AGRICULTURAL USE OF UNTREATED URBAN WASTEWATER IN LOW INCOME COUNTRIES

E-mail Conference
(June 24-July 5, 2002)

Synthesis

IWMI
International Water Management Institute

RUAF
RESOURCE CENTRE ON URBAN AGRICULTURE & FORESTRY

Conclusions and Recommendations of The IWMI-RUAF E-Conference on Agricultural Use of Untreated Urban Wastewater in Low Income Countries

24 June–5 July 2002

INTRODUCTION

The use of urban wastewater in agriculture is a widely established practice, particularly in the urban and peri-urban areas of arid and seasonally arid zones. Wastewater is used as a source of irrigation water as well as a source of plant nutrients (such as nitrogen, phosphorus and potassium) and trace elements (K, Na, etc.), allowing farmers to reduce or even eliminate the purchase of chemical fertilizer and organic matter that serve as soil conditioners and humus replenishers. Lunven (1992) estimated that one-tenth or more of the world's population currently eats food produced on wastewater (but not always in a safe way).

However, irrigating with untreated wastewater poses serious public health risks as sewage is a major source of excreted *pathogens*—the bacteria, viruses, protozoa, and the helminths (worms) that cause gastro-intestinal infections in human beings.

Wastewater may also contain highly poisonous chemical toxins from industrial sources as well as hazardous material from hospital waste. Relevant groups of chemical contaminants are heavy metals, hormone active substances (HAS) and antibiotics. The risks associated with these substances may, in the long run, constitute a greater threat to public health and be more difficult to deal with than the risks from excreted pathogens. Unregulated and continuous irrigation with sewage water may also lead to problems such as soil structure deterioration (soil clogging), salinization and phytotoxicity.

.These risks are not limited to "official" wastewater but often also apply to rivers and other open water sources, as indicated by data gathered by Westcott: 45 percent of 110 rivers tested carried faecal coliform levels higher than the WHO standard for unrestricted irrigation (FAO, unpublished, cited in Birley).

The ideal solution is to ensure full treatment of the wastewater to meet WHO guidelines prior to use, even though the appropriateness of these guidelines are still under discussion. In practice, however, most cities in low-income countries are not able to treat more than a modest percentage of the wastewater produced in the city, due to low financial, technical and/or managerial capacity. The rapid and unplanned growth of cities with multiple and dispersed wastewater sources makes the management more complex. In many cities, despite environmental consequences and health risks, a large part of the wastewater is disposed of untreated to rivers and seas. The perspectives regarding the increase in wastewater treatment capacity in these cities are bleak. It may safely be assumed that urban and peri-urban farmers increasingly will use wastewater for irrigation, irrespective of the municipal regulations and quality standards for irrigation water.

IWMI's past and ongoing studies in Pakistan, India, Ghana, Vietnam and Mexico have demonstrated the clear livelihood implications of wastewater irrigation while highlighting the human health and environmental impacts. Thus appropriate strategies for minimizing the risks and maximizing the benefits will contribute to the general well-being of the farmers as well as the consumers of the farm products.

Some of the management options identified with partners and stakeholders include improved health safeguards, cropping restrictions, blending wastewater with freshwater, appropriate irrigation techniques, primary stabilization or other low-cost alternatives, and pollutant source management. Farmer/consumer education on risk management strategies (e.g., appropriate choice of crops and appropriate selection and timing of irrigation techniques) and improved institutional coordination (especially between urban authorities, agriculture, and health and sanitation sectors) are equally important. However, institutions and individuals who lead wastewater treatment and sanitation globally have largely ignored the practice and its implications. The conference attempted to bridge this division by setting up a focused discussion on these issues based on the individual experiences of a wide range of participants and data that will be presented on water resources and quality, agricultural production, human health and ecological impacts.

Against this background the organizers chose to focus this electronic conference on the strategies that may be applied to reduce the health risks associated with the **use of untreated, partially treated or diluted wastewater in agriculture** whilst maintaining or enhancing the social and economic benefits for the poor urban citizens involved in irrigated production.

Rather than focusing on (end of pipe) treatment of wastewater, the emphasis of the discussion was on:

1. Strategies to ensure proper health risk management by the users of the untreated or partially treated wastewater.
2. Strategies to prevent and reduce chemical pollution by industries of domestic sewage water and rivers that are used for irrigation.

OBJECTIVE

To exchange, analyze and discuss strategies—as alternatives or complements to wastewater treatment—to reduce the associated health and environmental risks of using "untreated" urban wastewater in agriculture while maintaining or enhancing the socioeconomic benefits.

PARTICIPANTS

The conference was designed as a platform to facilitate exchange of experiences and debate between:

- Urban planners, representatives of municipal departments and policy advisors.
- Researchers (universities, research centres, and thematic networks).
- Technical staff of NGOs, international and local projects, and other persons that have interest in these issues.

THEMATIC AREAS AND KEY ISSUES

The discussion was divided into two topical areas.

Topic 1 focused on strategies to ensure proper management by the farmers of the health and environmental risks associated with the use of untreated wastewater.

To stimulate discussions, questions were posed to the participants on aspects such as: the relevance of developing a typology; quantifying health and environmental impacts; assessing the socioeconomic costs and benefits and the effectiveness of policies, regulations, and the institutional mechanisms for dealing with issues; the effectiveness of using water and crop quality monitoring, and farmer education and technical assistance as a tool for minimizing risks; the nature of standards to be set; and the strategies and solutions proposed by the farmers themselves.

Topic 2 focused on strategies to ensure prevention and reduction of industrial contamination of domestic sewage and rivers that are used for irrigation.

For this discussion, answers were sought for questions dealing with: the increasing discharge of industrial wastewater in developing countries; the possibilities for separating industrial and domestic wastewater in sewers; the capacity of local authorities to detect and monitor pollution; the barriers faced by industries in reducing waste generation and increasing recycling the possible strategies; the extent to which enforcement of regulations resolves the issues; and to what degree the provision of information, technical assistance, and economic incentives plays a key role. Questions on the potential for farmers and NGOs to play a role and the strategies provided by the local industries were also raised for discussion.

METHODOLOGY

RUAF developed the conference website and made the announcement about 2 weeks before the start on June 24, using the mailing lists of both IWMI and RUAF. For each topic a lead discussion paper was developed and circulated before the conference. Brief contributions at the start of each week were posted to the conference by invited resource persons. These indeed acted as triggers and the discussions were quite well animated from the start of the conference. The website carried the announcement, all postings, each week's summaries as well as the background papers and information.

The conference itself was divided into two sessions. During the **first week** of the conference the focus of the discussions in both topics was to be on the **analysis** of the actual situation and trends and the analysis of the effectiveness of certain strategies.

During the **second week** of the conference the discussion was to have more emphasis on the **formulation of recommendations** for policy development and action planning. The discussion in reality did not adhere to this rigidly, nor did it adhere rigidly to the two topics outlined—with some of the topic 2 issues being discussed in topic 1, and vice versa.

In total 333 participants, from 72 countries registered, and many more followed the discussions by visiting the RUAF website on the Internet. The participants were not as diverse as expected with predominance from research institutions and universities. A livelier debate would have ensued had there been better participation of policy makers and practitioners. The number of contributions received for the discussions was 143, and about 21 papers were added to the section "Background papers" of the Conference website. These are encouraging numbers, indicating a strong interest to gain access to and discuss alternative approaches and methods, which can be applied to ongoing or future projects.

The large number of contributions and papers submitted over the past 2 weeks has certainly enriched the methodologies, tools and techniques, which can be used to understand and contribute to strengthening the process of further work and developing pragmatic interventions.

Several very important points did emerge that have more wide-ranging implications for HOW we go about understanding the existing situations, doing research, supporting planning processes or conducting monitoring and evaluation activities with urban farmers and gardeners.

SYNTHESIS AND RECOMMENDATIONS FOR TOPIC 1

The two-week discussion centered on the following topics:

1. Socioeconomic benefits of wastewater use and the issue of pricing it.
2. Costs of wastewater use from a health and environmental risk perspective.
3. Risk management strategies which include:
    a. Regulation of irrigation water quality and the problems related to setting stan dards and monitoring
    b. Facilitating change through awareness raising, education and providing rel evant and timely information to target groups
    c. Crop selection and certification of produce (labeling)
    d. Improving irrigation practices and the limitations thereof
    e. Chemotherapy of affected persons
    f. Providing alternative sites and sources of water for relocating affected farm ers
    g. On-farm complementary treatment
    h. Remediation of heavy metal contamination of soils
    i. Participation of stakeholders in decisions relating to wastewater use for maxi mum impact —applying the concept of acceptable risk levels, or providing "response scenarios"
4. Role of researchers in improving the practice of wastewater agriculture.

SOCIOECONOMIC BENEFITS OF WASTEWATER USE AND THE ISSUE OF PAYING FOR WASTEWATER TREATMENT

Social benefits of wastewater use have been addressed under the notion of the livelihoods generation capacity of wastewater agriculture, the employment opportunities offered to women through vegetable cultivation thanks, to the availability of wastewater, and the different layers of society that benefit from it (the case of the Musi River peri-urban agriculture system is stated). In this regard, the potential to reduce urban poverty provided by wastewater agriculture must be understood and attempts made to associate wastewater use initiatives with poverty alleviation programs of donors.

Quantification of the **economic benefits** was made through the following examples:

- Farmer cooperation mechanism in Pakistan, whereby the price of wastewater was fixed through a unified bid when it was being auctioned by the municipality.
- Wastewater is synonymous with availability at low cost throughout the year in the case of Pakistan, which allows farmers to be in control over timing of water application to crops. However, this sometimes resulted in over-application.
- Comparative studies in Pakistan show cost savings related to water price and fertilizer use, and higher land rents for wastewater farmlands indicating the value given to wastewater farming.
- Some researchers suggest that wastewater application to land may be an alternative to treatment plants provided that monitoring of impacts is undertaken. Such application in the case studied in Pakistan had, so far, not shown adverse health effects, but confirmation of this result requires further monitoring over longer periods.
- Farmer's willingness to pay for untreated and not treated wastewater was shown in the case of the Indus River, which is cited as an example.

On the issue of **paying treatment costs** of wastewater, the possibility of **cost sharing** between residential communities and farmers was raised. Residents should pay not because they are the generators but because the water has a value for farmers as the users, and it was suggested that they contribute to the treatment cost. Treatment costs could be reduced substantially through applying cost-effective treatment technology and applying the treated wastewater to commercial crops, which would generate some of the treatment costs. Alternatively, farmers could treat the wastewater themselves before using it for growing vegetables, as shown in a Latin American study, (but this supposed secure land tenure); or let private companies bid for wastewater treatment and resale opportunities.

COSTS OF WASTEWATER USE FROM HEALTH AND ENVIRONMENTAL RISK PERSPECTIVES

From a health risk perspective all of the following were cited as posing health risks:

- Hookworm infections
- Disposable needles and syringes from contamination with hospital waste
- Gastrointestinal diseases
- Mosquito breeding in wastewater disposal and reuse schemes
- Giardia infections
- Entamoeba histolitica
- Salmonella

On farmer response to health risk, it was suggested that observable health risks are better understood by them than non-observable, abstract concepts (bacteria, heavy metals, etc.).

An idea was conceived that contamination also occurs during transport, processing and sale of consumable products, which might be more important than direct contamination.

In some of these cases, the studies may not be conclusive. Some participants have indicated the need for more research on the actual health impacts of use of wastewater on consumers and workers in production and processing/marketing of products.

The exposure of women to the hazards of wastewater poses the additional risk of rapid disease transmission to family members through contaminating food during preparation on their return from the fields.

From the perspective of possible environmental risks and associated costs, the following were discussed:

- Risk of pollution of groundwater if wastewater flows continuously.
- Steady reduction in yields and crop diversity and soil quality (permeability) after initial increases due to salinization of the soils.
- Reduction in fruit quality.
- Increased incidence of weeds.
- Heavy metals, especially Cadmium.
- In arid and semi-arid areas, the introduction of wastewater agriculture can have profound effects on crop pest reproduction cycles and populations.

In the light of data available on the negative health impacts (higher incidence of certain infections in children in areas where wastewater is used), do we accept health problems as inevitable? Countering this was the query about increased incidence when untreated wastewater was used and its comparative seriousness with respect to other predominant/existing risks in the context of these countries.

RISK MANAGEMENT STRATEGIES

Regulation of irrigation water quality and the problems related to setting standards and monitoring

Regulation of irrigation water quality through enforcing guidelines was found to be unsatisfactory in the context of developing countries because livelihood issues are overlooked. The present WHO guidelines applicable to treatment plants are not satisfactory in conditions where irrigation water is contaminated with wastewater, or where treatment is not an option and wastewater is the only source of irrigation water. Participants called for the development of new guidelines for untreated or diluted wastewater which are designed to be flexible so they can be adapted to the local conditions. A case of reasonable application of guidelines was exemplified in Latin America where water quality in terms of nematode eggs was limited to the best available technique under local conditions.

The approach of "acceptable risk levels" was proposed as a viable alternative, as was the concept of "response scenarios" for areas with similar conditions, that would assist municipalities identify appropriate risk reducing strategies. This idea supports the approach outlined in the Adelboden diagram for minimizing risks.

Utilizing current maximum permissible levels for heavy metals in sewage as the acceptable level for irrigation water was suggested as a way to render the guidelines more applicable. It was also suggested that globalization of food markets may lead to stricter health and irrigation water quality regulations being applied in view of export markets.

Convincing national authorities of these approaches is as important as setting suitable guidelines.

Facilitating change through awareness raising, education and providing relevant and timely information on best practices

Many viewed targeted health education as the most realistic, practical and cost-effective measure to reduce health risks associated with wastewater use in agriculture. The following categories and topics were mentioned:

- *Policy makers:* convince them that the use of wastewater is a reality that has to be accepted; provide them with data on food security, income generating capacity, health and nutrients aspects of wastewater use in agriculture; show trade-offs of costs and benefits of wastewater treatment and reuse in agriculture, co-management of water provision, sanitation, treatment and reuse, and strategies for handling wastewater from the source to the users.
- *Farmers:* provide information through interactive learning methods on health risks associated with wastewater use, information and technical assistance on proper crop selection in relation to wastewater quality, irrigation techniques, protective clothing (boots), personal hygiene, washing crops before marketing, group organization for on-field sanitation and washing facilities; preventing damage to soils and groundwater.
- *Consumers:* inform them on proper washing, cooking or blanching of vegetables, sufficient cooking time for fish raised with wastewater, and the necessity of paying for treatment of household wastewater as they are the generators.
- *Tradesman:* use of clean water for freshening products (vegetables) on the market; ways for minimizing contamination risks during transport and processing.
- *Local authorities:* help them understand the implications of wastewater use and the role they can play in minimizing the risks. An example of good practice adopted by local authorities in Uganda integrates health messages in local committees with responsibility for urban management.

The NGOs and media may have to play a vital role in this exercise, if authorities are slow to take the lead.

Crop selection and certification of produce (labeling)

Variations in absorption of certain chemicals by crops makes crop selection a suitable strategy, in the absence of market forces which discourage crop restriction.

Offering financial incentives, i.e., labeling clean products, which will fetch higher prices, is also a possibility provided customers are willing to pay more and certification programs, which are costly processes, can be set up.

Improving irrigation practices and the limitations thereof

Irrigation techniques that wet only the roots and not the leafy part of vegetables were suggested as a good practice for minimizing the risk of contamination. Bed and furrow irrigation, drip systems and other techniques, applying water close to the root systems were suggested. There is a further advantage in that there will be less infiltration into groundwater. Rotating wastewater application over fields, if this is possible, is another means to limit over-fertilization and pollution of groundwater. Avoiding irrigation with wastewater in the 2 weeks before harvest can minimize the risk from pathogen contamination of leafy vegetables, but this necessitates a freshwater source accessible to farmers, which is rarely possible in these peri-urban situations.

Therapy of affected persons

De-worming campaigns have been suggested as a cheaper alternative in cases where treatment of wastewater or regulation of its use is not possible.

Linking urban planning to urban agriculture—providing alternative sites and sources of water for relocating affected farmers

Viewing cities/urban areas as closed systems would necessitate finding a positive use for the waste produced within the system. In this context, obtaining recognition for urban agriculture as an integral part of urban design would ensure that the potential for waste use and closing the nutrient cycle that urban agriculture provides is realized.

Urban agriculture is also the major source of food for cities. One consequence of recognizing this might be the provision of alternative sites and sources of water for farmers producing food for cities using wastewater.

On-farm complementary treatment

In cases where regulation of water quality was possible, on farm treatment options were suggested as complementary measures in instances where city treatment of wastewater did not achieve the desired standards for restricted crops, and farmers who wish to cultivate such crops would require to treat the water further.

Remediation of heavy metal contamination of soils

Of all toxic wastes emanating from industry, heavy metals were seen to cause the highest risk to certain consumable crops and remediation techniques were discussed. Among them were liming, and other methods for minimizing the phyto-availability by increasing adsorptive and retention capacity for the contaminant in the soil.

Participation of stakeholders in decisions relating to wastewater use for maximum impact

Open dialogue and negotiations between urban citizens, urban and peri-urban wastewater farmers, municipalities, sanitation technicians, consumers and other stakeholders will result in practical and implementable solutions with regard to wastewater use. This could take the form of local democratic committees with representation from all stakeholders. This would also allow for jointly defining acceptable risk levels with the people at risk, for setting health guidelines on wastewater use.

ROLE OF RESEARCHERS IN IMPROVING THE PRACTICE OF WASTEWATER AGRICULTURE

A more holistic integrated, multidisciplinary approach to understanding all the implications of wastewater use was called for. The importance of developing a typology of wastewater/farmers to address issues in a concerted and universal manner was highlighted. The role of scientists and researchers should be to provide knowledge and information on the "current best practices" and communicate this information in a form that is understandable to the different stakeholder groups. Effective outreach to policy makers is also a role for the scientific community. Research on wastewater use in urban and peri-urban agriculture should be better focused and more participatory and action-oriented.

SYNTHESIS AND RECOMMENDATIONS FOR TOPIC 2

Water used for agriculture, particularly in the urban and peri-urban contexts, is often polluted by domestic and industrial sources. Often these wastes are combined in the city drainage and sewerage systems and together pollute agricultural water sources. Whilst domestic sewage, in spite of posing a risk from pathogens, has the advantage of containing nutrients, most industrial wastewater only poses a health risk from chemical contaminants. Limiting the mixing of industrial wastes in domestic sewage is one means of reducing risks from exposure to chemicals.

The two-week discussion centered around the reasons **why domestic sewage is contaminated with industrial wastewater, possible solutions to avoid such contamination, and low-cost options and methods for treatment** of wastewater that may or may not be a mix of domestic sewage and industrial wastewater.

The reasons why domestic wastewater contains industrial contaminants:

- Lack of planned segregation of industrial wastes and city wastes was evoked, the reason for this being that city planning is deficient; none or insufficient industrial estates to segregate these waste generating industries are in place, the scattered nature of small industries which are nonetheless polluting in large numbers, and the pattern of urban development make it difficult to find solutions.
- No impact studies done (Mali is an example) and there is no monitoring of waste sources.
- No enforcement of in-country existing regulations on pollution control and waste management, often as in the case of Nigeria cited, due to lack of technical and financial capacity.

- Resistance of industry to invest in treatment at the source, unless the authorities regulate seriously with consequences to the industry; or they provide financial and other incentives to industry to minimize pollution.
- Sometimes a lack of awareness/information particularly at industry level about pollution from industrial sources, methods to minimize waste generation, benefits from waste recycling and use.

Discharge of industrial effluents in watercourses in Latin America will increase in the next decade due to increasing activity in the informal sector and poor enforcement capacity. The lack of emphasis for health and environmental protection and the adoption of inappropriate standards will prevent the control of such discharges.

The discussion then proposed possible solutions:

- Better planning of industrial and urban development. This includes siting industries in estates, registration and regulation.
- Regulation through providing economic incentives to industries for on-site treatment and waste management.
- Providing information to industries, improving communication between industries and regulators, and working with industries to increase their awareness about the consequences and the approaches available to improve the quality of industrial wastewater.
- Providing information to farmers on appropriate techniques and technologies that help minimize health risks to them and consumers from industry-contaminated wastewater.
- Involving farmers, the public, other affected persons in campaigns/demonstrations and utilizing the media, to pressurize industries to take action.
- Monitoring the quality of wastewater discharges for regulation purposes and for waste management information systems; and developing and applying integrated waste management and reuse systems, adapted to the localized situations.
- Encourage better wastewater handling through combined and concerted efforts of municipalities, households and industries working together to find complementary solutions.

Application by industries of waste minimization strategies is limited due to unfair competition from some industries that avoid all forms of taxation and pollution control. Economic incentives can have a positive impact in changing behavior towards a more environmentally friendly conduct. NGOs can play a positive role in promoting public concern about the necessity for adequate treatment and encouraging its productive use in agriculture.

The main impacts mentioned, of industrially polluted wastewater on urban agriculture sites, were from soil salinization and heavy metal accumulation. Heavy metals accumulate in soils and in crops like potato. Initial positive responses, like increases in yield and productivity, are followed by reduction of yields with high salinity. Uncontrolled long-term loading of Cd, Zn, Pb, Hg, As, Cu, Cr^{6+}, Ni and Mn in agro-ecosystems will reduce yields and crop quality. Further, elevated levels of heavy metals in soils significantly reduce soil bio-diversity and consequently biologically driven soil nutrient re-cycling processes and plant-soil symbiotic relationships.

Solutions suggested were:

Lime application to acidified soils, restricting the cultivation of crops susceptible to accumulations depending on their physiognomy, and applying other methods like phyto-extraction. Treatment using kaolin, with farmer collaboration has been tried on an experimental basis.

One possible integrated approach to address the existing situation is to apply waste management principles at the generation points (households, industries, commercial establishments, hospitals) and the user points (farms) so that overall relative quality improvements are achieved.

Low-cost options and methods for treatment of wastewater:

In most developing countries, the lack of financial resources limits the construction of treatment facilities (low cost or otherwise) and even when they exist, operation and management of the systems is constrained by finances. The solution may be to find treatment alternatives that are robust enough to stay operational at moderate cost.

Stabilization ponds still remain the most cost-effective technology, which also removes pathogens. In this regard, activated sludge plants require 80 percent more investment than stabilization ponds and are not capable of meeting health guidelines.

Other environmentally friendly techniques (landscape techniques) like bio filters were discussed.

THE ORGANIZERS

ETC - Resource Centre on Urban Agriculture (RUAF)

ETC International is an independent professional non-profit organization that executes programs and projects, implements studies, gives policy advice and organizes training.

ETC's main objectives are to encourage and support local initiatives aimed at sustainable development, to strengthen local institutions and the participation of local stakeholders in the formulation and implementation of adequate policies and programs for sustainable rural and urban development.

ETC has a strong record in natural resource management, low external input agriculture, sustainable energy, and integrated land use systems, both in rural and urban environments.

The Resource Centre on Urban Agriculture and Forestry (RUAF) is funded by DGIS (Directorate General for International Development Cooperation of the Ministry of Foreign Affairs, The Netherlands) and IDRC (International Development Research Centre, Canada).

RUAF aims at integration of urban agriculture in the policies and programs of national and city governments and international organizations by:

- Collecting and disseminating research data and project experiences in the field of urban agriculture, maintaining databases, publication of the *Urban Agriculture Magazine* and the maintenance of a website (www.ruaf.org).

- Promoting networking and exchange of experiences and debate on key issues in the field of urban agriculture by organizing electronic conferences and international workshops in collaboration with regional institutes and networks.
- Provision of assistance to regional and local partners in the organization of policy seminars and training workshops and the formulation of policies and action programs
- ETC-RUAF closely cooperates with regional institutes that act as regional focal points on urban agriculture: UMP-Lac (Latin America), MDP (South and East Africa), IAGU (West Africa), CEDARE (North Africa and the Middle East), IWMI-India (South East Asia) and DUR (China).

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IWMI (International Water Management Institute)

IWMI is a non-profit international scientific research organization focusing on the sustainable use of water and land resources in agriculture and on the water needs of developing countries. IWMI works with partners in the South to develop tools and methods to help these countries eradicate poverty through more effective management of their water and land resources.

Its mission is: Improving water and land resources management for food livelihoods and nature, for which it has set itself the following objectives:

- To identify the larger issues related to water management and food security that need to be understood and addressed by governments and policy makers.
- To develop, test and promote management practices and tools that can be used by governments and institutions to manage water and land resources more effectively, and address water scarcity issues.
- To clarify the link between poverty and access to water and to help governments and the research community better understand the specific water-related problems of poor people.
- To help developing countries build their research capacities to deal with water scarcity and related food security issues.

IWMI's research is organized around five themes that are:

- Integrated Water Resource Management for Agriculture
- Sustainable Smallholder Land and Water Management
- Sustainable Groundwater Management
- Water Resource Institutions and Policies
- Water, Health and Environment

- Promoting networking and exchange of experiences and debate on key issues in the field of urban agriculture by organizing electronic conferences and international workshops in collaboration with regional institutes and networks.
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IWMI has research projects running in 21 countries in Asia and Africa.Work is coordinated through regional offices located in India, Pakistan, South Africa, Sri Lanka and Thailand.

The Institute has sub-regional offices in China, Nepal, Ghana, Kenya, Senegal and Uzbekistan.

The Institute has a multidisciplinary approach to water management research. Most of IWMI's research combines the expertise of economists, agronomists, hydrologists, engineers, sociologists, management specialists and health researchers. The *research team* is composed of approximately 100 scientists from 16 different countries. IWMI is a member of the Future Harvest group of agricultural and environmental research centres and receives its principal funding from 58 governments, private foundations, and international and regional organizations known as the Consultative Group on International Agricultural Research (CGIAR) that contribute to poverty eradication.

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