

FORMAT FOR PROPOSAL SUBMISSIONS

Proposing Institution: University of Copenhagen

Project Title: The impact of waste water irrigation on human health and food safety among urban communities in the Volta Basin – opportunities and risks

Brief Title: Waste water irrigation – opportunities and risks

Budget Requested: (DKR2.1m available)

DKR 1,050,000

Project Duration: Two years

Target commence date: 1 November 2004

1. Institution: Department of International Health and the Department of Epidemiology, University of Copenhagen

Name of Project Leader: Dr. Helle Samuelsen; researcher Dr. Henrik Friis

Postal Address: Blegdamsvej 3, 2200 Copenhagen N, Denmark

Email: H.Samuelsen@pubhealth.ku.dk

Primary discipline of importance to this proposal: Medical anthropology, public health, nutrition, epidemiology

Type of Institution: University

2. Institution: IWMI Ghana

Name of Researcher: Dr. Pay Drechsel/ Dr. Flemming Konradsen

Postal Address: IWMI, PMB CT 112, Accra

Email: p.drechsel@cgiar.org; f.konradsen@cgiar.org

Primary discipline of importance to this proposal: Environmental science, public health, epidemiology, health surveys

Type of Institution: CGIAR

3. Institution: Department of Veterinary Pathobiology, the Royal Veterinary and Agricultural University, Copenhagen, Denmark

Name of Researcher: Anders Dalsgaard,

Postal Address: Bulowsvej 17, 1870 Frederiksberg C, Denmark

Email: Anders.Dalsgaard@vetmi.kvl.dk

Primary discipline of importance to this proposal: Parasitology, microbiology, water quality assessments

Type of Institution: University

4. Institution: The Kwame Nkrumah University of Science & Technology (KNUST)

Name of Researcher: Dr. R.C. Abaidoo

Postal Address: Department of Biological Sciences, KNUST, Kumasi, Ghana

Email: Rcabaidoo@yahoo.com

Primary discipline of importance to this proposal: Environmental microbiology, parasitology, public health, epidemiological and community surveys.

<p>Type of Institution: NARES, university</p>
<p>Link with project number/s: CPWF 38. To strengthen its project, this proposal was jointly developed with the institutions involved in project CP 38. Both projects could begin simultaneously and will be implemented in close collaboration.</p>
<p>Link with thematic areas: 1: 20 % and 4: 80 %</p> <p>The project directly addresses the urbanization-agriculture interface identified under CPWF Theme 4 and, to a limited extent, looks at the upstream-downstream interactions identified as a priority under the same theme. Similarly, the project activities will support the development of integrated management strategies and techniques to improve crop-water productivity, a key issues under CPWF Theme 1.</p>
<p>Link with benchmark basins: 100% Volta</p> <p>The project addresses the need for more intensive production to feed the growing population, highlighted as issues under the CPWF focus on the Volta basin. Although field activities will only take place in the Volta basin the approach and findings will be relevant for other basins under the CPWF, especially the Limpopo and the Nile basins. Most field research will take place in Tamale (in the Volta basin) and Kumasi (just outside the Volta basin), Ghana. However, other activities related to capacity development, dissemination and wider impact will include other towns and cities in the basin, including Quaga in Burkina Faso.</p>
<p>1. MONITORING, EVALUATION, AND IMPACT</p>
<p>1.1 What is the goal of your proposal? (immediate goal showing relevance to the CPWF)</p> <p>Evidence based support for public health policy development that mitigates health risks of urban waste water irrigation without compromising livelihoods of farmers and traders.</p>
<p>1.2 What is/are the specific objectives of your proposal?</p> <ol style="list-style-type: none"> 1. To assess perceptions of environmental risks and risk avoidance among communities involved in waste water irrigation in selected urban and peri-urban areas of the Volta basin; 2. To estimate the relative contribution of waste water irrigated agriculture to the nutritional status and livelihoods of urban and peri-urban farming communities; 3. To assess post-harvest risk factors for fecal contamination of foods at the market place and evaluate appropriate interventions to protect the consumers; 4. Enhance capacities to undertake research in epidemiology, medical anthropology and specific microbiological techniques; 5. Formulate health risk reduction strategies for policy development in waste water irrigation.
<p>1.3 What are the major outputs of your proposal?</p> <ol style="list-style-type: none"> 1. A health risk reduction strategy with guidelines for health promotion, based on actual and

perceived health risks of urban waste water irrigation, jointly with CP38;

2. A policy brief presenting the contribution of waste water irrigated vegetable production to the nutritional status of children and livelihoods;
3. Appropriate strategy for the protection of consumer safety through the reduction of infective microorganisms; in particular, protozoan parasites in waste water irrigated vegetables sold at markets;
4. Human capacity built through training of students from Ghana or other West African countries at M.Sc. level;
5. Increased knowledge among international research community through the publication of journal articles, theses and research protocols.

1.4 Who is/are the target group/s for your proposal?

1. The general public will benefit through raised public awareness on risks and risk-reducing options related to food hygiene, personal hygiene and water quality;
2. The managers and planners of urban development activities at municipalities, engineering companies and aid agencies will be able to make better informed decisions on agriculture as part of urban planning;
3. The public health departments and NGOs involved with environmental health promotion will be able to formulate appropriate information, education and communication programs for urban communities and market traders;
4. The technical departments and research organizations, involved in CP 38 and elsewhere, designing agricultural, engineering or management type interventions for the reduction of health risks of waste water irrigation will benefit from increased knowledge of household level perceptions and practices;
5. At the international level, researchers will benefit from the dissemination of field tested research tools and study protocols;
6. The FAO and WHO will benefit from increased knowledge and specific inputs to the formulation of guidelines for urban agriculture and use of waste water.

1.5 How will they utilize the outputs? (i.e. what will be the outcomes against which the impact of your proposal could be measured?). (max 200 words)

Listed below are a number of short and medium term indicators, which will be used to measure the impacts of this proposal:

1. Agricultural based health risk reduction strategies tested in waste water producing areas incorporating the risk factors and community perceptions and priorities documented as part of this project;
2. Effects of interventions to reduce fecal contamination of foods at markets assessed and appropriate extension material produced;
3. In the research sites, health promotional activities implemented by public health, agriculture or education departments or by CBOs or NGOs incorporating specific finding of the project;
4. Protocols and research tools downloaded from the project web site used by other researchers in other countries;
5. Citing of Journal articles produced by project in research reports and policy documents produced by others;
6. Acceptance of two M.Sc. theses;
7. Findings of the project incorporated in FAO, WHO or other multilateral organizations guidelines on waste water use and in policies on urban agriculture;

Long-term impacts of the project will include:

1. Improved health status of urban and peri-urban communities;
2. Government and urban authorities provide support to urban waste water irrigation, acknowledging the need for integrating health and livelihood concerns in planning;

1.6 How do you intend to self-monitor the project? (roles of institutions/groups involved - you will be requested to provide an input/activity/output milestones list as part of the monitoring/management process. (max 200 words)

Partner monitoring: A four person project coordination team (Coordinating team), consisting of two members representing the Danish partners and two from the CP 38 project, will be formed. This team will be in regular communication to monitor the milestones and distribute a progress report every six months. The progress report will include specific technical progress and time tracker records for the project staff. At the field level, regular meetings and stakeholder consultations will take place as would be required for project coordination and for partners to influence project development. The coordinating team can request for focused external evaluations to review specific technical aspects or to assess progress. Before the end of the project a terms of reference will be formulated for evaluation of the project.

Output quality assurance: All research and policy reports and articles generated as part of the

project will be reviewed internally among the Danish and CP 38 partners. All policy and research documents to be published outside the normally peer reviewed journals will undergo an external review process before publication.

Financial monitoring: Financial report will be produced by the University of Copenhagen on a monthly basis and reviewed by the coordinating team. Inputs to the financial report will be from the partners in the project. The financial auditing procedures of the University of Copenhagen will be applied for this project.

Ethical aspects: Protocols developed to guide the collection of information at household level will be submitted for ethical review both in Ghana and in Denmark and the best practices established for international health research will be followed. Similarly, all involvement of individuals will be based on informed consent and a system for feedback to the communities will be established.

Milestones

December 2004: Project start-up workshop completed, Coordination team appointed, final work plan agreed on and lines of communication established among all involved (responsible: management of CP project 38 and Danish project leader);

February 2004: Study protocols for field project components completed and tested together with CP 38, research and ethical approval obtained, employment contracts signed with research officers and M.Sc. students identified (Coordinating team)

March 2005: Work initiated for field components in coordination with CP 38, procedures for data entry and quality assurance established (Danish project leader, Coordinating team and supervisors)

May 2005: Progress report compiled and distributed among partners (Coordinating team)

December 2005: Progress report compiled and distributed among partners (Coordinating team)

January 2006: Field work completed for anthropological and epidemiological component, initial analyses begun and final list of authors with their responsibilities indicated for each research output (Coordinating team and individual M.Sc. students);

April 2006: First authors circulate outlines of research papers, final re-visits to the field sites for verification and follow-up purposes finalized (Coordinating team)

May 2006: Field work and field evaluation of interventions completed for component focusing on improving food safety at the market place and key NGOs, government officials and community representatives invited for a visit to the market places (Coordinating team);

July 2006: Final drafts of research papers circulated and research protocols prepared for dissemination (dedicated first authors and Coordinating team)

August 2006: Feedback to community representatives and local stakeholders in study areas (Coordinating team)

October 2006: Policy briefs and feedback to international guidelines on the use of waste water

finalized and disseminated to a wide set of actors in the national, regional and international fora (Coordinating team and dedicated authors)

November 2006: Project completion workshop, to a national audience, with the dissemination of findings. Project completion report produced, findings presented at key international conferences and via international networks (e.g. RUAF) and research papers submitted to journals (Coordinating team).

2. METHODOLOGY:

2.1 Provide a summary of your project methodology/approach (maximum 500 words)

Coordination with existing CP projects

The joint coordinating team will ensure close liaison between this proposed project and the team working on CP project 38 on protocol development, logistics, and database management and in the selection of study sites. The coordination will also optimize the use of resources, facilitate interactions with stakeholders and provide an interdisciplinary study approach. This project will benefit from specific data being collected during the implementation of CP 38, including water quality of surface irrigation sources, agricultural practices and community assessments of socio-economic and demographic aspects. Lines of communication will be established with other CP projects such as CP 39 on informal irrigation (under IFAD review) to facilitate the exchange of lessons learned and research tools. It is the intention to establish contact to a number of the CPWF approved projects with a human health component to ensure exchange of information.

Qualify the perceptions of environmental risks in general and risk avoidance among waste water irrigating communities in selected urban and peri-urban areas of Ghana (addresses specific objectives one, four and five)

Waste water irrigation farming households will be selected for the in-depth study. The study objectives will be addressed through a series of qualitative approaches including consecutive open-ended interviews, focus group discussions and participant observations at different times of the production calendar. The in-depth information will supplement the information already generated by the CP 38 project through observations in the field, questionnaire surveys and key informant interviews and will provide an opportunity to triangulate information collected through the different approaches. The qualitative study will focus on community perceived health risks and livelihood opportunities associated with waste water-based farming, and specific factors that might influence this perception. Also, the community perception and awareness of food safety and consumer safety related to crop quality, in general, and waste water irrigated crops, in particular, would be covered. Similarly, gender and age specific practices followed by the community to reduce the risk of contamination will be mapped. As part of the survey, household level responses to proposed health risk reduction techniques and strategies of waste water irrigation will be documented to assist CP 38 in the exploration of safeguarding strategies and formulation of interventions. Also, perceived environmental risk with regard to downstream impacts in the Volta basin will be explored. The qualitative studies will cover six weeks of design, twelve months of field work and six months of analyses and write up. This will be followed by a period of active dissemination and interactions with relevant stakeholders to convey results. The qualitative studies will be conducted in the same settlements (but not the same households) as the ones included in the epidemiological study mentioned below. One senior medical anthropologist from Denmark, an agronomist and a sociologist from Ghana will supervise one Research Officer from Ghana and one M.Sc. student, also from Ghana. Additional applications will be submitted to Danish universities requesting for funds to support the M.Sc. field component of two Danish students of public health or anthropology as part of the project.

To assess the relative contribution of waste water irrigated agriculture to the food safety and nutritional status among under fives living in peri-urban farming communities in Ghana (of relevance to the second, fourth and fifth specific project objectives)

For the epidemiological study, 500 households, in a peri-urban area of Kumasi or Tamale where waste water (exposed) as well as other water sources (non-exposed) is used for irrigation of vegetables, will be selected randomly. For all children between 6 months and five years anthropometric measurements will be taken and the prevalence of stunting will be estimated. Stunting is selected as an indicator of chronic undernutrition that is associated with low socio-economic status, limited access to fresh foods, low household net income, low educational level, poor water supply and sanitation, and high infectious disease burden. In the analysis, when controlling for the other variables, with a direct or indirect influence on nutritional status, it will be possible to assess the relative contribution of waste water irrigation to the nutritional status of the children.

For the studies on nutritional status a number of additional variables will be collected, in close coordination with CP 38, during two surveys at household and individual level through questionnaires and observation check lists and the compiled information will be used as input in the epidemiological study. This will include information on, for example, type of irrigation practice, 24-hour dietary recall, consumption of field crops, on- and off-farm income, use of anti-helminthic drugs, distance of house from waste water irrigated field, socio-economic status, educational level of head of household, water supply, sanitation facility and hygiene standard. Information collected will be included in epidemiological models to control for confounding to better assess the real contribution of waste water irrigation to the outcome indicator. The epidemiological study will cover six weeks of protocol development and pre-testing, twelve months of fieldwork and six months of analysis and write-up. One month has been allocated to support the dissemination of findings at international workshops and in interactions with local and national stakeholders. A statistician, a senior epidemiologist and an environmental health specialist will provide input during the design phase. A M.Sc. student from Ghana will be identified to do her/his thesis work as part of the project. The candidate will be registered at KNUST. Two Research Assistants will assist in data collection during the surveys, a total of twelve months.

Assess risk factors and sources for fecal post-harvest contamination of foods at the market places and evaluate appropriate market interventions to protect the consumers (of relevance to the third, fourth and fifth specific objective)

In order to provide the consumer with safe products, programmes are needed to protect the consumer from microbial contamination. Besides the irrigation water source, crop contamination also takes place in post-harvest handling. This proposed activity will supplement the work already planned for CP 38 (which also analyses crop contamination in markets) by focussing especially on the hygienic conditions during handling, storage, refreshing and sales at the market places to identify the actual moment(s)/place(s) of contamination. This will facilitate targeted interventions. The reason for the increased focus on this part of the contamination pathway relates to the fecal contamination that is likely to take place between farm gate and market place. Also, CP 38 works on a number of interventions to protect the consumers purchasing from the markets and it is time they be tested. Additionally, together with CP 38, assess the importance of the contamination at the market place relative to the pre-market routes of contamination: a detailed sub-study will analyse vegetables when they first arrive at the market and at the point of selling.

This study will focus on the waste water-irrigated crops that are consumed raw and that are of

major economic importance. The microbiological analyses will be coordinated with CP project 38 but a special emphasis will be paid to the protozoan parasites, *Cryptosporidium parvum* and *Giardia intestinales*, including quantification of the parasites and the infectivity of the parasite oocysts. The focus on the protozoan is due to the important role they play in persistent diarrhoea and the threat they may have to HIV/AIDS patients. Epifluorescence microscopy following immunofluorescence staining will be used for detection of protozoan oocysts. The viability and potential infectivity of the oocysts will be tested by dye-staining assays. Molecular typing using PCR will be used for confirmation of species and to trace the origin of the oocysts (i.e. animal or human).

A simple questionnaire will be prepared to obtain information at the market places about possible risk factors for contamination with fecal matter and especially protozoan parasites such as exposure to contaminated water, packaging, water refreshing procedures, storage practises, hygienic conditions, toilet facilities and hand washing practices. Uni- and multivariate regression analyses will be used to identify and assess possible risk factors for protozoan parasites. Proposed intervention strategies will be exchanged with CP 38 and tested in a dialog with market traders and based on the outcome of the risk factor analyses. Interventions proposed by WHO and FAO to protect consumers will be discussed with the stakeholders and tested if found acceptable to the users.

The market studies of microbiological food quality, assessment of risk factors and formulation and testing of intervention strategies will cover a period of 16 months. A biostatistician, a senior epidemiologist and a microbiologist will provide input during study design, implementation and data analysis. In addition one M.Sc. student and one research officer will be involved in the study.

2.2 Provide a summary of the background leading to your proposal (maximum 300 words justifying why your proposal is important and the work it builds on)

The expanding urban centers of Africa provide both a challenge and an opportunity for the communities sustaining livelihoods through farming. The pressure on land and water resources are among the key challenges but the high demand for food at the nearby markets provides an opportunity for income. Increasingly the urban farming households depend on polluted surface water as an input to the production. The regular flows and the nutrient values of this water make it attractive for the farmers but at the same time environmental and human health concerns have been emphasized by national authorities and international organizations. However, the relative risks involved and the possibilities for realistic mitigating measures have not been worked out and the authorities need further evidence to guide the sector. In particular for Ghana, reports published by the Wageningen University, Wallingford and IWMI have described both challenges and opportunities in the context of Ghana (Wallingford reports OD/TN97 and OD/TN103; Wageningen University, 2003 "Use of waste water in irrigated agriculture: country studies from Bolivia, Ghana and Tunisia. Volume 2 Ghana"; IWMI 2002; "Integrated economic and environmental impact assessment of urban and peri-urban agriculture in the case of Kumasi. Final Technical Report on the FAO funded project PR 17951 IWMI/IBSRAM/KNUST, Vol. 2, 52 pp")

A number of guidelines, technical interventions, management strategies or legal frameworks have been proposed to regulate and safeguard workers and consumers of these waste water irrigated crops (WHO, 1998 "Surface decontamination of fruits and vegetables eaten raw: a review. Food Safety Issues. WHO/FSF/98.2"). These attempts of improving the sustainability and health of waste water use have to some extent been supported by technical feasibility studies, cost-effectiveness assessments and risk of contamination studies. However, few studies or development activities exist anywhere in the world that relate the proposed interventions with the

local understanding of hygiene, perceptions of water or food related disease and the willingness to invest in particular strategies. Most of the currently proposed interventions aim for a change of behavior before the current behavior is understood. A further mismatch is that most guidelines cannot be applied in low-income countries where water treatment is hardly possible, and farmers' options for change are limited in specialized urban agriculture (Drechsel et al, 2002 "Balancing health and livelihoods: Adjusting waste water irrigation guidelines for resource-poor countries. Urban Agriculture Magazine 8: 7-9"). This study compliments the detailed agricultural and community assessments already planned for the CP38 project with detailed medical anthropological studies among affected communities. Also, studies from Mexico have shown the importance of supporting the microbiological water and food analyses with epidemiological risk assessments to quantify the importance of waste water practices relative to other routes of contamination within the household or at community level (Cifuentes, 1991 "Health impact evaluation of waste water use in Mexico, Public Health Rev.19:243-50"). This type of evidence is clearly of importance to guide investment in the direction where they will make the greatest impact. This proposed study will provide detailed epidemiological analysis to assess the relative contribution of waste water to age and gender specific levels of disease. Finally, since the contamination taking place post-harvest, especially at the markets, has been highlighted in several studies and interventions have been proposed (by WHO/FAO and also CP 38 is working on suggestions for farmers, markets and consumers), it is time that this is field tested in a West African context (Worsfold D, 2004 "An assessment of food hygiene and safety at farmers' markets" Int J Environ Health Res. 14:109-19"; WHO, 1998 "Surface decontamination of fruits and vegetables eaten raw: a review. Food Safety Issues. WHO/FSF/98.2").

This proposed project was developed jointly with the institutions involved in CP 38. It would advance the CP 38 project through four specific methodological additions: stringent epidemiological studies, in-depth qualitative approaches of medical anthropology, public health theory; and assessment of risk sources for fecal pollution of foods at market places, including techniques for identification and viability testing of protozoan parasites. All activities of this project will support the goal set for the CP 38 project but will, at the same time, provide additional insight especially on the wider health aspects of the urban livelihoods.

2.3 How do the project outputs link together to reach your objectives?

The documented outputs of the project (health risk reduction strategy, guidelines for health promotion, policy brief, articles in international scientific journals) will provide insights into the perceived and actual risks of waste water irrigation and will estimate the relative contribution of waste water irrigation to nutritional status.

The assessments made at the market places and the strategies formulated will assist in the protection of consumers of vegetables from protozoan infections.

The training of students and the dissemination of research protocols will increase the capacity for research in medical anthropology, epidemiology, and microbiology and sustain progress that will be made during the project implementation and support other similar endeavours-.

In sum, output 1 relates to objective 1; outputs 2 relate to objective 2; output 4 relates to objective 3 and outputs 6 relate to objective 5. Output 6 also relates to objectives 1-4.

2.4 How do the objectives link together to reach your goal?

Insight into the perceived and actual health risks will make it possible for health and urban policy makers to arrive at better-informed decisions on the role of peri-urban agriculture in securing health and livelihoods.

2.5 How, if at all, does your proposal address issues of

1. stakeholder involvement (demand and inclusion in project activities)

Since 2002, all stakeholders have been involved through IWMI's research program on waste water use in Ghana. The next workshop with the Extension Directorate of the Ministry of Food and Agriculture is planned for November, 2004. Training workshops with farmers are regularly organized. It was agreed with CP 38, IWMI and KNUST, to co-host all forthcoming stakeholder meetings and training. Interaction with the Ministry of Food and Agriculture and other non-research and research stakeholders will thus be facilitated via the local IWMI office in Ghana.

2. gender disaggregation (for instance, of data collection and analysis, farmer group activities)

A key parameter in the analysis of epidemiological information will be the stratification and identification of gender, socio-economic and age specific risk factors. Also, in the anthropological perception and practices study, gender will be a central issue during information collection and analysis. Gender mainstreaming will be achieved through training of the research team during the initial project workshops. IWMI is taking the lead here and currently organizing a workshop for Gender and Urban Agriculture, funded by Urban Harvest, CTA and RUAF.

3. environmental security (i.e biodiversity, water quality)

As all project interventions aim at reducing contamination the project can be regarded as secure.

4. impact on the poor (including food security and wellbeing)

Urban agriculture allows farmers to jump over the poverty line. However, contaminated food might reach households without being washed suitably. Resulting diseases and loss of man-days negatively affect the households in various ways. An improved health status and a safer agricultural productivity greatly affect the livelihoods and coping capacity of the poor and poorer urban farming households. It is, therefore, essential to mitigate health risks and develop policies that are based on evidence to focus investments where it makes the greatest impact.

5. Intellectual property rights. (access rights and the need for outputs to be available free of charge as a global public good).

Following the policies of our partners, all results are public goods and will be made available through the web-pages and communication offices of IWMI. This does not only cover the results of the various surveys but also the protocols and research tools, which will be made available to the research community.

2.6 What is original/innovative about your project? (200 words)

The proposed project when combined with the capacities and set-up of CP project 38 provides a unique opportunity to formulate agricultural health risk reduction strategies based on microbiological, epidemiological and anthropological evidence. At the same time the clear interdisciplinary set-up of the project facilitates the formulation of public health strategies addressing risks of waste water use that acknowledges the constraints faced by the urban farmers.

The project will aim at field testing and evaluating the feasibility and impacts of interventions to be proposed by CP 38, or already suggested by FAO, WHO and others, to safeguard consumers of waste water irrigated crops focusing on the hygiene interventions at the market place. Such interventions relate to e.g. hygiene education at the vegetable markets or changed refreshing procedures. These field assessments are urgently needed to prioritize and bring forward the recommendations of relevance for many of the African urban centers. As part of the project

specific capacities for the infectivity of protozoan will be established in Ghana.