CGIAR Challenge Program on
WATER & FOOD

**Submission Document**

Project proposal

*V1 Targeting and Scaling Out*

Basin Development Challenges of the CPWF

*Integrated management of rainwater and small reservoirs for multiple uses*

Originally submitted April 2010
Revised and resubmitted August 2010

# PART A: SUMMARY

## 1. Project Data

BDC: Volta *Integrated management of rainwater and small reservoirs for multiple uses*
Project Title: Targeting and Scaling Out
Project Lead Organization: Stockholm Environment Institute (SEI)
Consortium partners (who receive budget): Institut National de l'Environnement et de Récherche Agricole (INERA), Civil Engineering Dept. of the Kwame Nkrumah University of Science and Technology (KNUST), the Savanna Agricultural Research Institute (SARI), and the Dept. of Geography of the University of Ouagadougou
Project Leader: Jennie Barron, Stockholm Environment Institute (SEI), University of York
York YO10 5DD, United Kingdom. Email: jennie.barron@sei.se
Duration: 3 years
Target start date: 1 October 2010 Finish date: 31 September 2012
Maximum budget requested from CPWF (in US$): 700,000
Any matching funds offered (provide brief explanation): nil

## 2. Project Summary

Numerous pilot studies and case studies in the Volta Basin have evaluated practices, methods, and tools that could prove beneficial to others, both within the basin and outside of it. However, the question whether an intervention successfully applied in one location has a reasonable chance of success at any other location remains extremely difficult to answer. A consistent finding in pilot studies is that detailed characteristics of the study location – economic, biophysical, institutional, and cultural – can all play an essential role in the eventual success, and failure of achieving a successful outcome. For out-scaling of initiatives it is impractical to collect detailed information at every potential site where an agricultural land and water management (AWM) intervention might be introduced. This project starts with the premise that, while certainty is unobtainable, degrees of certainty are both obtainable, using available information in a systematic way, and useful. The proposed work would build on promising developments under CPWF round 1 that sought to combine available information using Bayesian statistics to answer questions about targeting and scaling out. The CPWF Project V1, "Targeting and Scaling Out", proposal aims to develop an evidence and knowledge-based tool that will map the likelihood that a given intervention will be successful in given locations. The tool would be intended for non-expert users and would be available via the World Wide Web.

The proposed V1 project will contribute to achieving the BDC challenge of improving rainwater and small reservoir management to contribute to poverty reduction and improved livelihoods resilience by producing a framework and web-based and electronic "decision support", (or targeting and scaling out tool) that will identify likely sites to introduce AWM interventions for smallholder farming systems.

The research partnership of V1 involves Stockholm Environment Institute (SEI), Institut National de l'Environnement et de Recherche Agricole (INERA), University of Ouagadaougou, Kwame Nkrumah University of Science and Technology (KNUST) and Savanna Agricultural Research Institute (SARI). The project will be carried out in close collaboration with CPWF Volta basin projects V2, V3, V4 and V5, and with CPWF Limpopo (L1).

# PART B: PROJECT DESCRIPTION

## 3. BDC Goals to which the project will contribute

The V1 project seeks to contribute to the stated CPWF Volta Basin Development Challenge of "*Improving rainwater and small reservoir management in Burkina Faso and Northern Ghana to contribute to poverty reduction and improved livelihoods resilience while taking account of downstream and upstream water users including ecosystem services",* through development of a targeting and scaling out tool that will assist national and regional decision makers, implementers and investors (the Boundary Partners of the project) including Volta Basin Authority (VBA), the White Volta Basin Board (WVBB), Volta Water Governance Project (PAGEV) and national agricultural extension services, as well as research organizations and development non-governmental organizations NGOs – by identifying areas that exhibit the greatest opportunities for the out-scaling of agricultural water management interventions proven to be of greatest benefit to smallholder farming systems. The Bayes-based decision support tool will combine data from biophysical and socio-economic GIS data layers and survey results with expert knowledge (where it is available and appropriate) within a Bayesian framework. The output of the Bayesian analysis will be a spatial map of probabilities of success, based on the available information. Where data are scarce, the level of certainty will be correspondingly low. Using this tool, implementers and policymakers can identify where interventions may have a certain likelihood of success in adoption and adaptation. Ultimately, the improved targeting tool could help interventions and investments to be more efficient in reaching successful development targets on alleviating poverty, increasing agricultural productivity, and reducing environmental impact (especially water scarcity). By doing so, it will contribute to the objectives of the VBA to promote "the implementation of integrated water resources management and the equitable distribution of the benefits resulting from their various utilizations"; and "contributing to poverty alleviation, the sustainable development of the Parties in the Volta basin". It may also contribute to PAGEV's specific objective to demonstrate how water governance can be improved through the implementation of pilot activities by helping to identify sites.

The V1 project is a consultative research project designed to be iterative. At least four meetings/workshops designed to be mutual learning events with the project team and potential end users will take place over the project period as well as several more ad hoc meetings.

Ultimately, the improved targeting tool could help interventions and investments to be more efficient in reaching successful development targets in poverty alleviation, agricultural production, and environmental impacts.

## 4. Research questions and methodologies

The Volta basin development research of CPWF aims to contribute towards better rainwater and small reservoir management for increased food production and environmental sustainability. Part of this research can be addressed through learning from past successful cases of rainwater and small reservoir management interventions in the Volta basin, and synthesis of this knowledge to identify similar domains and potential locations that may be subject to further successful development interventions. Three key research issues guide the project V1 "Targeting and scaling out", addressing the 'what?', the 'which?' and the 'where'?

The research is undertaken as a collaborative effort between several southern research organizations and a limited number of northern ones. The proposal seeks to maximize the advantages of both with northern partners focusing on providing the AWM, Bayes, PGIS expertise, the latter two of which are absent in the other research partner organizations, and the local partners providing detailed AWM expertise, policy analysis and engagement experience and socio-cultural participatory research expertise. The project will seek to build capacity amongst the local partners in BBNs and PGIS over the course of the work, and of course build up the knowledge base of the northern partners of the basin. The project will also seek through V5 to ensure south-south learning between the partners involved in V1 and L1.

*1) What constitutes key social-economic and ecological conditions where 'successful' smallholder agricultural water management interventions (with particular focus on rainwater and small reservoir management) in semi-arid and sub-humid Volta basin (OP1)?*

To identify and learn from past and current cases of successful rainwater harvesting and small reservoir management interventions, the project starts with the identification of past successful interventions. The in-country project partners represent the key to this and will lead this component of the work. There are two key issues for the project to determine through stakeholder consultations and data analysis. The first is to determine which constitutes a "successful" initiative or case study. For example, the project must assess the relative importance of factors such as adoption rate, yield improvement, income, and environmental impacts, including water resource use and water efficiency. Second, based on these discussions and the subsequent identification of successful rainwater harvesting and small reservoir management interventions, the project will analyze, through consultation and data analysis, the characteristics considered most important in providing an indication of the likely success (or failure) of an intervention case. The project will develop a case study assessment protocol based on the five livelihood capitals (DFID1999). This approach has been used previously (Kemp-Benedict et al, 2009; Barron et al 2010) to assess multiple dimensions of impacts by agricultural water management interventions in smallholder farming systems.

*2) Which past and existing successful interventions can we learn from (OP1; OP2)?*

Once the protocol has been determined, four different sources of case information can be used to characterize successful intervention cases.

**Data from past studies:** Example cases will be sought in CPWF Phase I, including PN 5 (Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin), PN 46 (Small Reservoirs Toolkit overview of tools), PN 55 (Basin Focal Project Volta) and PN 65 (Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin). Cases will be drawn from other recent and relevant projects in the Volta basin such as the AgWater Solutions project, which is carrying out an ongoing characterization of successful AWM interventions in the basin.

**Existing GIS data layers:** The project will start with existing data layers from CPWF Phase I (e.g., those reported in Lemoalle and de Condappa, 2009). Further layers (mainly biophysical data) will be identified from other projects within the Volta basin, such as GLOWA and HYCOS.

**New data:** A consultation meeting at national level will be held in Ghana and Burkina Faso to identify additional successful cases, which will be assessed using a consistent protocol in combination with participatory GIS methodologies in field assessment (Wang et al., 2008; Cinderby, 2010).

**CPWF Phase II data:** Case information developed in CPWF Volta Phase II projects will be

incorporated as data become available. From those project plans, we anticipate data to be provided by projects V2, V3 and V4 in year 2 and 3. Special attention will be given to case information and basin-scale information on social and human capital, as it has been well documented that these factors have strong correlation with successful outcomes of AWM interventions (e.g. Noble et al., 2006; Joshi et al. 2008; Barron et al. 2010).

All collected data will be entered in a database using the Volta Basin Authority's recommended data format. The database will be made publicly available via the World Wide Web and through the distribution of CDs.

3) *Where in the Volta basin can similar conditions be found, which may present development opportunities in terms of increasing food production and help alleviate poverty in positively resilient ways (OP3, OP4)?*

The work will seek to build a GIS-linked Bayesian calculation tool utilising the data identified and gathered to answer this question. The Bayesian targeting and scaling tool will provide two estimates of the probability that an AWM intervention might be successful: first, the probability of success at a particular location based on evidence of successful and unsuccessful interventions elsewhere and evidence about the proposed site (OP3); second, a probability map of where within the basin an intervention is likely to be successful, provided the necessary spatial datasets are available (OP4). The decision support tool (or a targeting and scaling tool) will apply a Bayesian network model over a large spatial domain using GIS analysis. The use of Bayesian methods will enable outputs to be given confidence bounds (high, medium and low), indicating the degree of uncertainty whether an intervention will be successful. The tool will be designed for use by a non-expert audience. It will be available in the public domain and distributed over the web.

Bayesian statistical reasoning provides a coherent and effective way to combine diverse information under conditions of uncertainty. Conceptually, a Bayesian analysis starts by asking, "If you had only minimal information about a potential adopting community, what odds would you give for the success of a particular AWM intervention?" Then layers of information are added – about slope, precipitation, economic status, dominant livelihood strategies, ground cover, expert assessment of community capacity, institutional effectiveness, etc. – and the evaluation of the odds is updated. The "training" of a Bayesian belief network follows a similar logic: a preliminary set of relationships is specified and then, using available data collected from pilot sites and case studies, the model parameters (which are probabilities) are updated to reflect the observed information. In this way the proposed tool uses both a knowledge-based and evidence-based approach to targeting interventions. The Bayesian approach is unique in its capacity both to make use of diverse data sources and to capture and coherently accommodate uncertainty. The work will build on the "extrapolation domains" method that was developed in part through CPWF Phase I funding (Otero et al., 2006) and insights gained in applying Bayesian methods within the Mekong Basin Focal Project (Kirby et al., 2009; Kemp-Benedict et al., 2009). It will also draw on experience from the efforts by other researchers of applying Bayesian methods to problems of natural resources management (Cain 2001).

The targeting and scaling tool will also be informed by the results of two national policy analysis reviews undertaken by the local partners. These reviews will seek to inform the project team on what are current development priorities in the agriculture and water, environment. The first will explore the current targets, policies and expectations on water management in agriculture, poverty alleviation in rural development and identified priority areas in Burkina Faso and in Ghana

(OP4). In view of these reviews, a number of applications based on the identified successful cases will be assessed in the spatial domain with the tool to guide policymakers, potential investors, and other decision makers, in rainwater management and small reservoirs in the Volta basin.

For the limited set of interventions cases that will be explored in the targeting and scaling tool, a separate potential impact analysis at basin in scale water allocations will be explored using the WEAP Volta tool ( de Condappa et al, 2009; Keys , forthcoming).

*4) Generic approaches in research design of V1 project*

Human capacity development (OP1, OP5): The V1 'Targeting and out-scaling' project will feature human capacity development throughout the course of the project. The project will support two MSc. fellowships and four MSc.-level field budgets. The two fellowships will be offered at KNUST to carry out in-depth examination of existing case studies and management of GIS information with specific focus on the Ghana context. The field budgets will enable the University of Ouagadougou to support four students to associate their thesis work with the research activities of the project. Appropriate research foci include geography, environmental impact assessment, and social-economic information development. The thesis topics of students will be coordinated with the lead researchers of the project. Additional human capacity development will be for researchers in the project to apply participatory GIS (PGIS) methods for data collection (OP1), and testing the targeting and scaling tool with potential end-users and training them (OP5). These activities were first identified in the Impact Pathway Analysis undertaken for the project and were afterwards refined at the project inception meeting.

Communications and outreach (OP6): A plan of communication activities and outreach opportunities for the project will be developed in the project partnership during the inception meeting. This plan will be closely coordinated with V5 outreach and dissemination activities to ensure complementary activities. This V1 project will rely on V5 to enable and facilitate principal dialogues in dissemination with particularly targeted national, international, and regional policy actors, investors (both donors and private investors), and beneficiaries.

Project management, incl. M&E (OP6): Project coordination and administration will be the responsibility of SEI. Partners will provide a key person responsible on behalf of their respective institutions. These people along with representatives from the boundary partners will form the project steering committee group, where discussions and decisions on project management, developments and alterations will be reached. The strong emphasis on process learning will be reflected in the V1 project participation in various cross-basin project meetings. Due to the limited travel budget, special attention will be paid to ensure that partners and individuals are adequately represented at project meetings.

Project M&E will, in addition to CPWF guidelines, follow SEI's planning, monitoring and evaluation (PME) framework based generally on an outcome mapping approach. This seeks to ensure that during the inception phase of the project there is detailed consideration of the intended outcomes of the project for the boundary partners of the project. The project will, in accordance with the approach, identify boundary partners and their outcome challenges, identify progress markers relative to the proposed outcomes, develop a strategy map of broad strategies and activities for each outcome, develop outcome and activity monitoring plans, and develop an evaluation plan to ensure reflection and learning.

CPWF cross basin and within basin learning (OP6): The V1 activities will be planned in close collaboration with related activities, especially those under V5, and with other basin project meetings. This will ensure that, whenever feasible, parallel meetings will be held, giving formal and informal opportunities for interaction, sharing and learning. The V1 team will actively seek to provide information to the CPWF for it to disseminate through its website. Moreover, SEI will combine, where possible, work on V1 with Limpopo Project L1, which is also a "targeting and scaling out" project, and which SEI is also coordinating. For example, the development time for the generic Bayesian network-based out-scaling tool is split between V1 and L1, a necessity given budget limitations and modelling development costs. Under the process a generic model will be produced which will be populated with basin specific data. In this way the costs is shared across two projects.

The dual coordination will enable cross-learning and alignment of research efforts between the two projects. The principal flow chart of the outcome pathways for the project are shown in Figure 1.

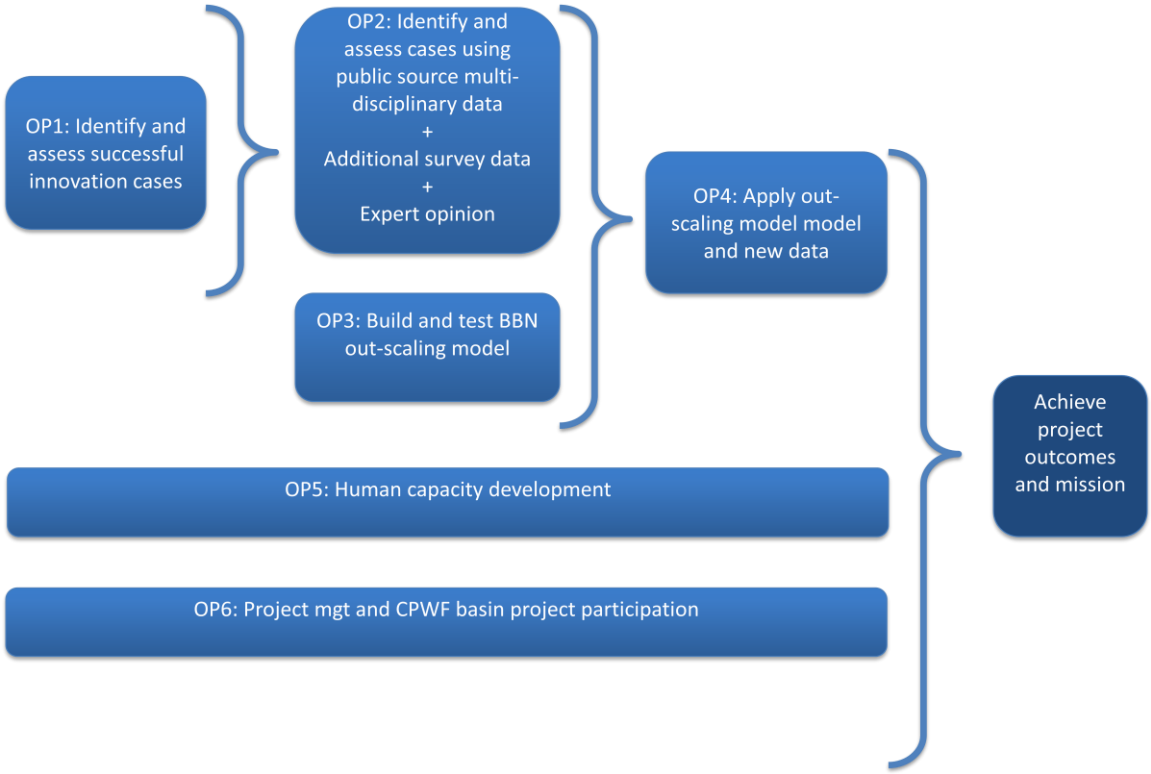


**Figure 1: Flow chart of the outcome pathways for the project**

## 5. Links to previous and ongoing work

There are already various spatial analysis/DSS tools available for identifying potential areas for AWM implementation for sub-Sahara Africa conditions. Some are more locally focused, whereas others are national to sub-continental (e.g. Mati et al 2006; Mbilinyi et al, 2007; Andersson et al, 2009 for more references). However, most of these tools focus primarily on biophysical aspects such as agro-ecological zone, climate, slope, soil, and surface water distance, with some incorporating some dimensions of human (labour availability, population density), financial (poverty/income proxies) and physical capitals (market access). To date, the incorporation of dimensions of social and human capital are uncommon, and factors such as institutional capacity absent.

Bayesian network models have been used for natural resource management in several different contexts (Bacon *et al*., 2002; Borsuk *et al*., 2004; Cain, 2001; Henriksen et al., 2007; MERIT, 2005; Newton *et al*., 2006; Sadoddin, 2005). The CPWF Phase I had its own examples (Otero *et al*., 2006 and Kemp-Benedict *et al*., 2007). Furthermore, the research team extensively explored the use of Bayesian networks for analyzing water and livelihoods in Phase I of CPWF (Kemp-Benedict et al., 2009). The project will benefit from the experience from these different sources. The methodology proposed for the project seeks to build on the experiences, knowledge and data of much of this work as well as that of AWM initiatives generally, particularly that of the CPWF progress as far as possible. However, the expansion of the model to include social, human and also institutional variables is innovative; furthermore, the need to include variables identified by specific successful intervention cases require a new model to be created. Experience of developing such Bayesian models currently resides with SEI but the capacity building elements of the programme will seek to begin to develop capacity to interrogate and construct such models over the course of the project.

Specific previous work with which the project will engage includes the following:
**The AgWater Solutions project** 2009-2011 (awm-solutions.iwmi.org). The expected outputs of this ongoing project will contribute to enhance and improve the CPWF V1 in terms of identified potential successful agricultural water management interventions specific to Ghana and Burkina Faso and the potential opportunities to scale out to alleviate poverty and hunger The project also initiated so-called country dialogues for outreach, dissemination and policy impact

**The transformations and shifts in productive landscapes for livelihood improvements in the Sahel project** 2009 (http://sei-international.org/projects?prid=1668), and the **Adapting to changing climate in drylands: The re-greening in Sahel as a potential success case project** 2010-2013: These projects take an interdisciplinary approach to assessing what constitutes the recent re-greening of formerly degraded areas of the Sahel, what has enabled these changes and what role these factors can play in a future of global and local climate and environmental change. In the Burkina Faso context this largely is ascribed so-called rainwater management interventions (or in-situ water management) such as zai, pitting, demi-lunes and other soil and water structures, in combination with fertilizers (e.g., Reij & Smaling, 2008).

CPWF Phase I projects are also envisaged to inform, and provide, the multidisciplinary data for successful rainwater management and small reservoirs intervention cases that are the focus of the CPWF Phase II V1. The PN05 (Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin), PN 46 (Small reservoirs toolkit), PN 55 (Basin Focal Project Volta) and PN65 (Shallow Groundwater Irrigation in the

White Volta Basin) all appear to exhibit promising results that will be considered and drawn on by V1. For example, the CPWF Phase I Small Reservoirs Project (SRP) carried out case studies in the Volta basin and developed techniques (summarized Toolkit web site: http://www.smallreservoirs.org/full/toolkit/index.htm) that may be used in this study.

Similarly, the CPWF Phase I Basin Focal Project (BFP) collected socio-economic and biophysical data in each of the Phase I Challenge Program basins. As part of the project, SEI staff and partners contributed support and human capacity development to the Volta Basin Authority development of the WEAP tool for water management purposes at basin scale (de Condappa et al, 2009). Further down-scaling of the WEAP model has been carried out for the Nakambe sub-basin by SEI, the Volta Basin Authority, and the Stockholm Resilience Centre, to explore climate change impacts and management opportunities on water flow (Keys 2010). Data collected during the Volta BFP will be a key starting point for V1.

Finally, it is anticipated that other BFP analyses can inform the V1 project. For example, the Niger basin project collected social and biophysical data layers that are likely to have analogues in the Volta basin. The Niger analysis can provide interesting insights into available data.

## 6. Links to other BDC projects

| **Research outputs** | **Dependencies on other BDC projects to produce it** | **Use of research output by other BDC projects** | **Risks and assumptions** |
|---|---|---|---|
| Pilot research site characterization | Input of site coordinates and site characterization by V2, V3, V4 | Knowledge on representativeness of pilot research sites | Assumptions |
| Characterization of selected rainwater management and small reservoir intervention systems being studied to feed into database | Assessment using V1 protocol in systems researched by v2, V3, V4 | Protocol developed and consulted with V2, V3, V4 | Risk: Protocol requirements being too demanding for V2, V3, V4 data collection; cases studied in V2, V3, v4 not suitable for V1 criteria |
| Creating spatial information layers on Institutional capacity (social a/o human capital) | Consultation / information from V4 Possibly V5: “innovation history” | | Risk: identifying existing data, proxies at relevant resolution |
| Reaching target beneficiaries /end-users at basin and national level | V5 to assist with national and international dialogue activities and contacts | Delivery of V1 database of cases and DSS tool tested and available for use | Assumptions: that some key outputs and meetings are facilitated with dual language |
| Access and permission to use | V5 for negotiating data access and use for all | | Assumptions: V5 will take on organizing |

| Research outputs | Dependencies on other BDC projects to produce it | Use of research output by other BDC projects | Risks and assumptions |
|---|---|---|---|
| different data layers without additional costs | project partners | | project knowledge management agreement between partners |
| Hosting of end product (tool and database) | V5 for assisting in identifying a host and providing framework fro data management | | Assumption: VBA will be interested and willing to host V1 end-products |

## 7. Suggested sites

The V1 project by virtue of its mission starts from a basin-wide perspective. The specific sites that the project will draw information from and may ultimately recommend for out-scaling of successful innovations as an output from the work will depend on the results of the consultation exercises to identify successful intervention cases, and the application of the tool. For example, the review of the CP Phase I may guide identification of sites relevant for characterization of possible 'success cases'. Furthermore, the AgWater Solutions project (led by IWMI) has already identified 3-5 successful water-related agricultural system interventions per country (Ghana, Burkina Faso). This information can be built upon at the initial project phase.

## 8. Project Outcome Pathways

See separate project workbook OLM worksheet.

## 9. Activities and Implementation Plan

See separate project workbook Gantt chart worksheet.

## 10. Communications

The communication plan for the project will be developed in the partnership at the inception workshop. This plan aims to contain key events, and activities relevant for awareness raising and dissemination of project outputs to various potential stakeholder, end users and beneficiaries. The V1 will also engage with V5 to ensure coordination of these activities between the five Volta basin projects. In addition, it is expected that V5 will facilitate some relevant contacts and network for outreach and dissemination activities, in particularly national and regional/international policy makers, donors and investors that potentially may be end-users of the V1 outputs. Through project human development efforts and training events, we expect to raise awareness and use of V1 outputs to targeted potential.

The project is designed to ensure engagement and communication with the boundary partners of

the project from the outset. The proposed capacity building exercises with boundary partners provide a means to communicate information on the project.

A key output of the project is the decision support tool itself with a user-interface to enable user-friendly application of the model and the linked database of successful interventions as described above. The tool, interface and case database will be available in public domain on web sites of CPWF and partners in V1. It will also be distributed as CDs at various events and for mailing. It is also intended to provide demonstrations of how to use the model through online visual aids such as Jing videos.

The project will also expect the tool and its application to be presented in submitted scientific papers and presented at relevant events over the last 12 months of the project. These would include submission to relevant components of the Stockholm World Water Week and Africa Water Week. This element of the work will be informed by the activities of V5, which will establish an events calendar for the projects. Similarly, the database of success cases and associated lessons learned will be submitted for peer-review publication purposes.

Manuals, users guides and instructions on methodologies will be documented in project reports and made available in public domain. The reports form the two supportive policy analyses of relevant policy context for Burkina Faso and Ghana produced at an early stage of the V1 project will also be made available. All training material will be made available in modules for off-the–shelf use in public domain.

Specific policy briefs on the relevance and application of the work in relation to specific policy issues will be developed. Posters for use by the CPWF will also be developed.

Nearer the completion of the project the in-country partners will also seek to raise awareness through opportunities with national media (newspapers and radio primarily). The value of, and responsibility for, these national awareness-raising activities will remain in the hands of the local partner members of the project team.

# PART C: CONSORTIUM DETAILS, INDICATIVE BUDGET AND REFERENCES

## 11. Consortium Details

| Names of team members | Professional discipline | Institutional affiliation and address |
|---|---|---|
| Jennie Barron | Ag water Eng/project manager | Stockholm Environment Institute(SEI)<br>University of York, Heslington,<br>York YO10 5DD, UK<br>Te.: +44 (0)1904 43 2944 |
| Matthew Chadwick | Water –livelihood analyst and Bayesian expertise | Stockholm Environment Institute(SEI)<br>University of York, Heslington<br>York YO10 5DD, UK<br>Tel.: +44 (0)1904 43 2897 |
| Steve Cinderby | GIS /P-GIS/RS specialist | Stockholm Environment Institute(SEI)<br>University of York, Heslington<br>York YO10 5DD, UK<br>Tel.: +44 (0)1904 43 2897 |
| Eric Kemp Benedict | Modeller of multidisc. Systems and Bayesian expertise | Stockholm Environment Institute(SEI)<br>11 Curtis Avenue, Somerville, MA 02144, USA<br>Te.: +1(617) 627-3786 |
| Unknown | Software developer | SEI |
| Unknown | Data manager | SEI |
| Mathias Fosu | Soil scientist, research coordinator | Savanna Agricultural Research Institute (SARI)<br>P.O. Box 52, Tamale, Ghana<br>Tel.: Office: +233 3720 91205<br>Mobile: +233 244 749893; +233201790880 |
| Unknown | Technical staff | SARI |
| Seraphine Kabore | GIS/research coordinator | Institut de L'Environnement et de Recherches Agricoles (INERA)<br>Direction de l'INERA - CNRST<br>04 BP 8645, Ouagadougou 04, BURKINA FASO<br>Tel : 226 50 34 02 70; 226 78 02 28 18<br>226 70 26 78 40 |
| unknown | Technical staff/ Researchers | Institut de L'Environnement et de Recherches Agricoles (INERA) |
| Frank Annor | Lecturer, Civil Eng., , River Basin Management, Hydrology, RS, GIS and Data Management | Civil Engineering Department<br>Kwame Nkrumah University of Science and Technology, Kumasi, Ghana<br>Tel. (Office): +233 51 60226/60235<br>Tel. (Home): +233 51 60684<br>Mobile: +233 249 129 987 |
| S. N. Odai | Ass. Prof., Hydrology, Water Resources Management | Civil Engineering Department<br>Kwame Nkrumah University of Science and Technology, Kumasi, Ghana<br>Tel. (Office): +233 51 60226/60235 |
| K. A. Adjei | Lecturer, Civil Eng., | Civil Engineering Department |

| Names of team members | Professional discipline | Institutional affiliation and address |
|---|---|---|
| | Hydrology | Kwame Nkrumah University of Science and Technology, Kumasi, Ghana<br>Tel. (Office): +233 51 60226/60235 |
| Da Dapola | Prof. Geographer, GIS | Department of Geography, University of Ouagadougou |

**The Stockholm Environment Institute (SEI - sei-international.org)** is a non-profit research for policy foundation based in Stockholm with regional centres in Thailand and Tanzania and additional centres in the USA, UK, and Estonia. The mission of SEI is to bring about change for sustainable development by bridging science and policy through integrated analyses that supports decision makers. SEI develops and synthesis new knowledge through scientific evidence-based approaches in strategic areas of development and environmental sustainability. In the area of water management for agriculture, specific focus is on how to attain development targets, including poverty and hunger goals, through wise and productive use of water, land and ecosystems services. The integrated analyses are carried out in various applied pilot research and policy –relevant partnerships from global to local scale. SEI commonly coordinates, facilitates and participates on various global and local research for development projects, and has the capacity to carry these multiple partnership collaborations in various countries and contexts.

SEI was involved in several aspects of the CPWF Phase I, in the Mekong, Volta and by developing the CN 17 project of Limpopo. In addition SEI is currently involved in several projects of research relating to agriculture, development and water management in Burkina Faso and Niger. In the CPWF Phase II, SEI will be activities in the V1 (and L1) by invitation, and as a partner in CPWF Nile basin N4 and in the CPWF Andes, specifically addressing water resource management and allocation issues.

**Institute de L'Environnement et de Recherches Agricoles (INERA - www.inera.bf)** is the Burkina Faso national research institute for environment and agricultural related sciences, including soil and water engineering, with key interest to advance research in agricultural water management and development. INERA has a key role in the project of research partner in collecting and assessing case information, characterization and knowledge development of smallholder farming systems from a multidisciplinary perspective in Burkina Faso. INERA is also excellent positioned to facilitate relevant network and contacts for potential end beneficiaries and end users (relevant ministries, NGOs, extension service other national and local development bodies) that V1 intends to engage with in consolations for different purposes throughout the project. INERA was a main partner in CPWF Volta Phase I projects PN05 Rain and nutrient efficiency, PN47 African models for transboundary governance, and PN55 Volta Basin Focal Project.

**Savanna Agricultural Research Institute (CSIR-SARI - www.csir.org.gh**) is the Ghanaian national research institution with mandate of the Savanna Agricultural Research Institute is to conduct agricultural research, particularly as it relates to food and fibre crop farming, in northern Ghana for the purpose of introducing improved technologies to enhance agricultural productivity. In this project, SARI lead the components of assessment of successful cases in northern Ghana. It will ensure relevant information, and appropriate approaches in selection of assessment and criteria for up/out-scaling. SARI also provide network to access potential end users/ end beneficiaries (relevant ministries, NGOs, extension service other national and local development bodies) to

carry out the proposed consultations at various project stages. As a key partner in CPWF PN05, knowledge and experience from Phase I is carried into V1 through the participation of SARI.

**University of Ouagadougou, Department of Geography** (www.univ-ouaga.bf**):** University of Ouagadougou (UoO) is the strongest tertiary education institution of Burkina Faso founded in 1974. The Department of Geography holds the mandate of teaching and research in geographical information systems. In this project the Geography Department, UoO will support with various geographical information products, enable creation of various new information layers, and not the least, support the development of human capacity through attaching field student grants to the project. The department has several on-going and past project contributions such as the AMMA (amma.mediasfrance.org). UoO/Dr Da Da Pola was also contributing to Niger Basin Focal project, Phase 1.

**Kwame Nkrumah University of Science and Technology (KNUST** www.knust.edu.gh/**):** the KNUST is one of the regions strongest academic institutions, and the Dept of Civil Engineering holds the mandate of civil engineering, planning and management of infrastructure of water, waste, transport and buildings. The department also hosts capacity to work with geographic information systems and remote sensing information for water resources management. In this project the role of KNUST/Dept Civil Eng. will be to coordinate database structures in coordination with Volta basin Authority/V5, host capacity building grants of 2 MSc students involved in project research, obtain and develop remote sensing products through the TIGER project to associate V1 evaluation. Past experiences of KNUST /Dep. Civil Eng. relates to Volta Basin modelling of water resources through application of WEAP, and the development of the SRP Tool-Kit in CPWF Phase1). Outputs from V1 are expected to contribute towards PhD of a KNUST staff member who has registered at the Technical University of Delft in the Netherlands.

## 12. Indicative breakdown of budget

See separate project workbook respective budget worksheets.

## 13. Bibliography


Andersson, J. C. M., Zehnder, A. J. B., Jewitt, G.P.W., and Yang, H.: Water availability, demand and reliability of in situ water harvesting in smallholder rain-fed agriculture in the Thukela River Basin, South Africa, *Hydrol. Earth Syst. Sci*., 13, 2329-2347.

Bacon, P. J., Cain, J. D. and Howard, D. C. (2002) Belief network models of land manager decisions and land use change. *J Environ Manage* **65**: 1, pp. 1-23.

Barron, J., Noel, S., Mihkail, M. 2010 review of Agricultural Water management Interventions; Impacts at the watershed scale: a synthesis using the sustainable livelihoods framework. SEI Project report, Stockholm Environment Institute, Stockholm, Sweden

Borsuk, M. E., Stow, C. A. and Reckhow, K. H. (2004) A Bayesian network of eutrophication models for synthesis, prediction, and uncertainty analysis. *Ecol Modelling* **173**, pp. 219-239.

Cain, J. D. 2001. *Planning improvements in natural resources management—Guidelines for using Bayesian networks to support the planning and management of development programmes in the water sector and beyond.* Centre of Ecology and Hydrology, Wallingford, UK.

Cinderby, S. 2010. PGIS Challenges and Opportunities for Environmental Management. Map

Middle East 2010 Conference Proceedings
de Condappa D., Chaponnière A. and Lemoalle J. 2009. A decision-support tool for water allocation in the Volta Basin. Water International, 34: 71 — 87
Henriksen, H.J., Rasmussen, P., Brandt, G., von Bulow, D. and F.V. Jensen. 2007. *Bayesian Networks as a Participatory Modelling Tool for Groundwater Protection* In A. Castelletti and Rodolfo Soncini-Sessa (Ed). Topics on System Analysis and Integrated Water Resources Management, 49-72. Elsevier Oxford.
Joshi, P.K., Jha, A.K. Wani, S.P. Sreedevi, T.K. Shaheen, F.A. 2008. Impact of watershed program and conditions for success: a meta-analysis approach, Global Theme on Agroecosytems Report No 46, International Crops Research Institute for the semi-Arid Tropics (ICRISAT)
Kemp-Benedict, et al. 2009. Working Paper. Stockholm: Stockholm Environment Institute. Management of the Environment and Resources using Integrated Techniques (MERIT). 2005.
Kemp-Benedict, E., S. Bharwani, E. de la Rosa, C. Krittasudthacheewa, and N. Matin. 2009. Assessing Water-related Poverty Using the Sustainable Livelihoods Framework. Stockholm Environment Institute Working Paper. Stockholm: Stockholm Environment Institute.
Keys, P. *forthcoming*. Refining WEAP=Volta for Nakambe sub basin: incorporating higher resolution data on small reservoirs and evaluating impacts on water allocations. MSc thesis University of Washington State/Stockholm resilience Centre, Stockholm University
Kirby, M., C. Krittasudthacheewa, M. Mainuddin, E. Kemp-Benedict, C. Swartz, and E. de la Rosa. Mekong Basin Focal Project: Final Report. Colombo, Sri Lanka: Challenge Program on Water and Food, 2009.
Lemoalle,J. and de Condappa, D. 2009. Water atlas of the Volta Basin - Atlas de l'eau dans le bassin de la Volta. Challenge Program on Water and Food and Institut de Recherche pour le Développement, Colombo, Marseille, 96 p.
Mati et al. 2006. Mapping the Potential of Rainwater, Technical Manual No. 6 Nairobi, Kenya: World Agroforestry Centre (ICRAF), Nairobi.
Mbilinyi, B. P., S. D. Tumbo, H. F. Mahoo, and F. O. Mkiramwinyi. 2007. GIS-based decision support system for identifying potential sites for rainwater harvesting. *Physics and Chemistry of the Earth* 32 (15-18): 1074– 1081
Newton, A. C., E. Marshall, K. Schreckenberg, D. Golicher, D. W. de Velde, F. Edouard, and E. Arancibia. 2006. Use of a Bayesian belief network to predict the impacts of commercializing non-timber forest products on livelihoods. *Ecology and Society* **11**(2): 24
Noble, A.D., Bossio, D.A., Penning de Vries, F.W.T., Pretty, J. and Thiyagarajan, T.M. (2006) Intensifying agricultural sustainability: An analysis of impacts and drivers in the development of 'bright spots', Comprehensive Assessment Research Report 13, Comprehensive Assessment Secretariat, Colombo, Sri Lanka
Otero, M., Rubiano, J., Lema, G., and V. Soto. 2006. Using Similarity Analyses to Scale Out Research Findings Across Andean Watershed Basins, *Water International*, 1941-1707, Volume 31, Issue 3, 2006, Pages 376 – 386
Reij, C.P. and Smaling, E.M.A. (2008) Analyzing successes in agriculture and land management in Sub-Saharan Africa: Is macro-level gloom obscuring positive micro-level change? In: Land use policy : the international journal covering all aspects of land use, 25 (2008)3, pp. 410-420
Sadoddin, A., Letcher, R.A., Jakeman, A.J., Newham, L.T.H., 2005. A Bayesian Decision Network Approach for Assessing the Ecological Impacts of Salinity Management. *Mathematics and Computers in Simulation* 69 162-176.
Wang, X.; Yu, Z.; Cinderby, S.; Forrester, J. 2008. Enhancing participation: Experiences of participatory geographic information systems in Shanxi province, China *Applied Geography 28(2): 96-109.*