developed information, tailored to stakeholders needs.

After assessing key questions for users we will establishment frequently asked questions (FAQ), providing short and targeted answers to stakeholder questions. This information covers the whole region as well as the specific catchments listed in the proposal. Users will find quick answers to their questions as well as access to specific analyses and datasets supporting these answers. The FAQ is just one entry point to information. Other tools will include Internet map servers (IMS), virtual globes, searchable databases and file galleries with different documents produced by the work packages.

All information collected throughout this process should be accessible freely (online) and in a user-friendly way, only restricted by property rights where applicable.

- Approach and activities to impact analysis – How will you assess the outcomes and early impacts of your work?

Outcomes will be assessed against the other WP needs and use of database platform. While this team will act as the intermediary for knowledge sharing it is expected that all the WP members will use it. We think that two years will not be enough time to assess impact regarding the products of this WP.

- Comments on the expected effectiveness of your approaches to reach the required outputs.

Considering the complexity and ammount of data and information it is assumed that only through out the use of information technologies it is possible to reach the expected outputs. This has prove in other fields as an open and transparent media by which many different users can access information and obtain additional knowledge.

### 3 INSTITUTIONS AND PROJECT TEAM

#### 3.1 See Attachment 3 Partnership Matrix

#### 3.2 Explain your methods for fostering innovation and cooperation within your team, and their abilities to cooperate with other BFP teams to exchange ideas. (300 words)

The project team has members from a wide range of academic disciplines. Despite working for different organizations, many team members have worked together previously. Some project members have experience with other BFP efforts. By bringing together researchers from around the globe, ideas and experiences can be shared. Focusing efforts on the Andean region enables innovations and innovation processes to be adapted and fostered. WP6 will provide forums with which to exchange and advance ideas.

#### 3.3 Please describe your approach to ensure participation of, and linkage between, national, regional, and international institutions in the river basin you intend to work in. (300 words)

Both WP4 and WP5 emphasize participation of stakeholder organizations. The process of institutional and intervention analysis brings diverse participants to share experiences, learn different perspectives and negotiate priority interventions.

**3.4 Basin Coordinator: explain the role(s) of the basin coordinator.**

Roles:

1. Help identify sources knowledge (e.g. documents, people) of biophysical and socioeconomic conditions and processes in the seven Andean basins,
2. Aid the process of information dissemination,
3. Contribute to scenario analyses and priority setting workshops,
4. Critique validity of large-scale analyses within basin contexts,
5. Review documents for accuracy and appropriateness.

**3.5 Capacity Building: explain the capacity building elements that you have identified as part of your work plan.**

The institutional and intervention analysis workshops will build the capacity of participants from the three focus basins and other invitees from other associated CONDESAN basins. Methods can be employed in other areas to analyze institutions and interventions. Capacity building can be achieved via user access to the WP6 website of databases, maps, software and documentation.

#### 4 RESPONSE TO REVIEWER COMMENTS ON YOUR EXPRESSION OF INTEREST

The invitation to develop a full proposal identified some negative factors of the EOI that required adjustment. Please list below the factors and explain how you have addressed the comments in your full proposal. Please add boxes as necessary.

**1 (Ability to build good team communications (both institutional style and practical logistics) - Very well placed and experienced, not much supporting information provided)**

The team has the advantage of having members that previously worked together, there are working mechanisms in place through which they communicate and meet together.

**2 (Technical and methodological expertise in work package 4 (Institutional analysis) - Reliant on one person, combines innovation systems theory with institutional analysis)**

We included Douglas White, CIAT Economist and other UNAL members with complementary experience working with institutions in the region in order to fill this gap.

**3 (Technical and methodological expertise in work package 5 (Intervention analysis) - Clear record, supporting information not provided on how they expect to conduct ex ante assessment of consequences of different strategies/ groups of interventions)**

As expressed in this proposal, WP5 and WP4 will be working together. It is suggested the use of state of the art techniques to assess the likelihood impact of potential interventions in a collective and informed manner. Details explain in the text of WP5.

#### 5 FINAL COMMENTS

The intent of this section is to enable you to pull together the most convincing aspects of your proposal that you would like to convey to the assessment panel members. (300 words)

We can summarize our proposal as having an integrated approach, state of the art use of technology and information, a strong network of partners, a diverse range of partners, a coherent framework for data collection, integration and analysis.