

**An Overview of Public Health and Urban Agriculture:
Water, Soil and Crop Contamination & Emerging Urban Zoonoses
(Includes Institutional Directory and Annotated Bibliography)**

by

Kathleen Flynn

International Development Research Centre (IDRC) Intern

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FIGURE 1 : The Life Cycle of *Echinococcus granulosus*

Executive Summary

This report provides an initial exploration into the potential health hazards associated with various practices in urban agriculture and highlights research which endeavours to protect producers and consumers from these hazards. A good deal of the material on urban agriculture has stressed its ecological, economic and nutritional benefits. The work to date by IDRC and their associates have fostered political and community support for urban agriculture in several cities in the South. However, many municipalities and researchers continue to have concerns about urban agriculture. Researchers and IDRC consultants, for example, have indicated in their assessments of urban agriculture that health hazards are an understudied area (Chimbowu and Gumbo, 1993; Lamba, 1993; Sawio, 1993, 1998; Greenhow, 1994; Bohrt, 1993, Mougeot, 1998). Identifying and dealing with potential health risks not only offers critical support to producers and consumers in urban areas, but also helps to dispel biases against urban agriculture. This report is intended to be a reference source for urban agriculture, health, and non-health practitioners and specialists.

The list of health risks identified by local and international researchers includes a wide array of potential hazards and sources of harm. These include: the use of untreated human and animal waste, reuse of urban waste, wastewater reuse, heavy metal contamination in soils and irrigation waters, vector breeding pools, air pollution, pollution from chemical and industrial byproducts, hospital wastes and zoonotic diseases. CFP has sponsored numerous projects on the reuse of urban waste in cities in Morocco, Mexico, India, Vietnam and Ecuador (see Dennerly, 1995 for more projects). IDRC has also extensively examined technologies for wastewater treatment and reuse (Rose, 1999). However, urban agriculture may have health hazards which are unique to city farming or which are intensified by urban conditions. Sawio (1998) in his study of urban agriculture in Dar es Salaam lists urban livestock keeping and heavy metal contamination as two key health concerns for urban agriculture. These are two problems which may present unique health risks in densely populated and informal settlements.

There is also an important gender dimension to understanding health hazards. CFP researchers and its partner institutions have indicated that in some cities women represent the majority of urban farmers. It is therefore logical that women's positions as producers, as well as their important role as family health care providers (particularly since the implementation of economic reform programs like structural adjustment) provide for gender disaggregated knowledge of health hazards and preventative measures. Likewise, the division of labour in farming activities exposes men to risks which women may not encounter. It is therefore essential that researchers and organizations incorporate gender analyses into their projects. This report will include references to material which focuses on the gender dimensions of this problem and ways to incorporate gender into health research.

This report will be divided into three sections:

Section One: An Overview of Public Health and Urban Agriculture: Water, Soil and Crop Contamination & Emerging Urban Zoonoses reviews research and literature on two key health concerns: contamination of soils and irrigation waters from heavy metals, industrial and pollutants; and zoonotic risks in urban areas. These are two areas of potential harm which CFP team members feel are particularly understudied.

Section Two: Directory of Institutions and Organizations lists institutions who are conducting research on health risks and hazard prevention in (urban) agriculture. The list will include organization names, website addresses and selected project titles.

Section Three: Annotated Bibliography is an annotated bibliography for urban agriculture and public health. It presents a compilation of selected readings organized topically for easier reference. At the end of this report I have included a glossary of the technical biological, chemical and epidemiological terms I have used throughout this report.

SECTION 1:

An Overview of Public Health and Urban Agriculture: Water, Soil and Crop Contamination & Emerging Urban Zoonoses

Abstract and Key Findings of Section 1

This report reviews the available literature on two public health concerns identified by CFP partners and researchers in Africa, Asia, and Latin America: contamination of water, soil and crops, and emerging urban zoonoses. It is an initial exploration of the public health impacts of urban agriculture which discusses issues of assessment, protection and intervention. The report also reflects on the conceptual issues that must be considered when studying public health and urban agriculture. Further research into all of the public health issues is required to assess ways in which the urban environment or urban agriculture practices impact on the health of practitioners and consumers, and the ways in which urban agriculture can contribute to improvements to public health through environmental recovery. The main conceptual issues, and findings from the literature review are summarized below.

Conceptual Framework:

- ◆ Gender Analysis: disaggregated risks and knowledge of public health; struggles over capital and human and natural resources
- ◆ Food Security: motivations for urban agriculture; survival strategies; primary and secondary income generation
- ◆ Urban Environments: geography of risk; industrial byproducts; dense populations; informal settlements
- ◆ Political Economy: struggle over resources; location of hazardous waste sites vis. lower income areas

Contamination of Water, Soil and Crops:

- ◆ Strong scientific research record on assessment of contamination and detailed analysis for different crops
- ◆ Protective measures emphasize agricultural zoning; garden planning and soil management using simple methods
- ◆ Future research should include analysis from the social sciences with a focus on the political economy and gender aspects of this problem

Emerging Urban Zoonoses:

- ◆ Zoonoses that were formerly regarded as rural diseases are emerging in urban areas
- ◆ Research record is small but there is a sufficient number of studies to suggest that this should receive more attention
- ◆ Brucellosis and echinococcosis in urban areas have been explicitly linked with animal husbandry and slaughtering practices in densely populated areas
- ◆ Intervention must be culturally appropriate and give due consideration to the social and political complexity of urban communities and households

Introduction to Section 1

Since 1997, the Cities Feeding People (CFP) Program Initiative has been funding projects and research which support and promote urban agriculture. The program in the first three years has concentrated on capacity building; regional networking and raising municipal, regional and international support for urban agriculture. The program builds on work sponsored by IDRC since the early 1980's within social sciences, urban management, and environment and natural resource management. Projects have focused on the benefits and opportunities for urban agriculture: improved nutrition, income generation, recycling of urban wastes etc. The constraints and potential environmental and health hazards have been recognized but, with the exception of wastewater reuse and some aspects of human excreta reuse and waste management, the extent of the potential problems and prevention has been under-researched. Over the next three years, CFP is also committed to concentrating on the economic and health aspects of urban agriculture.

This section focuses on the potential health hazards associated with urban agriculture practices. The purpose of this report is to identify and review the literature on some specific health hazards related to urban farming practices and discuss practical ways to address these problems. Very few studies have dealt explicitly or sufficiently with the potential health hazards in urban agriculture. In peri-urban resource management, the work of Birley and Lock (1998a, 1998b) on health and natural resource management in peri-urban areas stands alone as a comprehensive study with an exclusive focus on health. Addressing the potential hazards is essential first and foremost in order to protect producers, their families and consumers from contaminated foods and occupational hazards. However, addressing these potential health hazards will also help to secure the support of municipal authorities and state officials who have remained wary and sometimes even hostile to urban agriculture because of actual and perceived health and environmental risks. According to Smit, Ratta and Bernstein (1996: 197), “[i]t is vital for supporters of urban agriculture to face these potential problems head on because they can have the effect of reinforcing the sociocultural biases against urban agriculture”. In some cases the public health hazards associated with urban agriculture are the result of specific agricultural practices which introduce new areas of risk. However risks are also related to urban environmental factors which expose producers, food handlers and consumers to areas of contamination. However, in this case, farming is just one of several activities which exposes urban dwellers to these environmental hazards. The list below summarizes the potential health hazards identified for CFP by regional researchers in Africa, Asia and Latin America (see Cities Feeding People Series, Reports 1-7 and 14):

- contamination of crops grown on polluted soils or irrigated with river water contaminated with industrial and chemical byproducts
- microbial and heavy metal contaminants in untreated or improperly treated urban waste and human and animal excreta used in agriculture
- zoonotic diseases associated with urban livestock keeping
- the use of agrochemicals in confined urban spaces

- encouragement of vector breeding sites.

While many of these health risks are also concerns for rural agriculture, the unique geography of urban centres, particularly in the South, may intensify these health hazards resulting in health transition diseases¹; or facilitating the spread of these diseases and health risks among the densely populated settlements.

This section of the report is divided into three parts.

Part 1: Urban Health - Geography, Culture, and Gender discusses some of the conceptual issues involved in urban health research, with particular reference to the urban environment, social geographies, and gender issues. The two parts that follow, **Part 2: Contamination of Irrigation Water, Soil, and Crops** and **Part 3: Urban Zoonoses** present a review of the literature on two specific health issues. These sections expand on the conceptual issues, and review available knowledge on environmental and health risks, and preventative measures. These two health issues were selected from the list of health hazards because they are two areas of potential harm which CFP team members feel are particularly understudied in terms of conceptual and practical issues in urban agriculture research.

References for other health hazards identified by CFP researchers are included in **Section 3: Annotated Bibliography** of this report. Following the annotated bibliography there is a glossary of the terms used throughout this report; I refer readers to this glossary for explanations of the technical and health terms used in this paper.

1.0 Urban Health - Geography, Culture, and Gender

This report will focus on two of the health risks identified by regional researchers: public health risks associated with urban agriculture practiced in areas contaminated by industrial and chemical pollutants (Part 2); and zoonotic diseases associated with urban livestock keeping (Part 3). These two health hazards are particularly serious because of the nature of urbanization in the South. As Doreen Massey (1997: 100) indicates, urbanism for the majority of the world's city dwellers in the year 2000 will be characterized by increasing populations living in squatter settlements, shanty towns, favelas, and slums. CFP recognizes that urban agriculture is often a strategy for food security among the urban poor and that often it is practiced in open spaces such as roadsides and traffic circles, vacant and abandoned land, and in crowded informal housing communities (Mougeot, 1998).

¹Health transition diseases refers to those diseases which were formerly regarded as rural diseases and are now appearing in urban areas

Hardoy and Satterthwaite (1997) Kettel (1996) and Songsore and McGranahan (1998) have shown in their respective research that there is a geography of inequality in aspects of human and environmental health in urban areas that is influenced by socio-economic status, age, gender and migrant status. David Harvey (1997: 68) even attests that, “the best predictors of the location of toxic waste dumps in the *United States* is a geographical concentration of people of low-income and colour” (emphasis added). Likewise, Hardoy and Satterthwaite argue (1997: 140), “[t]he people who are most vulnerable to environmental hazards are those least able to avoid them”. Kettel, and Songsore and McGranahan have indicated that the nature of this vulnerability makes gender-sensitive research critically important. Kettel suggests that an appropriate gender-sensitive framework for research and policy is one that focuses on women’s and men’s interaction with their biophysical environment. Such a focus uncovers gender-disaggregated risks, as well as gender disaggregated knowledge regarding the management of the environment. Moreover, she claims that women also *manage health* through their roles as family care-givers which provides them with additional experiential knowledge of common environmental illnesses (1996: 1367-68). According to Kettel (1996: 1368), “[a] gender-sensitive approach to environmental and health policy formulation is a significantly lower cost alternative”.

Songsore and McGranahan (1997) have made complementary arguments which they have applied to a case study of gender, environment and epidemiology in the Greater Accra Metropolitan Area. Their research focuses on the environmental health risks in households and compounds. In this study they combined qualitative results from in depth interviews of men and women, with quantitative data from medical examinations. Their study revealed that there is a geography to health risks that is related primarily to gender and economic status. According to Songsore and McGranahan (1998: 395), “... most of Accra’s low income households face a far more burdensome set of local environmental problems than their counterparts in wealthier neighbourhoods and cities”. They argue that household environmental health risks to poor women are higher because they spend more time in and around the household, while men spend more time away from the home. Without denying the porous nature of the household environment, Songsore and McGranahan illustrate that “... the household and other local socio-spatial constructs are of considerable importance to both environmental management and disease transmission” (1998: 397). Their quantitative results more than confirmed the qualitative findings which indicated that women face much greater risks related to environmental health within the domestic sphere. Included in the health concerns Songsore and McGranahan are: water and sanitation; insect vectors and pest control methods including the use of aerosol pesticides; crowded conditions; and respiratory illnesses and poisonings related to indoor air pollution from cooking fires. Their work does not reflect specifically on urban agriculture, however it uncovers much useful information about urban environments. It is not difficult to apply their conceptual arguments to urban agriculture research and policies. Focusing on the geography of urban cultivation and the gender divisions of labour in urban agriculture uncovers gender-disaggregated knowledge of risks and environmental management.

Understanding why people farm on contaminated soils or use contaminated water (even where they may have been warned of the potential hazards) is essential for successful intervention and

capacity-building projects. The Royal Tropical Institute (KIT) project on human excreta management in Mali (Visker, 1999: 17) demonstrates the importance of understanding motivating factors. They describe the difficulties faced by emptiers (*vidangeurs*) who feel they have no choice but to empty temporarily stored human excreta on vacant lots and agricultural fields, despite laws against such practices, because there is no final discharge depot. Visker indicates that these practices, which create new points of contamination, continue despite harassment from authorities in Bamako and occasional protests from farmers. This case demonstrates the importance of researching the constraints which may limit actors' choices. For urban agriculture this has sometimes meant that health and safety are not high priorities in the face of household food and income needs.

Understanding the complexities of urbanism is important to consider in defining and dealing with the health hazards identified in this paper. What does urban livestock keeping mean for example in terms of the conditions and constraints of the urban environment, crowded urban settlements and social relations in a given place: how is the disease transmitted; who is it at risk; how can practical health interventions be conceptualized and implemented. Likewise, research must be contextualized in an understanding of the various motivations for farming in the city, with due consideration of the factors which constrain farmers from engaging in safer practices. It also means that researchers must situate public health within the context of other struggles over human and natural resources, infrastructure and institutional or government support. These considerations provide the conceptual grounds from which I have explored public health aspects of urban agriculture in the remaining sections of this paper.

2.0 Contamination of Irrigation Water, Soil, and Crops

Crop, soil, and water pollution from industrial and chemical byproducts can pose serious health risks within the urban food system. These risks to men, women, and especially children, range from occupational hazards from exposure to toxic elements while farming, handling and distributing food (and non-food) crops, to the short and long-term effects of consuming foods contaminated by heavy metals. The sources of heavy metal pollution in soils are plentiful and include: irrigation especially with sewage; solid waste disposal (sludge and compost refuse); fertilizer and pesticide application; and atmospheric deposition (Huamain et al.: 130). Hardoy and Satterthwaite (1997: 133) indicate that chemical pollution is one of the four most pressing urban environmental concerns as industrial and chemical pollutants are often disposed in local bodies of water or vacant land without adequate measures to protect human health. They claim, "reports from Third World cities of severe health problems arising from human contact with toxic or hazardous wastes are increasingly common" (Ibid: 133). This is a major issue for urban agriculture, particularly because it is an informal practice which uses empty lands that may be contaminated. The seriousness of this problem cannot be underestimated in light of findings from the World Health Organization (WHO) and Polish researchers who revealed that 60-80% of

heavy metal toxins found in human bodies in urban industrial areas were the result of consuming contaminated foods rather than through air pollution (in Bellows, 1999: 132).

Early reports for CFP (Cities Feeding People Series 1-7 and 14) indicate that exposure to toxic pollutants is a concern for urban agriculture practitioners and municipal authorities. One of the primary health concerns reported at a mini-workshop on urban agriculture in Dar es Salaam in 1993, was the persistent use of hazardous areas for urban agriculture (Sawio, 1998). Sawio reports that farmers continue to farm in the Msimbazi Valley where toxicology reports on the river water have shown that the heavy metal concentrations exceed the regulations set by the Water Utilisation (Control and Regulation) Act² for all but one of the rivers in this valley. However, there are also many sites where urban agriculture is practiced, but soils and waters are not tested. Sawio further states (Ibid: 13), “[s]ince a good number of small plots are in unsuitable areas (e.g. polluted railway-yard, in the harbour area; or around industrial areas known to produce much toxic waste water), health risks are being aggravated”. The land used for agriculture is often on the sites where other informal activities may also be ongoing - a battery recycling business for example; or in traffic circles and roadsides where there is a risk of crop and soil contamination from leaded gasoline. It has even been suggested that for urban agriculture one of the greatest risks may be related to unknown previous use - sites which may have been used as an industrial junkyard, or a former factory; or a site where industrial byproducts are buried. Without adequate records of land use there may be areas of unknown heavy metal contamination (Ken Torrance, personal communication). This type of environmental and public health risk is one which is unique to rapidly changing urban environments - particularly informal settlements. This may also be a distinct risk in urban agriculture as opposed to rural agriculture where previous use is often known. It also demonstrates the links between public health and other sectors such as land use planning.

2.1 Example of Irrigation Water, Soil, and Crop Contamination by Cadmium

There is a wealth of studies for specific regions throughout the world which have tested soils and crops for heavy metal contamination and which suggest practices and methods to prevent contamination or ameliorate soils. Studies in Poland, India, Russia, Taiwan, and China, for example, have shown that heavy metal toxicity is a major concern particularly for cadmium uptake. These studies looked at a variety of plants, testing roots, leaves and fruits for contamination levels. A study in India tested various parts of coconut trees irrigated with wastewater from a paper mill. The tests, which focused on coconut water, roots and leaves, found that heavy metal concentrations for copper, lead, zinc, nitrogen, cobalt and cadmium

²(Tanzania) 1974; Amendment 1981.

exceeded WHO guidelines (Fazeli et al., 1991). The authors, concerned about long-term accumulation and possible carcinogenic and mutagenic effects in humans, conclude “that irrigation of coconut palms with effluents charged with toxic heavy metals be avoided totally to prevent direct or indirect damage to biological communities” (Ibid: 48). Other studies also found food crops that were dangerously polluted by heavy metals. In Taiwan Li, Lai, and Lin (1994:153) highlighted the dangers of cadmium contamination in particular; they claim more attention should be paid to testing soils for cadmium concentrations as the concentrations in plants in this study exceed the tolerance levels for human consumption before causing any phytotoxic effects. The Russian researchers looking at gardens in three Siberian cities likewise flagged cadmium contamination as a special concern particularly because of “... the large number of sources emitting this metal into the environment (including factories of the electronic and metallurgical industries, motor vehicles, and mineral fertilizers) so that the probability of pollution of soil with cadmium is high everywhere” (Il’in, 1991: 112). Concerns over the concentration of cadmium uptake in plants is a serious health concern because of the suspected carcinogenic and mutagenic effects in humans with long-term, cumulative exposure.

2.2 Protective Measures Against Heavy Metals

Many of the studies have detailed countermeasures to protect human health in particular. These include planting advice and ameliorative techniques. Researchers generally recognize that attempting to discontinue cultivation on these soils is not a viable option for most people and that some treatment methods can be quite costly. Researchers have therefore sought ways to avoid harm without compromising the economic stability of households that depend on agriculture. In this paper, I will discuss two protective methods which may be the most suitable in the South in terms of cost and feasibility:

- Strategic garden planning or crop protection through agricultural zoning for sensitive areas (see **Part 2.2.i**)
- Soil amelioration and management (see **Part 2.2.ii**)

While these options appear to be the most appropriate, researchers must carefully consider household priorities, including the intra-household and community level struggles to establish these priorities in terms of access to and management over natural resources and labour.

2.2.i Strategic Garden Planning and Agricultural Zoning

To some extent crop contamination can be curtailed by careful selection of which plants are grown and where in the field they are grown. The research projects I reviewed tested a variety of

fruit, vegetable and non-food plants and trees, testing heavy metal uptake in the various parts of plants. Many studies showed that certain plants were less vulnerable to heavy metal uptake into the edible portion of the plant. The study in Russia for example found that although cadmium overall exceeded acceptable levels, cabbages and tomatoes (two very important vegetable crops) “... successfully protect their storage organs from an undesirable excess of the metal” (Il’in, 1991: 112). Researchers in Poland developed a land assessment ranking which divides farming land near industrial sites into three categories:

- Zone A is a safe zone where all plants for human consumption and pasture can be cultivated;
- Zone B allows for limited activity where crops that are more resistant to heavy metal uptake and do not absorb quantities that exceed tolerable levels for human health; and
- Zone C is an unsafe area where only non-edible plants (flowers, shrubs etc.) can be grown (Kucharski, Marchwinska and Gyzl, 1994: 304).

Two organizations in Palestine - Palestinian Hydrology Group, and Applied Research Institute (Jerusalem) - have also carried-out sensitivity mapping for different aquifers in the region.

In some of the informal communities and peri-urban areas in the South, this type of zoning may not be feasible given the lack of infrastructure and institutional support in these areas. The workshop findings in Dar es Salaam for the Msimbazi Valley (Sawio 1998) demonstrate that farmers may not always follow zoning guidelines or regulations if food security is a higher priority. However, farmers can protect their crops by planning their gardens to minimize absorption. The Developing Countries Farm Radio Network (DCFRN) (Radio Script: 1996) offers advice to farmers planting near roads where lead contamination is a problem. Their suggestions may be more feasible for poor farmers and do not involve (many) additional costs. DCFRN recommends building barriers like small fences or planting flower barriers close to roadsides to absorb lead particles. Where this is not possible due to costs or space, they recommend a carefully planned garden where fruiting crops such as tomatoes, peppers, eggplant, squash, cucumbers and melons, which absorb the least lead to the edible parts, are planted closest to the roadside. Behind these, farmers are advised to grow root crops, and furthest from the road should be leafy vegetables which are the most vulnerable to lead contamination. DCFRN also indicates that cabbage is the least vulnerable of the leafy vegetables as it has a tight head and grows from the inside out. DCFRN presents the simplest methods to protect humans from exposure to dangerous levels of heavy metal contamination through the food chain with minimal economic or labour costs to producers.

2.2.ii Soil Amelioration and Management

Soil management is another countermeasure which may be feasible for poor urban producers. Soil management can involve a number of processes including moisture management, amendment application, mulching, and application of organic matter. According to Huamain et al. (1999: 133), for some elements such as chromium, iron and arsenic, management of soil moisture can help to minimize the heavy-metal uptake in some agricultural products. They found that plants, such as wheat grain, grown on dry soils polluted with arsenic and mercury had lower concentrations of heavy metal uptake than plants, such as brown rice, grown in similarly polluted soils where moisture levels were significantly higher; they found the reverse of these results in cadmium polluted soils. Based on these findings, the researchers recommend careful monitoring of soil moisture and selective planting according to this information. Huamain et al. also found that the transfer of heavy metals to plants was hindered by the addition of salts (133). Their experiments revealed that the addition of salt amendments to soils, such as lime, reduced the arsenic and cadmium uptake in certain crops. However, this strategy must be balanced with environmental concerns regarding salinization.

The suggestions offered by the DCFRN are probably the most germane for urban agriculture in the South. DCFRN recommends mulching and adding organic wastes to manage the toxicity of soils. Likewise, Huamain et al. (1999: 133) found that “[o]rganic matter had an apparent effect on the fixation of heavy metals in soils”. DCFRN counsels farmers to add well decomposed organic matter because lead adheres to the organic waste rather than the plant roots. DCFRN also states that adding lime to soil raises the pH level of soils above 6.5 which hinders heavy metal uptake. They advise farmers on the steps they can take to find the measurements of their soil’s pH from a local extension office. Finally DCFRN informs farmers and consumers on food preparation guidelines which will help to remove the lead from vegetables including peeling and procedures for proper cleansing of vegetables.

2.2.iii Gender Considerations in Association with Protective Measures Against Heavy Metals

The studies on heavy metals and crop contamination focus largely on the bio-chemistry and even when providing information on preventative measures, do not frame their advice within the specific contexts of urbanism and socio-cultural norms. With the exception of the DCFRN, the studies do not reflect on the urban dynamic nor the social aspects of this problem. There is very little reflection on who is affected and under what circumstances (men / women / children / elderly etc.?).

Bonnie Kettel (1996) discusses a conceptual framework which researchers can use to incorporate gender into research and policy analysis which reflects on the interface between health and the environment. This framework allows researchers to consider the complexity of gender analysis which is often framed in simultaneous analysis of age sets and class. According to Kettel (1996:

1368), “[a] detailed understanding of how women’s (and men’s) patterned interaction with the life space they occupy exposes them to health risks is central to articulating and promoting a gender-sensitive environmental health agenda”. Therefore, the question of who does what in urban farming becomes an important factor in evaluating the occupational risks. If, for example, men are responsible for clearing land for cultivation, and this task involves the removal of hazardous debris and initial tilling of the land, their acute risks may be enhanced. By the same token, if women and children are responsible for more of the daily household farming tasks, their ongoing risks of exposure may be significant in another way.

Both Kettel (1996) and Anne Bellows (1995) argue that women’s knowledge of health risks are enhanced by the role they play as primary healthcare providers in many countries. Bellows’ case study from Upper Silesia in Poland, demonstrates the important role that women played, both through their responsibilities in the family and through work as professional scientists, in drawing attention to the serious problem of industrial contamination of soils in gardens and farmers in an industrial area. This resulted in a special program - Tested Foods for Silesia - which tested the soils in gardens for heavy metal toxicity and provided advice to farmers. Work like Bellows’ needs to be incorporated into the biochemical and technical studies if proponents of urban agriculture wish to give adequate support to poor urban farmers. Research is urgently needed which combines the quantitative results of the biochemical studies with in-depth qualitative work on the social, economic, and political circumstances under which urban agriculture has become either a necessity or a viable informal business.

3.0 Urban Zoonoses

A number of the regional reports for CFP have indicated that some municipal authorities and researchers see urban livestock keeping as a public health risk (Cities Feeding People Series 1, 4, 20). Many appraisals of urban agriculture have noted calls by municipal authorities for restrictions on urban livestock keeping because of noise, odours, and sanitation (mainly as a result of animal droppings which are left at roadsides etc.). However, the potential health hazards associated with livestock keeping in general, and urban livestock keeping in particular are more accurately related to the intense, close interaction between humans and animals in densely populated areas, and the lack of appropriate space for healthy practices when slaughtering animals. The relationship between urban agriculture and health transitions in zoonotic diseases is a serious public health concern which has been largely understudied. By health transitions in urban diseases I refer to the increases of typically rural zoonoses in urban areas. Birley and Lock specifically discuss brucellosis, bovine tuberculosis, anthrax, Q fever, echinococcosis and leptospirosis as public health concerns in peri-urban natural resource management (1998a). Likewise, Chimbowu and Gumbo (1993: 10) indicate that urban livestock in Dar es Salaam has exposed people to a wide range of zoonoses. As urban agriculture has become increasingly practiced and urban populations have grown, particularly in informal

settlements, some specialists in tropical epidemiology and medicine have documented the emergence of (formerly rural) zoonotic diseases on a significant scale in urban areas. Unfortunately, there is still a paucity of research which looks at this problem, particularly in terms of urban agriculture. Furthermore, there is little work which addresses the health implications of zero-grazing practices, especially with regards to the disposal of animal waste.

In this section, I will discuss two zoonotic diseases in transition: brucellosis and echinococcosis. These are two diseases on which there is enough information from which to suggest that the changing epidemiology of zoonotic diseases is rapidly becoming a major public health concern for urban agriculture. There is a need for sound methodological approaches which are sympathetic to the vital importance of urban agriculture for so many people, and further, ones that have carefully considered the social and cultural context of various practices in livestock keeping and animal slaughter. A few researchers have begun to examine the health transitions of various zoonotic diseases in cities in the South, however studies are isolated.

The few studies which do exist for brucellosis suggest that urban livestock keeping is contributing to this health transition. Brucellosis is “[a] bacterial infection which may cause recurrent or chronic fever in humans” (Bell et al., 1988: 28). It is spread to humans by drinking unpasteurized milk, and by close direct contact while caring for animals and in slaughter houses. It is the latter transmission route that has become a new concern in urban areas. Birley and Lock (1998a) suggest that transmission of brucellosis through direct contact of workers is a new worry in densely populated areas. They also point to recent epidemiological evidence which suggests that infection may be airborne. According to Birley and Lock (1998a) “[u]ncontrolled livestock movement in urban areas is of particular concern for brucellosis control”.

This corresponds with an in-depth study of brucellosis in an urban community in Saudi Arabia conducted by C.W. Cooper (1991). Cooper argues that the persistence of pastoral practices in urban areas in Saudi Arabia has contributed to incidences of brucellosis in urban areas. According to Cooper (1991: 416), “[t]he incidence of animal and human brucellosis has increased in the last two decades as rapid urbanization and improved transportation has concentrated herds that were traditionally small and dispersed”. Cooper’s study is also important because it demonstrates the importance of examining human infections in terms of age, sex, nationality, and seasonal variation. Cooper’s results showed that infections varied according to this criteria, particularly when age and sex were mapped on the same graph. The results indicated that women were more commonly infected between age 15 and age 64, however the infection rate in men over 65 was significantly higher than that for women in the same age bracket. The author speculates on possible reasons for these numbers in terms of the cultural norms of this pastoral society, and gender divisions of labour in this society. The reflection on the social and cultural context in which brucellosis has become an urban health concern is vital to developing appropriate prevention strategies.

Echinococcosis is an “[i]nfection by the cystic larval form of a canine tapeworm” (Bell et al., 1988: 74). The disease runs in a cycle with sheep and goats as the main intermediate hosts.

Dogs and other canids are the final host reservoirs. Humans, and sheep and goats are infected when they ingest the tapeworm eggs excreted by infected dogs. Dogs in turn are infected by consuming the raw offal containing the cysts from infected sheep and goats. (Ibid: 74) (For a diagram of the life cycle of echinococcosis refer to Appendix 1). Given the cyclical nature of this disease, interventions must consider a variety issues and risk areas including location of abattoirs, slaughtering practices, feeding practices for dogs with known owners and the number of stray dogs in neighbourhoods around abattoirs and meat markets.

Studies of echinococcosis in urban areas are scattered, however they all demonstrate a common concern about the transition of echinococcosis from a predominantly rural disease to an urban disease. Investigations in Nigeria (Ayanwale et al. 1982), India (Pillai et al., 1986), Argentina (Larrieu et al., 1988) and Nepal (IDRC, project 92-1055) have indicated that this is a health transition of serious concern given the urban dynamic. Ayanwale et al. (1982) tested dogs, sheep and goats around an abattoir in Ibadan, Nigeria, for the echinococcosis infection. They found high rates of infection around the area with the largest abattoir and in the public market area. The authors concluded by stating “[t]he public health significance of hydatid [echinococcosis] can... not be overlooked especially in view of the fast growing backyard swine, goat and sheep husbandry practices presently being encouraged by the Nigerian government”(Ayanwale et al., 1982:67). The authors also note the relationship between the number of stray dogs and the incidence of infection. They were therefore not surprised to find a high rate of infection around the public market where there is a large number of stray dogs. A similar study in India (Pillai et al., 1986: 161) did not find a large incidence of infection, however the researchers nonetheless concluded that this was a “... serious public health hazard...” and speculated that the low prevalence in their study may have been due to the high quality of the livestock in the study. Finally, Larrieu et al. (1988), claim echinococcosis is becoming an urban disease as a result of the migration of rural practices in livestock keeping to confined urban dwellings. They claim that although the incidence of canine infection in the urban centre was lower than that in the surrounding rural area, the potential for human infection was much greater in the urban centre because of the significantly higher population density. This supposition was supported by their findings which showed a high incidence of human infection in the urban centre.

IDRC has supported public health research in Kathmandu, Nepal, which measured the incidence of echinococcosis in two wards in the municipality most involved in cattle butchery and sale. This research established echinococcosis in Kathmandu as an emerging urban zoonosis (IDRC project # 92-1055). The project looked at the changing epidemiology of the disease as it came to be identified in urban areas. This project placed an epidemiological study within the context of specific cultural practices in animal husbandry and slaughter. It was in part through this project that IDRC supported a new paradigm for health research and intervention. IDRC is now working with a new ecosystems approach which frames public health research and intervention within cultural norms and practices, and environmental management³. The approach emphasizes gender

³“The [Ecosystems Approach to Human Health (ECOHEALTH)] Program Initiative supports research on the relationship between all components of an ecosystem to define and assess priority problems that affect the health of

analysis and participatory methods, linkages with interrelated activities and practices, as well as socially and culturally feasible interventions.

In this paper I have argued that health concerns in urban agriculture must be understood in relation to the benefits and constraints of urban agriculture and within the context of urbanism in the South. Both of the current Ecohealth project in Kathmandu and its predecessor have attempted to place specific practices within the complex interaction of social, cultural, economical and environmental determinants. Such an approach may prove useful for projects which deal with urban agriculture and health because it opens discursive spaces in which to consider the unique characteristics of urban environments. Cooper's work on brucellosis among pastoral people in Saudi Arabia is another example of an instance where animal husbandry practices are interrelated with cultural norms. Both Cooper's study and the IDRC project on echinococcosis in Nepal illustrate the importance of framing health studies regarding urban livestock keeping within a holistic research paradigm which considers cultural norms and environmental practices, and includes social and gender analyses.

Future Research

I have discussed only two of several identified public health risks which are associated with urban agriculture. Research into the potential health hazards is needed to better support urban farmers and municipal authorities. In this paper I have argued that this health research must be grounded in a conceptual framework and methodology which carefully considers the meaning of urbanism in most Southern cities; the importance of urban farming for producers and consumers; and the social and economic geography of risk, including gender and class analysis. I suggest that the frameworks put forth by Kettel, and Songsore and McGranahan which focus on life spaces and relations of power in terms of gender and economic status are crucial for sustainable interventions. Research needs to be situated within the context of related struggles (both intra and inter household) over access to and management of labour and resources and in the identification of health priorities.

An excellent foundation for future work on public health which explicitly addresses the unique importance of urban agriculture can be gleaned from the available information on heavy metal contamination in soils and crops provided that it includes a social analysis similar to Bellows' work in Poland. Some of the public health risks in urban agriculture are introduced by the environment rather than specific agricultural practices. The literature I have discussed focuses on identification and prevention of contamination of crops. However, more research is needed

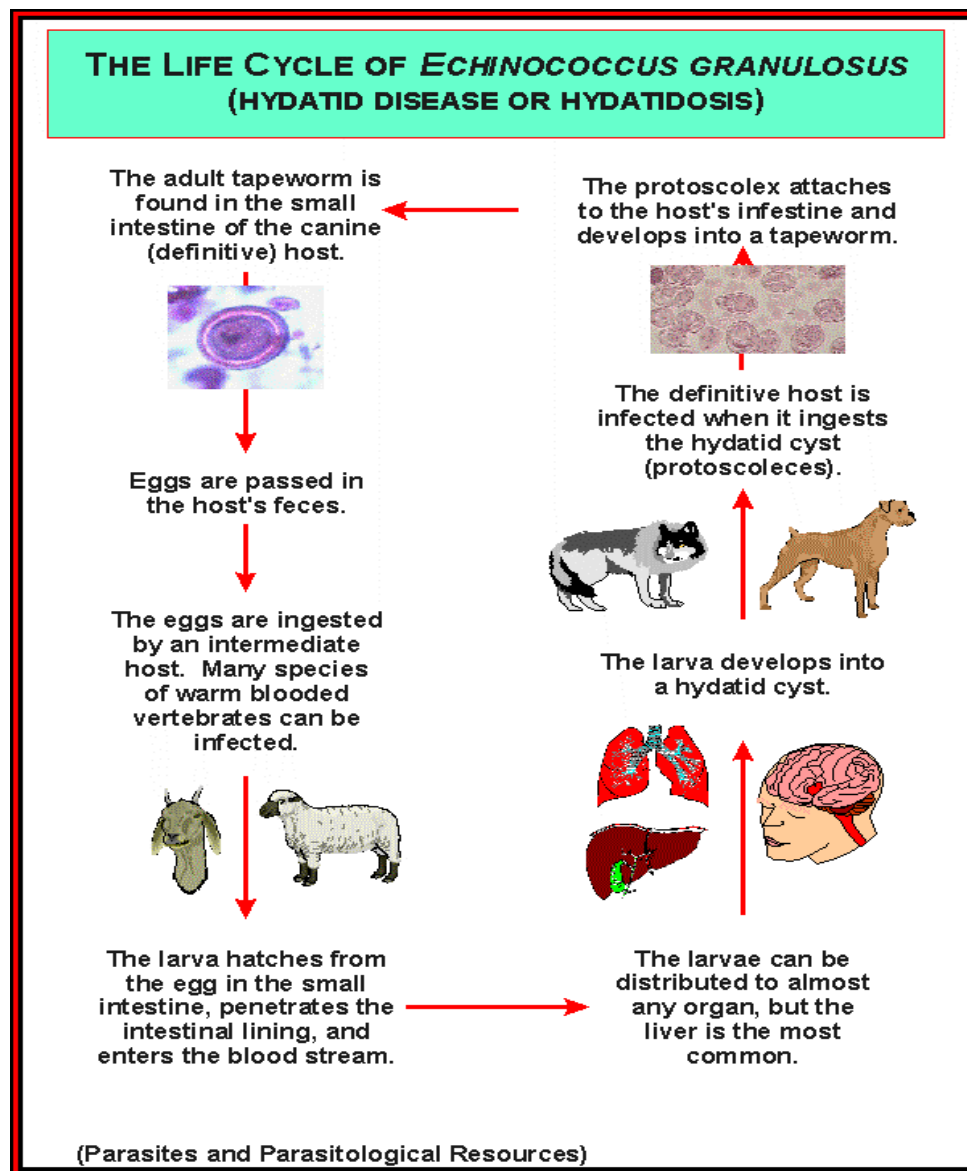
people and the sustainability of their ecosystem. In pursuing the aim of improving human health and well-being while simultaneously maintaining a healthy ecosystem, the emphasis is on the design of solutions based on ecosystem management rather than health sector interventions" (ECOHEALTH, 1998). For more information on ECOHEALTH at IDRC please visit their website: <<http://www.idrc.ca/ecohealth/index.html>>.

which explicitly explores the role that urban agriculture, particularly the cultivation of non food crops, can play in environmental regeneration (see references 31 and 40 in section three). As environmental managers, urban farmers may contribute to environmental clean-up and control of vector breeding sites.

While work on the relationship between urban agriculture and health transition in zoonoses is still relatively recent, the examples included in this paper suggest that this should be a matter of growing attention. There is little work which addresses the health implications of zero-graze practices, as they relate to urban zoonoses and sanitation in crowded, informal settlements. In addition to further studies on brucellosis and echinococcosis, multidisciplinary research teams need to consider a variety of other zoonotic diseases (chagas, leishmaniasis, toxoplasmosis, bovine tuberculosis, anthrax, Q fever and leptospirosis).

IDRC has already done extensive work on trypanosomiasis (chagas) and leishmaniasis, however these studies have been limited to rural areas where these diseases were found to be endemic. Where chagas has been studied in urban areas, the causes were limited to congenital pathways and blood transfusions. As urban agriculture rises in popularity, tick-borne diseases like leishmaniasis and chagas may increasingly be identified as urban diseases. Already Birley and Lock have cited preliminary investigations which raise concerns about the increases in chagas infections in peri-urban areas from livestock keeping. These earlier studies from rural areas provide a foundation from which to explore these zoonoses in the context of urban agriculture.

Appendix 1



Source: "Graphic Images of Parasites" Parasites and Parasitological Resources, College of Biological Sciences - Ohio State University
<http://www.biosci.ohio-state.edu/~parasite/lifecycles/echinococcus_lifecycle.html>

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SECTION 2:

Directory of Institutions and Organizations

Introduction to Directory

This directory contains a list of fourteen organizations whose research is particularly relevant to issues regarding health and (urban) agriculture. The directory includes a brief description of each organization and the web address for their site. The descriptions are copied verbatim from the organizations' websites and do not include any personal commentary. However, the list is composed of organizations which the author has found most useful and relevant.

This list is narrowly focussed on institutions who have projects, programs or publications that specifically examine health issues. This information was collected through searches and referrals. It is by no means an exhaustive list of organizations who are researching in this area or related areas. As research into the health aspects of urban agriculture is still relatively new, the list is short. Many of these organizations have focussed more on rural agriculture, however their concerns can be extrapolated to urban agriculture and aquaculture, and they provide a starting point for guiding further research into the health aspects of urban agriculture. The bibliography in section three also includes on-line articles on this subject matter. I also recommend the **CityFarmer** website which posts articles and announcements on matters related to urban agriculture: <<http://www.cityfarmer.org>>.

For further links to institutions researching urban agriculture in general, please see the **Cities Feeding People website**: <<http://www.idrc.ca/cfp/>>

The goal of the **Cities Feeding People (CFP)** Program Initiative (PI) is to support development research to remove constraints and enhance the potential for urban agriculture interventions to improve household food security, income generation, public health, and waste and land management. The three main research areas for the PI are: appropriate space-intensive production systems for low-income urban farmers; safe and affordable use of organic wastes by small-scale urban farmers to reduce risks to human health and the environment; and policy instruments to enhance low-income urban farming.



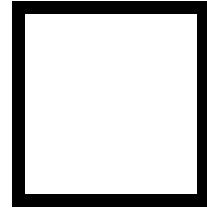
Sample Projects:

Urban Agriculture in Local Waste Management : Santiago (DOMINICAN REPUBLIC), Centre file number: 95-0024 (002759);

Household Small Animal Production (PERU), Centre file no.: 93-0028.

Asian Institute of Technology Mission

AIT will take a leadership role in the promotion of technological change and its management for sustainable development in the Asia and Pacific region, through high-level education, research and outreach activities which integrate technology, planning and management. The focus of the Institute's activities is in technology, with special emphasis on the interdisciplinary interface among the above three fields, and will include attention to environmental and socioeconomic considerations.



<http://www.ait.ac.th/>

Academic Programs: Aquaculture and Aquatic Resources Management Program; Urban Environment Management Program

The Asian Vegetable Research and Development Center



The Asian Vegetable Research and Development Center was established in 1971 to help improve the nutrition, health, and incomes of people in developing countries. Its goal is to develop environmentally safe and sustainable vegetable production technologies that can be adapted by national agricultural research systems.

<http://www.avrdc.org.tw/>

Sample Project: Safer vegetable pest management (focuses on peri-urban agriculture)

CEPIS



The Pan American Center for Sanitary Engineering and Environmental Sciences, CEPIS, is the specialized center for environmental technology of the Pan American Health Organization (PAHO), Regional Office for the Americas of the World Health Organization (WHO). CEPIS mission is to cooperate with the countries of the Americas to evaluate and control environmental risk factors that, directly or indirectly, affect the health of the population.

<http://www.cepis.org.pe/>

Sample Project: Impacto del ambiente en la salud de la población involucrada con el manipuleo

de aguas residuales

Developing Countries Farm Radio Network



DCFRN has been helping farm families learn about simple, proven ways to increase food supplies and improve nutrition and health since 1979. Radio is our primary method of communication. We're a Canadian-based, not-for-profit organization that gathers and researches information about practices that farm families find helpful. We produce radio scripts in print format, and distribute them free of charge to more than 1,500 Network members. They, in turn, share the information with farmers and family members in about 100 developing countries around the world.

<http://www.web.net/~dcfrn/>

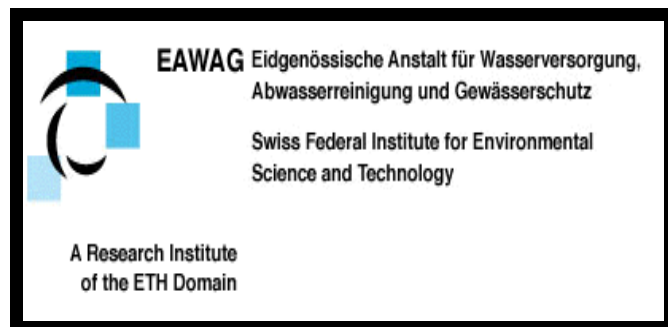
Sample Script Title: Reduce Lead in City Gardens Package 41, Script 2, 980 words, July 1996

EAWAG

Swiss Federal Institute of Environmental Science and Technology (EAWAG)

's task as the national research center for water

pollution control is to ensure that: Concepts and technologies pertaining to the use of natural waters are continuously improved. Ecological, economical and social water interests are brought into line.



http://www.eawag.ch/e_welcome.html

Sample Project: SANDEC (Water and Sanitation in Developing Countries) (formerly IRCWD - see references in section three re: night soil and waste water)

<http://www.sandec.ch/>

International Food Policy Research Institute



The International Food Policy Research Institute (IFPRI) was established in 1975 to help developing countries devise appropriate food policies and the policies needed to ensure the optimum use of new agricultural technologies. Without such policies, there is no guarantee that technical improvements will translate into adequate food supplies and improved nutrition for fast-growing Third World populations.

www.ifpri.org

Sample Publication: 2020 Brief 61: *Livestock to 2020: The Next Food Revolution*

International Institute for Environment and Development



International Institute for Environment and Development is an independent, non-profit organisation with a mission to promote sustainable patterns of world development through collaborative research, policy studies, consensus building and public information.

<http://www.iied.org/>

Sample Publication: Environment and Urbanization (journal)

Centre for Research and Information on Low External Input and Sustainable Agriculture



Centre for Research and Information on Low External Input and Sustainable Agriculture. Global trends in land degradation, deforestation, genetic resource erosion, the loss of indigenous knowledge, and reduced farm productivity indicate an urgent need to develop more sustainable forms of agriculture. Optimising the efficient and complementary use of locally affordable internal and external resources is the goal of increasing numbers of farmers, agricultural scientists, policy makers, development workers and extension staff. ILEIA calls this approach 'Low-External-Input and Sustainable Agriculture' (LEISA).

<http://www.oneworld.org/ileia/index.htm>

Sample Project: ILEIA Newsletter (see articles by Drescher, Lardinois and Bing in Section 3)

International Livestock Research Institute



The International Livestock Research Institute works to improve the well-being of people in developing countries by enhancing the diverse and essential contributions livestock make to smallholder farming. ILRI research products are helping to solve the severe problems that hold back animal agriculture, sustainable food production and economic development in the tropics.

<http://www.cgiar.org/ilri/>

Sample Project: Linking Animal Science with Human Health



Royal Tropical Institute

The Royal Tropical Institute (KIT) is an international knowledge institute. KIT contributes to furthering a better understanding between the nations worldwide. KIT plays a significant role in both Dutch society, as a window to other cultures, and internationally, as a partner in many collaborative development programmes. KIT connects people and sources of knowledge.

<http://www.kit.nl/>

Sample Project: Les gestion des excréments humains à Bamako et à Niono, Mali; une utilisation comme fertilisant dans agriculture.

Natural Resources Institute



The Natural Resources Institute of the University of Greenwich is an internationally recognised centre of expertise in research and consultancy in the environment and natural resources sector. The Institute carries out research and development for international donor agencies. Most of NRI's work provides support to development assistance programmes and contributes to environmentally sound management of physical and biological resources ('natural capital') for use by future generations.

<http://www.nri.org/>

Sample Project: Peri-Urban Interface Research
Centre of African Studies

Centre of African Studies, University of London
Research Profile: People and the environment in Africa
Environmental science, management and impact assessment

<http://www.soas.ac.uk/CAS/resenv.html>

Sample Projects: Assessment of horticultural farming systems used by resource-poor groups in urban and peri-urban environments

WASTE



WASTE is a non-profit organization for development projects in countries in Africa, Asia, and Latin America. WASTE works for organizations that aim at a sustainable improvement of the living conditions of the urban low-income population and of the urban environment in general.

<http://www.waste.nl/>

Sample Project: Urban Waste Expertise Programme (UWEP), 1995-2001

World Resources Institute



World Resources Institute believes a healthy environment and healthy economy can coexist. Since 1982, we have used information and knowledge as tools to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.

<http://www.wri.org/wri/index.html>

SECTION 3:

Annotated Bibliography

Introduction to Annotated Bibliography

The purpose of this annotated bibliography is to provide researchers from a variety of disciplines with concepts and research related to health risks and hazards associated with urban agriculture. The health impacts of urban agriculture (with the exception of nutritional studies) has been largely under-researched. For this reason, many of the references in this section do not explicitly discuss urban agriculture. However, these references provide information and conceptual frameworks which can be applied to studies of urban agriculture and health.

The references were collected over a period of three months in 1999 through database and Internet searches and from recommendations from colleagues. This is by no means an exhaustive list of references. For the most part, reference are from the last decade only. While this was done in part for expediency, it is also a reflection of the both infancy of urban agriculture research, and the growing interest and support for urban agriculture.

The bibliography is divided topically into the following categories:

- General;
- Gender;
- Pollutants and Contamination;
- Vectors;
- Urban Waste and Compost;
- Wastewater and Human Excreta Reuse; and
- Zoonoses.

The author's names are listed in alphabetical order in each category. In some cases a reference may appear in more than one category. Each entry includes a brief abstract and a list of key words. The abstracts do not entail a full description of a source. In some cases, health issues were not the main thrust of the research, however, insights into health risks and priorities were significant enough to include the reference. The section on gender for example, includes references which discuss key concepts and frameworks which can be usefully applied to urban agriculture research. For further notes on the sources for abstracts please see *Author's note on sources for annotation*. Key words for each source were selected from the OECD MacroThesaurus for Information Processing in the Field of Economic and Social Development 5th Ed (Paris 1998). At the back of the bibliography I have included a geographical index for researchers focussing on a specific region.

General

1. Abutiate, W.S. "Urban and Peri-Urban Horticultural Activity in Ghana" NRI Peri-Urban Interface Research, Workshop Proceedings 23-25 August 1995, Kumasi, Ghana Chatham Maritime, Kent: National Resources Institute, 1995, 45-50.

KEYWORDS: Ghana, horticulture, urban areas, diseases, environment, health

This presentation reviews a number of issues in peri-urban horticulture including organization of production, maintenance and care, disease and pest control, irrigation and intercropping. The section covering chemicals for insect control outlines the hazards associated with their use including human and environmental risks. The author claims that the indiscriminate use of agrochemicals, especially in vegetable production, results in a high potential risk of chemical hazards to humans, animals, beneficial insects, arthropods and the environment at large. Furthermore, the author indicates that many farmers are using unrecommended [sic] insecticides to control insects.

2. **Allen, Adriana with Nilvo L.A. da Silva and Enrico Corubolo. Environmental Problems and Opportunities of the Peri-Urban Interface and their Impact on the Poor Document for the Peri-Urban Interface Research Project, Development Planning Unit, University College London, March 1999.**

KEYWORDS: urban areas, environment, pollution, health

The objective of this document is to provide an overview of the problems and opportunities of the peri-urban interface (PUI) with regard to the broader concerns of environmental sustainability and poverty. Health aspects, including the social and economic geography of peri-urban health and environmental problems are raised in sections three and four. The document calls attention to such issues as air and soil pollution from industrial waste, and waste reuse.

3. **Birley, M. H., and K. Lock. A Review of the Health Impacts of Peri-Urban Natural Resource Development. International Health Impact Assessment Research Group, University School of Tropical Medicine, Draft 1998; updated by M. Birley 2/2/1999. 14/5/1999**
<<http://www.liv.ac.uk/~mhb/publicat/Periurban/Start.html>>.

KEYWORDS: Ghana, India, urban areas, natural resources, public health

This draft paper presents a thorough assessment of the health impacts associated with natural resource development including various practices in peri-urban agriculture. This paper is designed for non-health specialists including managers of natural resource projects, researchers and recipients of development aid. The paper identifies the kinds of health hazards that natural resources managers, researchers and users should be aware of, describes how these can be assessed, examines what other agencies are doing about these issues, and suggests topics for future research. The report organizes health issues into categories of *communicable diseases, non-communicable diseases, injury, malnutrition, and psycho-social disorder*. Sections covering energy efficiency, crop production intensification, fisheries, livestock, and recycling and waste reuse are analyzed for each of the above health categories. The report also includes details from case studies in Hubli-Dharwad and Kumasi, and a review of cross cutting issues. It includes a number of useful diagrams and figures and a sample health impact assessment survey.

4. **Birley, Martin H. and Karen Lock. “Health and peri-urban natural resource production” Environment and Urbanization. Vol. 10 no.1, April 1998, 89-106.**

KEYWORDS: urban areas, natural resources, public health

This paper examines the health problems facing the enterprises and inhabitants of peri-urban areas, including risks posed by malaria, heavy metals, the re-use of solid and liquid wastes, agro-chemicals, biomass fuels and food contamination. It also emphasizes how both research and assessment procedures are required to ensure that natural resource production in peri-urban areas also safeguard human health. For a more detailed report of this study, see the on-line report at www.liv.ac.uk/~mhb/publicat/Periurban/Start.html.

5. **Chimbowu, Admos and Davison Gumbo (ENDA-Zimbabwe) “Urban Agriculture Research in East & Southern Africa II: Records, Capacities and Opportunities” Cities Feeding People Series. No. 4, Ottawa: International Development Research Centre (IDRC) 1993.**

KEYWORDS: Southern Africa, East Africa, urban agriculture, research capacity, research needs

This report assesses the research capacities and opportunities for urban agriculture in East and Southern Africa and makes recommendations for research areas, needs and field specialists in the area. The Report includes a section on urban agriculture, water, waste and disasters which reflects on some of the public health concerns. In particular the section looks at pollutants, solid waste, and zoonotic diseases associated with urban livestock keeping. Among the suggested research projects, the authors call for a study into the use of agrochemicals in urban agriculture and their possible ecological effects.

6. **ETC Netherlands “Second Bulletin on Urban Agriculture in Europe” September 1997 reproduced in Urban Agricultural Notes www.cityfarmer.org/etcbulletin2.html Sept. 1997 1999/06/28.**

KEYWORDS: Europe, urban agriculture, environment, health hazards, research

The bulletin aims to support the networking and development of urban agriculture in Europe. This issue focuses on sustainability, European projects and case studies, contacts and selected literature on the environmental aspects of urban agriculture. In the discussion on sustainability environmental and health risks of urban agriculture are highlighted. The authors argue that several general risks in agriculture are intensified in urban agriculture because urban production is more intensive and the human population is more concentrated. They conclude that urban agriculture systems must be carefully designed and monitored.

7. **Hardoy, Jorge E. and David Satterthwaite. “Health and Environment and the Urban Poor” in Gurinder S. Shahi, Barry S. Levy, and Todd Kjellström (Eds.) International Perspectives on Environment, Development and Health; Towards a Sustainable World. New York: Springer Publishing Company Inc., 1997, 123-162.**

KEYWORDS: urban environment, public health, poverty, hazardous wastes, gender analysis

This paper looks at an array of health problems associated with urban environments in the South. The authors draw attention to the geography of inequality in the aspects of human and environmental health which have differential impacts according to age, sex, gender roles and migrant status. The authors argue that the people most vulnerable to environmental hazards are those least able to avoid them. Of particular interest for urban agriculture is the focus on chemical and industrial pollutants in urban areas. The authors mark chemical pollutants as one of the four most pressing urban environmental concerns. They claim that reports from Third World cities of severe health problems arising from human contact with toxic or hazardous wastes are increasingly common.

8. **Helmore, Kristen and Annu Ratta. “The Surprising Yields of Urban Agriculture” Choices; The Human Development Magazine. Vol. 4 no. 1 April 1995. 22-26.**

KEYWORDS: urban agriculture, health hazards, environmental management, food contamination, waste recycling, waste management

This a general article on the emergence of urban agriculture which devotes a considerable portion to health aspects. The authors draw much of their research from the Urban Agriculture Network (TUAN). The paper recognizes that there are significant health hazards associated with urban agriculture including improperly treated waste-water, heavy metal contamination and toxicity of urban refuse used for compost. The author’s also draw attention to the importance of crop selection in urban farming to reduce the health hazards. They cite TUAN’s assertion that proper research, city planning and extension services would enable urban producers to correct hazardous conditions such as food contamination and water table pollution that result from inadequate waste processing and poor farming practices.

9. **Koc, Mustafa, Rod MacRae, Luc J.A. Mougeot, and Jennifer Welsh (Eds.) For Hunger-Proof Cities; Sustainable Urban Food Systems Ottawa: International Development Research Centre (IDRC), 1999.**

KEYWORDS: food security, food planning, food policy, urban agriculture, urban renewal, urban communities

A collection of articles which address the multitude of aspects of a sustainable urban food system with sections covering food security, local food systems, urban agriculture, distribution, gender, ecology, health, politics and governance. Most of the papers were presented at the International Conference on Sustainable Food Systems hosted by the Centre for Studies in Food Security at Ryerson Polytechnic University, Toronto in May 1997. This book aims to develop a conceptual and practical framework for sustainable urban food systems.

10. **Kurnicki, Alexander F. “Urban Growth: Urban Agriculture at South East False Creek” Urban Agriculture Notes April 1999.
www.cityfarmer.org/FalseCreek.html 1999/06/28.**

KEYWORDS: Canada, urban agriculture, soil pollution

This paper is a detailed case study of the opportunities and constraints for an urban agriculture project in South East False Creek. While discussing some of the important advantages that the urban agriculture project can bring to the environment and the community, the author also devotes a section to the serious problem of soil contamination in the area. The author discusses some options for soil remediation, but also notes that many methods are expensive.

11. **Lamba, Davinder (Mazingira Institute). “Urban Agriculture Research in East Africa: Record, Capacities and Opportunities” Cities Feeding People Series no. 2 Ottawa: International Development Research Centre (IDRC), 1993.**

KEYWORDS: East Africa, urban agriculture, research capacity, research needs

This review of UA research in East Africa divides itself between areas of strength and areas of weakness in the research record. In particular the report shows that research into health risks are understudied areas for each of the countries examined. Among the health concerns raised are air quality, use of untreated sewage, pollution from industrial firms and water quality.

12. **Mlozi. M.R.S., I.J. Lupanga and Z.S.K. Mvena “Urban Agriculture as a Survival Strategy in Tanzania” in Jonathan Baker and Ove Pedersen Eds. The Rural-Urban Interface; Expansion and Adaptation. Uppsala: Nordiska Afrikainstitutet, 1992, 284-294.**

KEYWORDS: Tanzania, urban agriculture, soil pollution

This a general article about urban agriculture in Tanzania. Among the issues addressed as limitations to urban farming was the contamination of crops, particularly in areas like Tabata in Dar es Salaam where urban farmers had settled on refuse dumps. Among the recommendations in the conclusion, the authors call for authorities to improve presently unusable land, and for town planning officials to liaise with professionals such as agriculturalists, veterinarians, engineers, police, health workers, medical personnel, sociologists and conservationists in the initial plot identification phase.

13. **Mougeot, Luc J. A. “Farming Inside and Around the Cities” Urban Age; The Global City Magazine. Winter 1998, 18-21.**

KEYWORDS: urban agriculture, waste recycling, waste management, public health, pollution

A short article which reviews a number issues in urban agriculture including causes, spaces and responses to its rapid growth. The article includes a brief discussion on the public health aspects of urban agriculture. Health issues discussed include agrochemicals, treatment of solid and liquid waste, air, soil and water pollution, vector-carrying animals, manure and human waste, and groundwater contamination. Among the conclusions the author states that urban waste will be more commonly applied as an input, as home and community-based waste treatment outperforms massive and non-selective systems.

14. **Nelson, Toni “Closing the Nutrient Loop” World Watch November/December 1996, 10-17.**

KEYWORDS: urban agriculture, food supply, waste management, pollution

This article highlights the important contributions that urban agriculture can make to urban food supplies and waste management. The article is sensitive to the potential for health hazards in urban agriculture particularly those associated with the reuse of wastewater and pollution. Included in the list of seven areas of research need is the impact of pollution on toxicity of soils and plants. The author discusses a number potential sources of contamination including leaded gasoline emissions from cars, and heavy metal and PCB contamination on sites where buildings have been demolished. She suggests that researchers find affordable means for testing and reconditioning the contaminated soils.

15. **Sawio, J. Camillus. “Managing Urban Agriculture in Dar es Salaam” Cities Feeding People Series No. 20. Ottawa: International Development Research Centre (IDRC), June 1998.**

KEYWORDS: Tanzania, urban agriculture, public health, pollution, animal husbandry

This paper proposes strategies for urban development plans for Dar es Salaam. The findings are based primarily on feedback and recommendations made at a mini-workshop on urban agriculture that took place in November 1993 in Dar es Salaam. A number of important health related issues are raised in this paper: livestock keeping in high density areas, persistent use of hazardous areas for agriculture where heavy metal contamination levels are high and practices which have the potential to encourage mosquito breeding were key health concerns. Among the proposed strategies, workshop participants called for plans to integrate urban agriculture with other urban processes such as health, nutrition, gender, education, environmental awareness and aspects of poverty alleviation.

16. **Smit, J., Ratta and J. Bernstein “Chapter Eight: Problems related to urban agriculture” in Urban Agriculture: Food, Jobs and Sustainable Cities New York: United Nations Development Programme (UNDP), 1996, 198-209.**

KEYWORDS: urban agriculture, health hazards, pollution, animal husbandry, waste management

This chapter is part of a comprehensive book on urban agriculture. Half of the chapter is devoted to the health risks involved in certain agricultural practices. According to the authors, it is vital for supporters of urban agriculture to face these problems head on because they can also have the effect of reinforcing socio-cultural biases against urban agriculture. Among the health concerns raised are: crop cultivation in polluted environments, use of chemicals, use of domestic waste, and rearing livestock in the city.

17. **Smith B. Olanrewaju. (ed.) Agriculture urbaine en Afrique de l’Ouest / Urban Agriculture in West Africa. Ottawa: International Development Research Centre (IDRC) 1999. www.idrc.ca/books/focus/890/index.html 1999/07/12.**

KEYWORDS: West Africa, urban agriculture, public health, sanitation, conference papers

This book is the result of a workshop attended by approximately 60 participants coming from 12 West African countries, and two others coming from France and Holland. The chapters describe the valuable contribution that urban agriculture is making to food security and urban sanitation in the cities of West and Central Africa. It also presents a strategy for launching a multi-stakeholder network on urban agriculture, and does so with input and support from producers; NGOs; national, regional and international research institutions; donors; and policy makers and government officials at both the municipal and national levels. Papers are in French and English. Several papers discuss health issues.

18. **von Braun, Joachim, John McComb, Ben K. Fred-Mensah, Rajul Pandya-Lorch. Urban Food Insecurity and Malnutrition in Developing Countries: Trends, Policies, and Research Implications. Washington: International Food Policy Research Institute, 1993.**

KEYWORDS: urban, urbanization, food security, food hygiene, poverty, public health, waste management, urban agriculture

This report discusses conceptual issues and policy focus implications of urbanization for growth and poverty including sections on food consumption, dietary patterns, nutrition, and food costs. Section 5 on policy choices and research implications includes information on health, sanitation and food safety, and on urban agriculture. The authors argue that comprehensive policies for health programs, safe water, safe street food, and sanitation are urgently needed.

19. **Waser, Katherine. "Editor's note: The newly recognized importance of urban agriculture" Arid Lands Newsletter no. 42 Fall/Winter 1997. 25/5/1999 <<http://ag.arizona.edu/OALS/ALN/aln42/ednote42.html>>.**

KEYWORDS: urban agriculture, water resources, waste waters, policy making, health

This editorial note for the Aridlands Newsletter issue on urban agriculture highlights some key issues surrounding the legitimate health concerns of urban agriculture. The editor claims that in arid lands especially, where water is scarce, policies and practices need to be developed that encourage the use of wastewater and other urban waste while protecting against the spread of diseases.

20. **Wekwete, Kadmiel H. (University of Zimbabwe) “Urban Agriculture Research in East and Southern Africa I: Record, Capacities and Opportunities” Cities Feeding People Series, no. 3 Ottawa: International Development Research Centre (IDRC), 1993.**

KEYWORDS: East Africa, Southern Africa, urban agriculture, research capacity, research needs

This report reflects on the research that has been done in the area of urban agriculture and assesses the regional capacity to continue this research. According to the author research has focussed on defending UA and dispelling common myths about its hazards. However the author also claims there is a lack of scientific work on the potential health risks.

Gender

For more resources on gender and urban agriculture please see:

Hovorka, Alice J. “Gender Resources for Urban Agriculture Research: Methodology, Directory and Annotated Bibliography” Cities Feeding People Report Series Report 26, 1998.

- 21 **Bellows, Anne C. “Where Kitchen and Laboratory Meet; The ‘tested food for Silesia’ program” in Dianne Rocheleau, Barbara Thomas-Slaytor and Esther Wangari (Eds.) Feminist Political Ecology: Global issues and local experiences London: Routledge, 1996, 251-270.**

KEYWORDS: Poland, soil pollution, gender analysis, environmental management, urban, horticulture

This paper examines community action against the industrial contamination of foods in Upper Silesia, Poland. The author pays particular attention to the roles and participation of women in organizing a local movement to test foods and educate farmers on hazards and prevention. The author draws attention to the treatment of women as social actors in public protest and to the ways in which gender roles open and limit the spaces for women’s voices. The author discusses an organization founded and largely run by women whose position as mothers and as scientists gave them a unique perspective on this problem. She concludes by discussing future challenges to the organization and to the participation of women in the organization.

- 22 **Cooper, C.W. “The epidemiology of human brucellosis in a well defined urban population in Saudi Arabia” Journal of Tropical Medicine and Hygiene 1991, 94: 416-422.**

KEYWORDS: Saudi Arabia, urban, zoonoses, cattle production, age sex distribution

Pastoral elements persist as an important component of contemporary Saudi Arab culture. Domestic livestock animals (sheep, goats and camels) are kept as a means of livelihood, but also play a central role in religion, ritual and culture. This study was undertaken to determine the incidence and demographic characteristics of human brucellosis in a representative Saudi community. Researchers recorded results under the following categories: Saudi nationals v. non-Saudi nationals; age; sex; and seasonal incidence. Researchers also cross referenced age and sex results and postulated possible gender roles which account for greater incidences of infection in women between 25-64 than men in the same age sets and greater incidences in men over 65 as compared to women.

- 23 **Harris, Craig “Water of Life - Women and Water Sanitation” IDRC Reports 1993, 21(1).**

KEYWORDS: Egypt, water utilisation, women’s participation, sanitation, hygiene

In Egyptian communities as elsewhere, women are central agents for improving hygiene and sanitation in water use. This paper focuses on the sanitation of drinking water. It shows how women, through the gender division of labour, in Egypt are key actors for systems and projects that wish to improve the hygienic use of water. Moreover, the paper demonstrates the continuity between household tasks showing that contamination of household drinking water results not only from contamination from the water source but also through crossover contamination from other unhygienic practices related to animal husbandry, latrines, and food preparation.

- 24 **Hill, Catherine L.M. “Healthy Communities, Healthy Animals; Reconceptualizing Health and Wellness; A Discussion Paper”. October 1993 in Indigenous and Local Community Knowledge in Animal Health and Production Systems - Gender Perspectives - A Working Guide to Issues and Initiatives. 1995, Section 2.**

KEYWORDS: gender analysis, animal husbandry, health, indigenous knowledge, science

This discussion paper grapples with a re-visioning of the definitions of health, science, and knowledge as they pertain to the care of animals and their associated production systems. While the paper highlights the need to address the importance of recognizing gender-disaggregated knowledge in these systems, it importantly addresses the need to transform the dominant health approaches to be more inclusive of other, often more appropriate, local and indigenous strategies. In moving towards a broader conceptualization of health, the paper focuses on three areas in particular: 1) the connections between animal health, human health, and socio-cultural, political, and economic structures; 2) the current state of ethnoveterinary research and lack therein of gender-disaggregated knowledge systems; and 3) the gendered state of a reductionistic, mechanistic western science from which the biomedical model evolved.

- 25 **Kettel, Bonnie. "Women, Health and the Environment" Social Science and Medicine 1996, 42(10): 1367-1379.**

KEYWORDS: Africa, Asia, gender analysis, environmental health, urban, research methods, policy making

This paper develops a conceptual framework for gender-sensitive research and policy analysis that centers on women's interaction with the biophysical environment and the implications of that interaction for their environmental health. The paper argues that there is a need for increased research and policy formulation dealing with women's environmental health in both developing and developed countries, however most researchers interested in women's environmental health lack an appropriate conceptual model. According to the author, attention to women's interaction with the biophysical environment within their own 'life spaces' reveals that women are exposed to the hazards of environmental illness in a manner that is clearly gender-differentiated. She claims that a detailed understanding of how women's (and men's) patterned interaction with the life space they occupy exposes them to health risks is central to articulating and promoting a gender-sensitive environmental health agenda. Evidence of the impact of such disease environments on women's environmental health is drawn from the urban setting and women's experiences of desertification in Africa and Asia.

- 26 **Peters, Kim. "Community-Based Waste Management for Environmental Management and Income Generation in Low-Income Areas: A Case Study of Nairobi Kenya", Urban Agriculture Notes City Farmer, Canada's Office of Urban Agriculture. March 1998. 17/5/1999**
<<http://www.cityfarmer.org/NairobiCompost.html>>.

KEYWORDS: Kenya, waste management, women's role, nongovernmental organizations, community participation, public health

This study focuses on the problems and opportunities of community-based waste management in Nairobi, Kenya. The paper focuses on women's concerns and opportunities in waste recycling and concludes with a number of recommendations for local authorities, the informal sector, community-based organizations, non-governmental organizations, formal private sector and the international donor community. While the paper does not focus specifically on the health impacts or urban agriculture, these are introduced as key issues. The paper mentions both positive and negative health impacts and encourages the promotion of urban agriculture because of the important role this can play in the success of composting.

- 27 **Songsore, Jacob and Gordon McGranahan “The Political Economy of Household Environmental Management: Gender, Environment and Epidemiology in the Greater Accra Metropolitan Area” World Development 1998, 26(3): 395-412.**

KEYWORDS: Ghana, urban environment, gender analysis, poverty, epidemiology, women's health

In many low-income cities, environmental problems in and around the home impose an enormous burden, particularly on women, children and the elderly. Practical strategies are needed to assist women in diminishing or transcending the environmental hazards associated with their traditional roles. This paper examines the gender dimension of local environmental management in Accra, relating this in turn to household wealth and the environmental hazards children face. It provides a qualitative account of the gender division of labour in and around the home and a quantitative analysis of some of the environmental risks that women and children are exposed to, and their possible health effects. The results also help explain why women have reason to be sceptical of government-led improvement efforts, particularly those in the areas where they ought to benefit most from better conditions.

Pollutants and Contamination

- 28 **Bellows, Anne C. “Urban Food, Health, and the Environment: The Case of Upper Silesia, Poland” in Mustafa Koc, Rod MacRae, Luc Mougeot and Jennifer Welsh (Eds.) For Hunger Proof Cities; Sustainable Urban Food Systems Ottawa: International Development Research Centre (IDRC), 1999, 132-135.**

KEYWORDS: Poland, soil pollution, environmental health, environmental management, urban, horticulture

In 1997, Poland celebrated 100 years of urban allotment agriculture, which has buffered local publics from alternating problems of food supply and food costs. However, the yields and safety of local food labour are sometimes sabotaged in regions burdened with severe pollution, most characteristically in household food production from contaminated landscapes in and near urban and industrialized areas. Urban food sustainability ultimately must reflect a local determination of food needs, which, among other things, reflects experience with local complications of environmental health. The case study from Gliwice in Upper Silesia region of Poland discusses (1) organizing an acquisition, labelling, and distribution system for retailing chemically tested organic products linking farmers to consumers; (2) distributing chemically tested produce directly to schools and hospitals and creating subsidies for their purchase; and (3) educating community groups about food contamination and the benefits of organic foods and farming.

- 29 **Bellows, Anne C. “Where Kitchen and Laboratory Meet; The ‘tested food for Silesia’ program” in Dianne Rocheleau, Barbara Thomas-Slaytor and Esther Wangari (Eds.) Feminist Political Ecology; Global issues and local experiences London: Routledge, 1996, 251-270.**

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This paper examines community action against the industrial contamination of foods in Upper Silesia, Poland. The author pays particular attention to the roles and participation of women in organizing a local movement to test foods and educate farmers on hazards and prevention. The author draws attention to the treatment of women as social actors in public protest and to the ways in which gender roles open and limit the spaces for women’s voices. The author discusses an organization founded and largely run by women whose position as mothers and as scientists gave them a unique perspective on this problem. She concludes by discussing future challenges to the organization and to the participation of women in the organization.

- 30 **Coullery, P. “Gestion des sols faiblement pollués par des métaux lourds” [Management of soils weakly polluted by heavy metals] Revue Suisse Agriculture 1997, 29(6) 299-305.**

KEYWORDS: soil pollution, toxic metals, food crops, plant ecology, public health

Several crop fields have been cultivated on heavy metal polluted soils, in order to evaluate the risks they can imply for humans, animals and plants. Wheat proved able to accumulate Cd strongly; even on alkaline soil. It thus implies a risk for humans, even on a weakly polluted site. Cultivation of leaf vegetables on acid Cd polluted soil can also imply a risk to humans. The amount of Pb in plants was very low, except in some cabbage lettuces, which accumulated Pb in a totally unpredictable way. A plant could contain as much as 250 times more Pb than its neighbour. Phytotoxicity problems appeared in the cereals in a Cu polluted former vineyard. On another Cu rich site, no problem arose. This absence of phytotoxicity was due to a higher amount of organic matter. No problem was noted with Ni or Zn polluted soils.

- 31 **Davis, Laura, John Middleton and Sue Simpson. “Community Agriculture Initiatives in the Metropolitan Borough of Sandwell, United Kingdom” in Mustafa Koc, Rod MacRae, Luc Mougeot and Jennifer Welsh (Eds.) For Hunger Proof Cities; Sustainable Urban Food Systems Ottawa: International Development Research Centre (IDRC), 1999, 46-53.**

KEYWORDS: United Kingdom, urban agriculture, urban communities, pollution, health, environmental protection, urban renewal

This paper explores the issues raised in a 1996 study of the practical, legislative, and economic feasibility of community agriculture in Sandwell. Sandwell's people have experienced at first hand the economic, social, and health effects of the processes of industrialization and decline. Local regeneration policy will affect health, and health services can improve regeneration. A coordinated approach to developing a community agriculture program in Sandwell may make an important contribution to the realization that environmental regeneration and the regeneration of the health of Sandwell's people are inextricably linked. This paper focuses in particular on general issues of health and sustainability and health and economic inequality, how these must be tackled at the local level, why Sandwell is the kind of place where one should try to tackle them, and the potential role of community agriculture and direct food link schemes if they are integrated with existing initiatives in community development. Finally problems and ways forward are considered.

- 32 **Developing Countries Farm Radio Network “Reduce Lead in City Gardens”
Package 41, Script 2, July 1996. 27/5/1999
<http://www.idrc.ca/cfp/DCFRN08_e.html>.**

KEYWORDS: urban agriculture, lead, soil pollution, food crops

This script from the Developing Countries Farm Radio Network focuses on practices which would reduce the dangerous levels of lead in urban gardens. The script discusses the potential health effects from eating contaminated crops and discusses measures which will protect gardens from lead contamination. Included in the protection measures are the creation of barriers between gardens and roads (fences, hedges), planting flowers which absorb lead from the air near roadsides or barriers, treating soil with organic matter, and advice on crop selection and planting distances.

- 33 **Drescher, Axel “Gardening on garbage: opportunity or threat?”, ILEIA Newsletter vol. 10 no. 4 December 1994, 20-21.**

KEYWORDS: Zambia, urban agriculture, waste disposal, toxic metals, health hazards

A short article which looks at the practice of farming on a former waste disposal site in the peri-urban area of Lusaka, Zambia. The study found high concentrations of heavy metals in the soil, exceeding any European threshold, however, the uptake of heavy metals in the crops remained low. Nonetheless, the author argues that heavy metal pollution and toxic wastes are likely to be found on many waste disposal sites, and threaten the health of people who consume products from gardens established there. He concludes that advisors and researchers are urgently needed for gardeners to control the use of these sites and protect gardeners and consumers from contamination.

- 34 **Fazel, M. Sharif, S. Sathyanarayan, P.N. Satish and Lata Muthanna. “Effect of Paper Mill Effluents on Accumulation of Heavy Metals in Coconut Trees near Nanjangud, Mysore District, Karnataka, India.” Environmental Geology and Water Science 1991, 17(1) 47-50.**

KEYWORDS: India, irrigation, waste water, toxic metals, industrial wastes, coconuts, public health

Physicochemical characteristics of wastewater from one of the paper mills near Nanjangud, and the differential accumulation of heavy metals in parts of coconut trees growing in the area irrigated directly by the wastewaters of a paper mill were investigated. The total dissolved and suspended solids of wastewater were 1,136.9 mg/l and 2,185.4 mg/l respectively. Biological oxygen demand (BOD) expands and COD is beyond the tolerance limit proposed by Indian standards. The concentrations of Pb, Zn, Ni, Co and Cd in coconut water, root and leaf are higher than the limits suggested by the World Health Organization. Survival of the coconut trees irrigated with polluted waters indicates tolerance of toxic heavy metals. Since coconut forms part of the human food chain, accumulation of toxic heavy metals may lead to organic disorders.

- 35 **Huamain, Chen, Zheng Chungrong, Tu Cong and Zhu Yongguan. “Heavy Metal Pollution in Soils in China: Status and Countermeasures” Ambio 1999 28(2): 130-134.**

KEYWORDS: China, urban agriculture, toxic metals, soil pollution, public health, environmental protection

Heavy metal pollution of soil greatly affects not only the yield and quality of crops, animal and human health, but also the quality of the whole environment. The current status and the effects of heavy-metal pollution in China are reviewed in this paper. Soil pollution by heavy metals from sewage irrigation and metal mining, smelting and processing activities was seen to be serious. Urban enterprises also contribute to heavy metal pollution of soils in China. The effects of soil pollution on plants, animals and human beings are discussed. Effective countermeasures for pollution control are also presented.

- 36 **Il'in, V.B. "Heavy-Metal Pollution of Vegetable-Garden Soils and Crops in the Cities of the Kubass" translated from Agrokhimiya 1991, 7:67-77. Scripta Technica Inc. 1992.**

KEYWORDS: Russia, urban agriculture, horticulture, toxic metals, soil pollution, food crops, public health, plant protection

A detailed report on the instances of heavy-metals pollution in soils in plants of urban gardens in Siberia. Accumulations of heavy metals, often significantly exceeding safety standards, were found in the garden soils of three Siberian cities where pollution sources are a metal mining complex, a zinc smeltery, and several metallurgical plants. Pollution from the zinc smeltery is particularly strong. The uptake of heavy metals from soils into the top organs of plants, especially storage organs, is limited to some nonspecific protective mechanisms in plants. The uptake of heavy metals is less in cabbage and tomatoes than it is in beets and potatoes. All the cities under study have areas where crops are dangerously polluted with some heavy metals, primarily cadmium. The most dangerously polluted vegetable crops were found in the city with the zinc smeltery.

- 37 **Kucharski, Rafai, Ewa Marchwi_ska and Jadwiga Gyzl "Agricultural policy in polluted areas" Ecological Engineering 1994, 3: 299-312.**

KEYWORDS: Poland, polluted soils, industrial wastes, food crops, public health, land management, plant protection, environmental protection

Farming in polluted regions creates several problems, especially in the densely populated countries. The soils contaminated with persistent pollutants are of special concern, as there are no technical means known to restore the original fertility of the deteriorated areas on a large scale. Thus, very careful land management is required to grow safe crops. This is particularly true of Katowice District, the most industrialized and polluted part of Poland. Agricultural activity is practised in about 50% of the area; 7% of this area is considered an unsafe zone due to the extent of soil and air pollution, mainly from heavy metals. An agricultural land assessment method is described, which enables us to classify the pollution of an area. The classification is based on a simple set of indices, which are easy to employ and which identify those species of plants that could be grown without exposing consumers to high levels of contaminants. The method has been used for several years by local administration and environmental protection services.

- 38 **Li, Gwo-Chen, Haw-Tarn Lin and Chi-Sen Lai. “Uptake of Heavy Metals by Plants in Taiwan” paper from Conference Title: Biogeochemistry of trace elements. (1994) Environmental Geochemistry and Health (Special issue) p.153-160**

KEYWORDS: Taiwan, toxic metals, food crops, public health

Concentrations of As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn were determined in crop samples (687, including rice, root vegetables, leafy vegetables and fruity vegetables), as well as in the surface (0-15cm depth) and subsoils (15-30cm depth), from major agricultural areas in Taiwan. The ability of crops to take up heavy metals was evaluated from the ratio of metal concentrations in the plants and soils. Cadmium (Cd) was more easily absorbed by plants than the other metals. Since Cd can be absorbed easily by plants and is more toxic to animals than plants, Cd levels in plants often reach levels that are hazardous to human health before any plant stress symptoms appear.

- 39 **Rao, Jeeven K., and M.V. Shantaram. “Contents of heavy metals in crops treated with urban solid wastes” Journal of Environmental Biology 1995, 16(3): 225-232.**

KEYWORDS: India, urban, solid wastes, toxic metals, food crops

A survey conducted to study the impact of the application of fresh urban solid wastes (USW) on plant uptake of heavy metals in farmers fields around Hyderabad City, revealed that the heavy metal content of plants varied widely among the plant species and plant parts. The content of Zn, Cu, Pb and Ni were elevated in some plant species pointing to a potential pollution hazard through their entry into the food chain. The concentration of Fe, Mn, Cr, Co, and Cd did not exceed the toxic limits and in many plants the roots tended to retain heavy metals more than foliage or above ground plant parts. The authors conclude that monitoring of heavy metals in USW treated soil and crops is essential for safe utilization of USW as a source of manure to improve soil fertility and productivity for sustainable agriculture.

- 40 **Rogriguez, Harahi Gamez. “Agriculture in the Metropolitan Park of Havana, Cuba” in Mustafa Koc, Rod MacRae, Luc Mougeot and Jennifer Welsh (Eds.) For Hunger Proof Cities; Sustainable Urban Food Systems Ottawa: International Development Research Centre (IDRC), 1999, 84-89.**

KEYWORDS: Cuba, urban agriculture, urban renewal, environmental protection, ecology, social participation, education

The Metropolitan Park of Havana (PMH) is an urban, social, and ecological project being developed around the final 7km of the Almendares River, the most important river in the Cuban capital. It overlaps four of the capital's municipalities - Playa, Plaza, Mariano and Cerro - an area of great cultural, racial, and social diversity. As an urban project, the PMH will retain a dense urban network of industries, military entities, and population centres that today occupy the territory. As an ecological park, the PMH will provide a solution to the problems of deforestation in the zone, the uncontrolled social and industrial waste, and the general lack of care for the region that threatens the areas flora and fauna and the Almendares River itself. As a social project, the PMH will provide a space for a population of nearly 9,000 inhabitants, who will be an integral part of the development planning of the park. The PMH is committed to integrating development, environmental recovery, education, and participation - concepts that are frequently addressed independently in large urban-development projects. This paper outlines the fundamental mission, objectives, goals, and strategic planning of the PMH, which is still in the planning phase.

- 41 **Wade, Isabel City Food: Crop Selection in Third World Cities San Francisco: Urban Resources Systems Inc., 1986.**

KEYWORDS: urban agriculture, urban environment, lead, hazardous wastes, plant protection

This report is a reference guide for urban agriculture practitioners, project organizers, researchers or others in a position to implement or assist urban agriculture projects. The author argues that careful selection of crops appropriate for tough urban conditions is central to urban food production strategies. While health hazards are not highlighted as key factors in the crop selection guide, a section devoted to pollutants discusses the issues of lead poisoning and contamination from hazardous wastes such as chemical and industrial byproducts. This section distinguishes between leafy, root and fruit tree crops and offers advice on planting practices, and cleaning.

Vectors

- 42 **Lines, J., Trudy Harpham, Colin Leake and Chris Schofield. “Trends, priorities and policy directions in the control of vector-borne diseases in urban environments” Health Policy and Planning 9(2): 113-129.**

KEYWORDS: urban environments, disease vectors, malaria, filariasis

This review describes how the physical and social changes associated with urbanization have altered the transmission of vector-borne disease. It concentrates on the important mosquito-borne infections: malaria, dengue and filariasis. Dengue virus vectors breed in relatively clean water in man-made containers, while urban filariasis vectors breed in highly polluted water, and these mosquitoes have now been spread by human activity to almost every tropical city. The authors point out that with important exceptions, anopheline malaria vectors have not generally succeeded in adapting to urban life, but malaria can still be a problem where there are rural pockets in the middle of town. They specifically cite African cities as an area of potential risk because they tend to be relatively open, with patches of abandoned land and cultivation close to the centre.

- 43 **Rodier, G.R., J.-P Parra, M. Kamil, S.O. Chakib and S.E. Cope. “Recurrence and emergence of infectious diseases in Djibouti city” Bulletin of the World Health Organization. Vol. 73 no. 6, 1995, 755-759.**

KEYWORDS: Djibouti, urban, malaria, horticulture

This paper reflects on public health concerns over the increase in infectious diseases in an urban area. Of significance for researchers and advocates of urban agriculture is the finding that the emergence of urban malaria closely followed the progressive inclusion of the wadi Ambouli, known for its gardens and wells, in the growing agglomeration of Djibouti.

Urban Waste and Compost

- 44 **Déportes, Isabelle, Jean-Louis Benoit-Guyod and Denis Zmirou “Hazard to man and the environment posed by the use of urban waste compost: a review” The Science of the Total Environment 1995, 172:197-222.**

KEYWORDS: urban, composting, health hazards, environmental health

This article reviews the current state of knowledge on the relationship between the environment and the use of municipal waste compost in terms of health risk assessment. The hazards stem from chemical and microbiological agents whose nature and magnitude depend heavily on the degree of sorting and on the composting method. Composting methods, routes of exposure and quantitative data on the concentration of contaminants in selected composts are discussed.

- 45 **Drescher, Axel “Gardening on garbage: opportunity or threat?”, ILEIA Newsletter vol. 10 no. 4 December 1994, 20-21.**

KEYWORDS: Zambia, urban agriculture, waste disposal, toxic metals, health hazards

A short article which looks at the practice of farming on a former waste disposal site in the peri-urban area of Lusaka, Zambia. The study found high concentrations of heavy metals in the soil, exceeding any European threshold, however, the uptake of heavy metals in the crops remained low. Nonetheless, the author argues that heavy metal pollution and toxic wastes are likely to be found on many waste disposal sites, and threaten the health of people who consume products from gardens established there. He concludes that advisors and researchers are urgently needed for gardeners to control the use of these sites and protect gardeners and consumers from contamination.

- 46 **Furedy, Christine, Virginia Maclaren and Joseph Whitney “Reuse of Waste for Food Production in Asian Cities” in Mustafa Koc, Rod MacRae, Luc Mougeot and Jennifer Welsh (Eds.) For Hunger Proof Cities; Sustainable Urban Food Systems Ottawa: International Development Research Centre (IDRC), 1999, 136-144.**

KEYWORDS: Asia, Thailand, Vietnam, India, Indonesia, Phillippines, waste recycling, composting, agriculture, aquaculture, public health, economics

Asian communities have any practices involving the reuse of organic wastes in agriculture and aquaculture, even in urban areas. These practices contribute to sustainable development by using resources that are otherwise a burden on the waste-management system. Improvements in organic waste reuse in the context of modern urbanization require attention to health and economic considerations. This paper discusses the aspects of reuse of organics from municipal wastes in South and Southeast Asia. Recent research in this region is used to suggest the potential for wise exploitation of links between waste reuse and urban agri-aquaculture. Research draws from studies in Bangkok, Bandung, Bangalore, Hanoi, Ho Chi Min City, Jakarta and Manila.

- 47 **Hunt, Caroline. “Child waste pickers in India: the occupation and its health risks” Environment and Urbanization, 1996, vol. 8 no. 1, 111-118.**

KEYWORDS: India, children, waste management, health

This paper describes the health risks to which waste pickers are exposed in their work (and often in their homes). It then presents the findings of a study on the health problems of a group of 100 children living in informal settlements in Bangalore (India) in which the health problems of those who work as waste pickers were compared to those who do not.

- 48 **Lardinois, Inge and Arnold van de Klundert “Recovery of organic waste in cities” ILEIA Newsletter. Vol. 10 no. 3 October 1994, 6-8.**

KEYWORDS: Kenya, domestic wastes, solid wastes, waste utilization, urban agriculture, health hazards

This article is based on research for the Undugu Society of Kenya (USK) which examined options for solid waste recycling appropriate for small-scale enterprises. The authors argue that recovery of organic waste has many benefits, however reprocessing methods may pose health hazards since small-scale, informal activities are often carried out within crowded residential areas. They also cite a case in Egypt in 1991 where chemical analyses of compost showed high levels of heavy metal contamination (most likely from poor sorting of inorganic waste such as household batteries). The authors note that the precise dangers for people dealing with waste, especially women and children, are not yet known. The authors also suggest in the conclusion that urban agriculture could be an option for the application of large amounts of organic waste.

- 49 **Lewcock, Chris. “Farmer Use of Urban Waste in Kano” Habitat International. Vol. 19 no. 2, 1995, 225-234.**

KEYWORDS: Nigeria, urban areas, waste management, health hazards

This paper examines the use of urban solid waste by the peri-urban farmers of Kano, Nigeria, who use it on a large scale as a minimally composted fertilizing material. While the paper largely focuses on the changing logistics of acquiring urban wastes, there is some reflection on the potential health hazards associated with tannery waste on the soil and polluted irrigation waters from industrial and household waste. Among the key issues the author identifies is the lack of knowledge about the safety of waste materials used for fertilizer and livestock feed. The author states that assessment of health hazards which may arise at different points in urban waste use and recommendations on mitigation measures are priority study areas.

- 50 **Peters, Kim. “Community-Based Waste Management for Environmental Management and Income Generation in Low-Income Areas: A Case Study of Nairobi Kenya”, Urban Agriculture Notes City Farmer, Canada’s Office of Urban Agriculture. March 1998. 17/5/1999**
<<http://www.cityfarmer.org/NairobiCompost.html>>.

KEYWORDS: Kenya, waste management, women’s role, nongovernmental organizations, community participation, public health

This study focuses on the problems and opportunities of community-based waste management in Nairobi, Kenya. The paper focuses on women’s concerns and opportunities in waste recycling and concludes with a number of recommendations for local authorities, the informal sector, community-based organizations, non-governmental organizations, formal private sector and the international donor community. While the paper does not focus specifically on the health impacts or urban agriculture, these are introduced as key issues. The paper mentions both positive and negative health impacts and encourages the promotion of urban agriculture because of the important role this can play in the success of composting.

- 51 **Rao, Jeeven K., and M.V. Shantaram. “Contents of heavy metals in crops treated with urban solid wastes” Journal of Environmental Biology 1995, 16(3): 225-232.**

KEYWORDS: India, urban, solid wastes, toxic metals, food crops

A survey conducted to study the impact of the application of fresh urban solid wastes (USW) on plant uptake of heavy metals in farmers fields around Hyderabad City, revealed that the heavy metal content of plants varied widely among the plant species and plant parts. The content of Zn, Cu, Pb and Ni were elevated in some plant species pointing to a potential pollution hazard through their entry into the food chain. The concentration of Fe, Mn, Cr, Co, and Cd did not exceed the toxic limits and in many plants the roots tended to retain heavy metals more than foliage or above ground plant parts. The authors conclude that monitoring of heavy metals in USW treated soil and crops is essential for safe utilization of USW as a source of manure to improve soil fertility and productivity for sustainable agriculture.

- 52 **Rodrigues M. S., and J. M. Lopez “Urban Organic Wastes, Urban Health and Sustainable Urban and Peri-Urban Agriculture Linking Urban and Rural By Composting” paper presented at the UNDP-sponsored workshop *Rural-Urban Linkages*, Brazil, Urban Agriculture Notes City Farmer, Canada’s Office of Urban Agriculture March 1998. 17/5/1999**
<<http://www.cityfarmer.org/urbanwastes.html>>.

KEYWORDS: Brazil, urban, rural, urban agriculture, composting waste management, health

This paper promotes urban agriculture as an important component in successful waste management. The paper discusses the potential negative health impacts associated with untreated public waste and advocates community-based composting. The authors argue that composting is of direct public health importance as it enables potentially polluting and disease-ridden materials to be sanitized and stabilized. The paper highlight the positive health impacts of composting and urban and peri-urban agriculture.

- 53 **t Hart, Doortje , and Jacomujn Pluimers. “Wasted Agriculture, The use of compost in urban agriculture, Composting of Organic Household Waste” Urban Waste Expertise Programme (UWEP) Working Document #1 1996. 15/5/1999**
<<http://www.waste.nl/wd1index.html>>.

KEYWORDS: Asia, Africa, Latin America, urban agriculture, domestic wastes, environment, health hazards

This paper details an inventory study of the use of compost in urban agriculture. The report is designed to stimulate people working for CBOs, NGOs, governments and research institutes to pay attention to the use of urban compost in urban agriculture. The report draws from a literature review and a questionnaire sent to organizations in Asia, Africa and Latin America. The project focuses on compost and the use of fresh garbage in urban agriculture, detailing advantages and disadvantages of these practices. The use of manure and human waste are discussed only when used in combination with garbage. The study includes a section on environmental and health risks which details concerns regarding pathogens, heavy metals and toxic organic substances. The conclusions suggest areas for follow-up and further research based on the gaps in the relevant literature and the responses to the questionnaire.

Wastewater and Human Excreta Reuse

- 54 **Amahmid O. and K Bouhoum “Health Effects of Urban Wastewater Reuse in Agriculture in a Peri-Urban Area of Marrakech (Morocco)” Abstracts: Urban stability through integrated water-related management The 9th Stockholm Water Symposium: 9-12 August 1999, 124-126.**

KEYWORDS: Morocco, waste water, water reuse, urban agriculture, public health, epidemiology

An epidemiological study was carried out to determine the impact of the urban wastewater reuse in agriculture on the transmission of two protozoan infections, giardiasis and amoebiasis, to children in a peri-urban areas of Marrakech. These two infections are pathogenic and recently giardiasis is being recognized as the most frequent protozoal infection and is becoming a major public health concern. An increase in the incidence of waterborne outbreaks of giardiasis is reported in many parts of the world, yet the role of sewage reuse has played on the transmission of these parasites is not established.

- 55 **Blum, Deborah and Richard G. Feachem. Health Aspects of Nightsoil and Sludge Use in Agriculture and Aquaculture Part III: An Epidemiological Perspective. IRCWD Report 05/85. Dubendorf: International Reference Centre for Waste Disposal (IRCWD), 1985.**

KEYWORDS: waste utilization, agriculture, aquaculture, epidemiology, public health

Part of a three-part series for the International Reference Centre for Waste Disposal in Switzerland examining the health aspects of human excreta reuse. Parts I and II are included in one report (IRCWD 04/85) and Part III is published as a separate report (IRCWD 05/85). A summary of the entire study is included in IRCWD Report 04/85. This section on the epidemiological literature reveals that only a few studies have been published on the epidemiology and actual - as opposed to potential - health risks of human waste utilization. The authors conclude that in general little is known about the attributable risk of nightsoil utilization; i.e. the extent to which the prevalence or incidence of particular infections would change if the practice of excreta utilization was introduced or altered.

- 56 **Blumenthal, Ursula J., Bakir Abisudjak, Enrique Cifuentes, Stephen Bennet, and Guillermo Ruiz-Palacios. “Recent epidemiological studies to test microbiological quality guidelines for wastewater use in agriculture and aquaculture” Public Health Review 1991/92, 19:237-242.**

KEYWORDS: Mexico, Indonesia, waste water, agriculture, epidemiology, public health

A discussion of case studies in Mexico and Indonesia which used epidemiological studies to test the 1989 WHO guidelines for wastewater reuse in agriculture and aquaculture. Each study involved an exposed group using wastewater/excreta with no treatment, a control group with no wastes used, and an intermediate group where wastewater / excreta was used but some health protection measures existed. The authors' studies found that the guidelines for restricted irrigation and for aquaculture may be around the right level.

For more information on the Mexico case study see:

Enrique Cifuentes, Ursula J. Blumenthal, Guillermo Ruiz-Palacios and Stephen Bennett. Public Health Review 1991/92, vol.19.

- 57 **Bruins, Henrik J. “Drought mitigation policy and food provision for urban Africa: Potential use of treated wastewater and solar energy” Arid Lands Newsletter no. 42 Fall/Winter 1997. 25/5/1999
<<http://ag.arizona.edu/OALS/ALN/aln42/b Bruins.html>>.**

KEYWORDS: Africa, drought, water resources, waste water, water reuse, health hazards, water treatment

This article is a revised version of a paper originally submitted to a workshop sponsored by the Netherlands-Israel Development Research Programme (NIRP) in June 1996. While advocating the use of urban wastewater the author suggests that agricultural extension education, legislation and supervision concerning the use of treated wastewater by individual farmers is needed in view of the possible health hazards. The author follows a 1986 World Bank report in advocating the use of wastewater stabilization ponds as a robust method of wastewater treatment well suited to the needs of developing countries.

- 58 **Buras, Netty. "Bacteriological Guidelines for Sewage-Fed Fish Cultures" in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 223-236.**

KEYWORDS: aquaculture, waste water, bacteria, public health

This paper examines whether or not *Escherichia coli* (e. coli) is a good natural indicator for bacteriological quality of fish. The author also argues that the health of workers who handle fish prior to cooking must be considered, as handlers and cleaners constitute the primary foci for the transmission of pathogens to their families, and later when the infection has ensued, to other people. The author concludes with principles to be considered from a public health view point, suggested bacteriological quality standards for fish reared in wastewater-fed ponds, and recommendations to include public health lectures and demos in the basic training programmes for fish farmers.

- 59 **Cross, Piers. Health Aspects of Nightsoil and Sludge Use in Agriculture and Aquaculture Part I: Existing Practices and Beliefs in the Utilization of Human Excreta. IRCWD Report 04/85. Dubendorf: International Reference Centre for Waste Disposal (IRCWD), 1985.**

KEYWORDS: China, Islam, Africa South of Sahara, waste utilization, agriculture, aquaculture, social aspects, cultural factors

Part of a three-part series for the International Reference Centre for Waste Disposal in Switzerland examining the health aspects of human excreta reuse. Parts I and II are included in one report (IRCWD 04/85) and Part III is published as a separate report (IRCWD 05/85). A summary of the entire study is included in IRCWD Report 04/85. This section focuses on the socio-cultural aspects excreta utilization. Behavioural, cultural and social factors are distinguished as being of importance in programs promoting excreta usage. Three case-studies (China, Islamic cultures and sub-Saharan Africa) are presented to illustrate the manner in which socio-cultural factors influence excreta utilization. The author argues that socio-cultural factors are of significance to the adoption and improvement of excreta utilization. The section concludes that such research should become a priority and that social anthropological field methods be adopted as the principal methodology for this research. Priority research topics are proposed.

- 60 Edwards, Peter. "General Discussion on Wastewater-Fed Aquaculture" in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 281-291.

KEYWORDS: waste water, aquaculture, cultural factors, economics, biology

The general discussion is based on taped discussions of each paper presented at the seminar and the final debate towards the end of the seminar. It is structured around the following topics: terminology, cultural systems, biology of fishponds, public health, social issues, and economics. Public health was felt to be the most important topic at the seminar. Wastewater reuse in aquaculture may pose less of a threat to public health than is commonly supposed but systems should be designed that do not subject either producers or consumers to unacceptable risks. Participants agreed that there is a general lack of knowledge concerning the incidence of human disease from consumption of fish cultured in wastewater-fed ponds.

BY THE SAME AUTHOR:

----- "Wastewater-Fed Aquaculture Systems: Status and Prospects" NAGA ICLARM 1996, 19:1, 33-35.

----- "Wastewater Reuse in Aquaculture: Socially and Environmentally Appropriate Wastewater Treatment for Vietnam" NAGA ICLARM 1996, 19:1, 36-37.

- 61 **Edwards, P. and R.S.V. Pullin (Eds.). Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990.**

KEYWORDS: China, Germany, India, Vietnam, Nepal, Hungary, Israel, Thailand, aquaculture, agriculture, waste waters, waste utilization, conference papers

A collection of the conference proceedings on wastewater-fed aquaculture with particular reference to cases in China, Germany, India, Vietnam, Nepal, Hungary, Israel and Thailand. Conference participants also visited four working sites in Calcutta during the conference. The conference has a multi-disciplinary approach covering technical, economic, social and public health aspects. Public health concerns are brought forward in a number of papers and is the principle topic in most of the third section of the report. Details about papers which deal specifically with health concerns are included under the authors' names in this bibliography.

- 62 **Faruqui, Naser I. "Wastewater reuse in urban agriculture" in Abstracts: Urban stability through integrated water-related management The 9th Stockholm Water Symposium: 9-12 August 1999, 127-129.**

KEYWORDS: West Bank, Senegal, waste water, water reuse, water treatment, water shortage, urban agriculture, aquaculture, public health

This paper describes three on-going projects funded by the *Cities Feeding People Program* (CFP) of the International Development Research Centre. CFP supports applied research projects in urban agriculture (UA), to help address food insecurity resulting from rapidly increasing urban populations in lesser developed countries (LDCs). When practised sustainably, UA can help absorb liquid and solid wastes generated in a city. The three projects analyze potential waste management solutions for wastewater reuse in UA, appropriate to the local context

- 63 **Fazel, M. Sharif, S. Sathyanarayan, P.N. Satish and Lata Muthanna. “Effect of Paper Mill Effluents on Accumulation of Heavy Metals in Coconut Trees near Nanjangud, Mysore District, Karnataka, India.” Environmental Geology and Water Science 1991, 17(1) 47-50.**

KEYWORDS: India, irrigation, waste water, toxic metals, industrial wastes, coconuts, public health

Physicochemical characteristics of wastewater from one of the paper mills near Nanjangud and the differential accumulation of heavy metals in parts of coconut trees growing in the area irrigated directly by the wastewaters of a paper mill were investigated. The total dissolved and suspended solids of wastewater were 1,136.9 mg/l and 2,185.4 mg/l respectively. Biological oxygen demand (BOD) expands and COD is beyond the tolerance limit proposed by Indian standards. The concentrations of Pb, Zn, Ni, Co and Cd in coconut water, root and leaf are higher than the limits suggested by the World Health Organization. Survival of the coconut trees irrigated with polluted waters indicates tolerance of toxic heavy metals. Since coconut forms part of the human food chain, accumulation of toxic heavy metals may lead to organic disorders.

- 64 **Feachem, Richard G., David J. Bradley, Hemda Garelick and D. Duncan Mara Health Aspects of Excreta and Sullage Management: A State-of -the-Art Review Appropriate Technology for Water Supply and Sanitation vol. 3 Washington: World Bank, 1980.**

KEYWORDS: waste utilization, waste management, sanitation, water treatment, public health, epidemiology

Public Health is of central importance in the design and implementation of improved excreta disposal projects. Improvements in health are the main social and economic benefit which planners hope to achieve by investing in excreta disposal. This book sets out to provide information on the broad epidemiological impacts on diseases from improvements in excreta disposal, and the ways in which particular excreta disposal and reuse technologies affect the survival and dissemination of particular pathogens. It is intended for planners, engineers, economists and health workers and it has been written with a minimum of jargon so that it can be easily absorbed by people from differing professional backgrounds. The book presents a distillation of available knowledge on excreta, night soil, sewage and health.

- 65 **Furedy, Christine. “Social Aspects of Human Excreta Reuse: Implications for Aquacultural Projects in Asia” in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 251-266.**

KEYWORDS: aquaculture, waste utilization, waste water, cultural factors, social aspects

This paper draws attention to the complexities of social and economic structures where human excreta reuse in aquaculture (HERA) is practised and analyses some of the issues of social acceptability. Mention is made of food habits and cultures, and the social status of excreta handlers. While recognizing the lack of research on the health risks associated with excreta and wastewater handling, the author argues that discussions on risks and regulations should include an understanding of cultural taboos, practices etc. It is recommended that aquacultural projects be designed as components of community development, with interdisciplinary research teams. The paper suggests some ways to overcome constraints upon social research in such projects.

- 66 **Ghosh, Apurba. G.N. Chattopadhyay and P.K. Chakraborti. “Environment and Sanitary Aspects of Wastewater Recycling for Productive Use” in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 179-185.**

KEYWORDS: India, aquaculture, waste water, environment, sanitation, diseases

The possibility of pathogen transfer through wastewater has been a matter of concern of a large number of people for a long time. It is essential that the problem is dealt with carefully. The purpose of this paper is to elucidate some of the environmental and sanitary aspects of wastewater recycling for productive purposes with special reference to aquaculture. A general discussion is presented of sewage-fed fish culture with emphasis on Indian studies in which extrapolated gross fish yields of 5.0-7.2 t/h/yr have been reported. The authors argue that attention needs to be paid to adequate dissolved oxygen and low un-ionized ammonia concentrations. Consideration also needs to be given to the possibility of the bioaccumulation of toxic substances in fish and the potential hazard of pathogens in fish cultured in sewage-fed ponds.

- 67 **Kolsky, Peter J. and Ursula J. Blumenthal. “Environmental health indicators and sanitation-related disease in developing countries: limitations to the use of routine data sources” World Health Statistics Quarterly 1995, 48(2): 132-139.**

KEYWORDS: developing countries, environmental health, health indicators, sanitation, disease, water management

This article explores conceptual issues in the development and use of environmental indicators for disease related to water and sanitation in developing countries. The article focuses on faecal contamination. Among the concerns raised is the limitation of routinely-collected data on faecal contamination and water quality because these often address concerns over the health of the aquatic ecosystem rather than human health. The authors call for pragmatic alternatives to routinely collected data.

- 68 **Ling, Bo. “Safe use of treated night soil” ILEIA Newsletter vol. 10 no. 3 October 1994, 10-11.**

KEYWORDS: China, waste utilization, agriculture, aquaculture, waste treatment

This article discusses the resurgence in China for the use of human waste (night soil) to fertilize crops and feed fish. The paper looks at the potential health risks from pathogenic bacteria, viruses and parasitic ova and argues that night soil management and treatment are particularly important. Furthermore, the author concludes that urban night soil treatment in particular needs more attention as a sound system has not yet been developed and treatment processes have not been standardized.

- 69 **McCollough, Fergus S.. “Schistosomiasis and Aquaculture” in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 237-249.**

KEYWORDS: China, Africa South of Sahara, schistosomiasis, aquaculture, disease control

In many countries where schistosomiasis is endemic, the infection can be an occupational hazard in freshwater fish farming. Permanent, standing impoundments of freshwater, together with the potential of human-water contact and contamination represent in areas endemic to schistosomiasis and obvious risk for the introduction, spread and aggravation of schistosomal infection. This is particularly true in Sub Saharan Africa. In China, however, schistosomiasis transmission in association with fish culture has been eliminated through an outstandingly successful national control programme. This paper provides an introduction to the special problems which exist between schistosomiasis and aquaculture and the more important mechanisms for managing the disease on fish farms. The presentation was prepared with the hope of stimulating further more penetrating field research into this understudied area.

- 70 **Moscoso, Julio C. “Uso de aguas residuales en la agricultura urbana” La Era Urbana; suplemento para american latina y el caribe Winter 1998, XIX- XXI.**

KEYWORDS: Peru, waste water, water pollution, urban agriculture, water treatment, health hazards

This paper focuses on the contamination levels of wastewater used in peri-urban agriculture in Peru. According to the author the contamination levels in untreated water are well above the WHO guidelines for faecal coliforms. He argues that it is absolutely necessary to treat waters in order to reduce public health risks. The paper describes the benefits of a water stabilization pond used in San Juan, a village in the peri-urban area of Lima. The study compared contamination levels in treated and untreated waters and found that without treatment ninety percent of the water had pathogens and bacteria. In addition to the public health benefits, the study also revealed that the treated wastewater was nutrient rich and reduced the need for expensive fertilizers.

- 71 **Niang, Seydou. “Utilisation des eaux usées domestiques en maraîchage périurbain à Dakar (Senegal)” Secheresse 1996, 7: 217-233.**

KEYWORDS: Senegal, waste water, agriculture, bacteria, diseases

In 1937, market gardening was introduced in Senegal. As part of a farming development project, about 2400 ha of land was initially cropped to take advantage of the Niayes (a series of small valleys between dunes along the northern coastline of Senegal). Subsequent to several years of drought, the main water supply has been tapped to the limits. Wastewater has thus become an important alternative irrigation source. Analysis of the physical, chemical and biochemical wastewater characteristics, as compared to those of water from shallow wells and piped drinking water, highlighted the considerable advantages of wastewater use in market gardening. However, wastewater faecal coliform bacteria and streptococcus concentrations are much higher than acceptable by WHO standards for market gardening.

- 72 **Olayemi, A.B. “Microbiological hazards associated with agricultural utilization of urban polluted river water.” International Journal of Environmental Health Research 1997, 7: 49-154.**

KEYWORDS: Nigeria, water pollution, irrigation, bacteria, health hazards

Vegetable and fruit crops grown under irrigation with polluted urban river water from the Asa River in Nigeria were investigated for their bacteriological qualities and health risks. The bacterial isolates were predominated with member of the Enterobacteriaceae including pathogens. The faecal coliforms counts recorded from the samples, including the river water, exceeded the standards of 1000/100ml. Washing and disinfecting significantly reduced their microbial loads. The public health risks and suggestions for ameliorating the same in agricultural use of polluted water was highlighted.

- 73 **Pearson, Howard. "The Biology of Waste Stabilization Ponds" in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 187-200.**

KEYWORDS: aquaculture, waste water, water treatment, biology

Waste stabilization ponds are relatively easy to construct and maintain but their biology is complex. This paper emphasizes the importance of understanding the biology of these systems to modern pond design and to ensure long-term, trouble-free operation. Algal activity, biomass concentration and specialization are related to the key parameters of organic loading, light penetration and sulphide and ammonia concentrations. The use of algae indicators of pond performance and the mechanisms of pathogen removal in ponds are reviewed. Final effluent quality is discussed in terms of discharge consents and the need for algal removal.

Pescod, M.B. Human Waste Use in Agriculture and Aquaculture; Utilization Practices and Health Perspectives Executive Summary IRCWD Report 09/90. Dubendorf: International Reference Centre for Waste Disposal (IRCWD), 1990.

KEYWORDS: Mexico, Guatemala, Peru, Chile, Argentina, Tunisia, Saudi Arabia, India, Indonesia, South Korea, waste management, agriculture, aquaculture, public health, epidemiology, cultural factors, social aspects

This document is a thorough summary of a large project examining the health aspects of human excreta reuse. Drawing on early IRCWD studies which revealed the paucity of epidemiological literature on human excreta reuse, this study was based on two objectives: 1) initiating new epidemiological studies and 2) observing and understanding reuse practices and problems. Pescod describes the full report as both a compilation of case studies which stand on their own as well as an integrated overview which can be used as an arm-chair guide on excreta and wastewater use. The report is based upon visits to Mexico, Guatemala, Peru, Chile, Argentina, Tunisia, Saudi Arabia, India, Java (Indonesia) and South Korea. The objective of the Executive Summary is to provide a concise yet comprehensive review of the main IRCWD Report and to serve as a ready reference to the subject. Both the Executive Summary and the main report are addressed to planners, decision makers, support agency officials and others interested in the curious aspects of human waste use.

MAIN REPORT:

Strauss, Martin and Ursula J. Blumenthal. Use of Human Wastes in Agriculture and Aquaculture; Utilization practices and health perspectives IRCWD Report 08/90. Dubendorf: International Reference Centre for Waste Disposal (IRCWD), 1990.

- 75 **Pescod. M.B. (Warren). “The Urban Water Cycle, including Wastewater Use in Agriculture” Outlook on Agriculture 1992, 21(4): 263-270.**

KEYWORDS: urban, agriculture, water management, waste water, industrial waste, cultural factors, public health

Discusses the advantages and constraints of using wastewater in agriculture. The author expresses particular concern over the possible presence of toxic materials in industrial effluents discharged to sewers which can create unacceptable health risks if its use in agriculture is not strictly controlled. While highlighting the importance of the WHO and FAO guidelines, the author also argues that approaches to wastewater use must be consistent with local socio-cultural, environmental and institutional factors and thoroughly planned as a programme of wastewater disposal and food production.

- 76 **Rose, Gregory D. “Community-Based Technologies for Domestic Wastewater Treatment and Reuse: options for urban agriculture” Cities Feeding People Series, No. 27. Ottawa: International Development Research Centre, Spring 1999.**

KEYWORDS: waste management, technical aspects, public health

This paper presents a comprehensive analysis of technologies for domestic human waste management in urban environments. The majority of the paper focuses on a review of natural or naturally based technologies which can be implemented as alternatives to centralized electro-mechanical treatment technologies. The paper looks at the spatial requirements, costs, advantages, drawbacks and effectiveness of on-site and off-site land-based and water-based technologies including waterless latrines, biogas reactors, water hyacinth-based systems, duckweed-based systems, and sludge blankets. The author gives a limited amount of consideration to public health aspects in terms of re-use, fertilization, irrigation, and disease vectors. He states that further research into the health aspects and guidelines for wastewater reuse in aquaculture are needed. The author argues in his conclusion that in general natural treatment processes are viable, but not without barriers and impediments. He concludes with strategic, technical, socio-cultural and economic recommendations for research and action.

- 77 **Shuval, Hillel I., Charles G. Gunnerson, and DeAnne S. Julius. Night soil Composting Appropriate Technology for Water Supply and Sanitation vol. 10 Washington: The World Bank, 1981.**

KEYWORDS: waste management, composting, diseases, sanitation

This report reviews two treatment systems for night soil composting. The main concern with the reuse of nightsoil is the need for safe and inexpensive treatment systems which remove pathogenic bacteria, viruses, protozoans and helminths. This report was part of the World Bank initiative to study appropriate disposal of water supply and waste disposal in developing countries.

- 78 **Strauss, Martin. Health Aspects of Nightsoil and Sludge Use in Agriculture and Aquaculture Part II: Pathogen Survival. IRCWD Report 04/85. Dubendorf: International Reference Centre for Waste Disposal (IRCWD), 1985.**

KEYWORDS: waste management, disease transmission, public health

Part of a three-part series for the International Reference Centre for Waste Disposal in Switzerland examining the health aspects of human excreta reuse. Parts I and II are included in one report (IRCWD 04/85) and Part III is published as a separate report (IRCWD 05/85). A summary of the entire study is included in IRCWD Report 04/85. This section comprises a state of knowledge review on excreta pathogen survival on crops, in soil and in fish grown in nightsoil-enriched ponds. The report details pathogen survival periods on leaf, fruit and root crops and makes tentative recommendations for excreta storage periods in warm climates based on the current knowledge of pathogen survival in faecal wastes.

- 79 **Visker, Cindy. La gestion des excréments humains à Bamako et à Niono, Mali; Une utilisation comme fertilisant dans l'agriculture Amsterdam: Institut Royal des Tropiques (KIT), Mars 1999.**

KEYWORDS: Mali, waste management, waste utilization, public health, economics, cultural factors

A report on a study of the use of human excreta in agriculture in two cities in Mali. The study addresses the occupational health risks to workers, 'emptiers' (*vidangeurs*) in particular. In Bamako and Niono there is no final depot for human excreta, therefore it is disposed on vacant land and agricultural fields after storage at a temporary facility. Often the waste is emptied on fields against the wishes of farmers and despite the fact that these practices are illegal. Enforcement of the laws varies between the two cities. The paper looks at the relationship between laws, norms and public health. The paper also discusses the different perceptions and levels of knowledge that workers, farmers and consumers have regarding human excreta reuse. According to the author, current practices introduce new and uncontrollable points of contamination with excreted related disease.

- 80 **World Health Organization Health guidelines for the use of wastewater in agriculture and aquaculture. Technical Report Series 778, Geneva: 1989.**

KEYWORDS, waste water, agriculture, aquaculture, public health, disease prevention

A comprehensive guide which includes chapters on practices, health protection measures, planning and implementing safeguards and research needs. The report also discusses the economic and socio-cultural aspects of wastewater reuse and makes an explicit argument for feasible measures. The paper discusses four main health protection measures: treatment, crop restriction, control of wastewater application, and exposure control and promotion of hygiene. The report includes figures illustrating risk levels, prevalence of infections, transmission routes and quality guidelines. While the focus is not specifically on urban agriculture, the report includes examples of health protection measures used in urban agriculture.

Zoonoses

- 81 **Amin, A.M. and T.A. Morsy “Anti-toxoplasma antibodies in butchers and slaughtered sheep and goats in Jeddah Municipal Abattoir, Saudi Arabia” Journal of the Egyptian Society of Parasitology 1997 27(3): 913-18.**

KEYWORDS: Egypt, urban, zoonoses, parasitic diseases, disease transmission, animal husbandry, slaughtering

Toxoplasma gondii is a zoonotic parasite of world-wide distribution. It is more or less endemic in all countries of the Middle East. In Jeddah Municipal abattoir, anti-Toxoplasma IgG was found to be 39% in sheep and 28% in goats as indicated by IHAT. On the other hand, anti-Toxoplasma IgG and IgM in butchers were 80% and 20% respectively, as indicated by the micro-ELISA. The risk of Toxoplasma transmission particularly from meat inadequately cooked was discussed.

- 82 **Ayanwale, F.O., O.O. Dipeolu and G.O. Esuruoso “The Incidence of Echinococcus Infection in Dogs, Sheep and Goats Slaughtered in Ibadan, Nigeria” International Journal of Zoonoses. 1982, 9: 65-67.**

KEYWORDS: Nigeria, urban, zoonoses, disease transmission animal husbandry, slaughtering

An investigation was conducted to determine the incidence of Echinococcus infection among dogs and slaughtered sheep and goats in Ibadan Municipality. According to the authors, adequate information on the incidence and the prevalence of this infection in Nigeria, particularly in densely populated areas such as Ibadan was not available, however some local situations and customs indicated that there was considerable risk of acquiring echinococcosis. They conclude that the public health significance of hydatid infections cannot be oversighted especially in view of the fast growing backyard swine, goat and sheep husbandry practices that were being encouraged by the Nigerian government.

- 83 **Cooper, C.W. “The epidemiology of human brucellosis in a well defined urban population in Saudi Arabia” Journal of Tropical Medicine and Hygiene 1991, 94: 416-422.**

KEYWORDS: Saudi Arabia, urban, zoonoses, cattle production, age sex distribution

Pastoral elements persist as an important component of contemporary Saudi Arab culture. Domestic livestock animals (sheep, goats and camels) are kept as a means of livelihood, but also play a central role in religion, ritual and culture. This study was undertaken to determine the incidence and demographic characteristics of human brucellosis in a representative Saudi community. Researchers recorded results under the following categories: Saudi nationals v. non-Saudi nationals; age; sex; and seasonal incidence. Researchers also cross referenced age and sex results and postulated possible gender roles which account for greater incidences of infection in women between 25-64 than men in the same age sets and greater incidences in men over 65 as compared to women.

- 84 **Hill, Catherine L.M. “Healthy Communities, Healthy Animals; Reconceptualizing Health and Wellness; A Discussion Paper”. October 1993 in Indigenous and Local Community Knowledge in Animal Health and Production Systems - Gender Perspectives - A Working Guide to Issues and Initiatives. 1995, Section 2.**

KEYWORDS: gender analysis, animal husbandry, health, indigenous knowledge, science

This discussion paper grapples with a re-visioning of the definitions of health, science, and knowledge as they pertain to the care of animals and their associated production systems. While the paper highlights the need to address the importance of recognizing gender-disaggregated knowledge in these systems, it importantly addresses the need to transform the dominant health approaches to be more inclusive of other, often more appropriate, local and indigenous strategies. In moving towards a broader conceptualization of health, the following paper focuses on three areas in particular: 1) the connections between animal health, human health, and socio-cultural, political, and economic structures; 2) the current state of ethnoveterinary research and lack therein of gender-disaggregated knowledge systems; and 3) the gendered state of a reductionistic, mechanistic western science from which the biomedical model evolved.

- 85 **Larrieu, Edmundo, Jorge Iriarte and Omar Zavaleta. “Aportes al Conocimiento de la Hidatidosis Como Zoonosis Urbana” [Hydatidosis as an Urban Zoonosis] Revista do Instituto de Medicina Tropical de Sao Paulo. 1988 30(1): 28-31.**

KEYWORDS: Argentina, urban, zoonoses, animal husbandry

This article discusses the transition of hydatidosis (Echinococcosis) from a predominantly rural disease to an urban zoonosis. The authors draw a relationship between urban growth and this health transition. Among the suspected causes of this transition is what the authors describe as the migration of rural customs (animal agriculture) to urban centres where livestock raising is restricted to confined urban dwellings.

- 86 **McCollough, Fergus S.. “Schistosomiasis and Aquaculture” in P Edwards and R.S.V. Pullin (Eds.) Wastewater-Fed Aquaculture: Proceedings of the International Seminar on Wastewater Reclamation and Reuse for Aquaculture, Calcutta, India, 6-9 December, 1988. Bangkok: Environmental and Sanitation Center, Asian Institute of Technology, 1990, 237-249.**

KEYWORDS: China, Africa South of Sahara, schistosomiasis, aquaculture, disease control

In many countries where schistosomiasis is endemic, the infection can be an occupational hazard in freshwater fish farming. Permanent, standing impoundments of freshwater, together with the potential of human-water contact and contamination represent in areas endemic to schistosomiasis and obvious risk for the introduction, spread and aggravation of schistosomal infection. This is particularly true in Sub Saharan Africa. In China, however, schistosomiasis transmission in association with fish culture has been eliminated through an outstandingly successful national control programme. This paper provides an introduction to the special problems which exist between schistosomiasis and aquaculture and the more important mechanisms for managing the disease on fish farms. The presentation was prepared with the hope of stimulating further more penetrating field research into this understudied area.

- 87 **Oliveira-Neto, Manoel P., Cluade Primex, Elizabeth Rnagel, Armando Schubach and Gabriel Brimaldi Jr. “An Outbreak of American Cutaneous Leishmaniasis (*Leishmania Braziliensis Braziliensis*) In a Periurban Area of Rio De Janeiro City, Brazil: Clinical and Epidemiological Studies” Mem. Inst. Oswaldo Cruz 83(4): 427-435.**

KEYWORDS: Brazil, leishmaniasis, urban, zoonoses, disease transmission

From July 1984 to September 1986, 105 cases of American cutaneous leishmaniasis were studied in a locality closely situated to an urbanized area of the City Rio de Janeiro, Brazil. Settlement in this area was established at least 20 years ago but the first cases were noted only six months prior to the beginning of this study. Cases were almost exclusively cutaneous and ulcerated, with one to six months evolution. Montenegro's skin tests were positive in all cases and anti-patients. Parasites were demonstrated in 69.5% of cases. Domestic animals were easily found infected: 32% of the examined dogs and 30.8% of the examined equines were positive to the presence of *Leishmania* in cutaneous ulcerated lesions. Parasite isolates from human, dog and equines were immunologically characterized and identified as *L. b. braziliensis*. 73.0% of the sandfly population were *Lutzomyia intermedia* mainly caught on human baits and on domestic animals.

- 88 **Pillai, K. Janardhana, P.L. Narayana Rao and K. Surya Rao. “A study on the prevalence of hydatidosis in sheep and goats at Tirupati municipal slaughter house” Indian Journal of Public Health 1996 30(3): 160-165.**

KEYWORDS: India, urban, zoonoses, animal husbandry, slaughtering

Sheep and goats are important to the national economy of a country for their contribution by way of meat, milk, wool, hair skin and manure. Hydatidosis, recognised as an important public health problem is causing severe economic losses in sheep and goat. It is considered a human health hazard throughout the world, including India. Measurement of the prevalence of cystic infections in sheep is the most reliable indication of the extent of environmental contamination with *Echinococcus* eggs in a given geographical area. This work was undertaken to find out the prevalence of infection among sheep and goats.

- 89 **World Health Organization The Control of Schistosomiasis: Second report of the WHO expert Committee. Technical Report Series 830 Geneva: World Health Organization, 1993.**

KEYWORDS: schistosomiasis, zoonoses, urban areas, disease control, agriculture, aquaculture, health hazards

A broad report covering a number of control strategies and technical issues of control, as well as assessments of control programs in countries where the various forms of schistosomiasis are endemic. The report raises concerns over aquaculture and urban schistosomiasis. In particular, the report raises concerns over the risk to farmers in peri-urban areas and reinforces the importance of a safe water supply and proper sanitation.

Author's note on sources for annotation

The abstracts for the following entries were written by Kathleen Flynn. In some cases they do not reflect the true nature of the article but rather they comment on the article's reflection on health issues in agriculture and urban agriculture. This is particularly true for the first section as these general texts often discuss a great deal more about urban agriculture than just health concerns. Even though I have written and compiled these abstracts, I have tried as much as possible to integrate the author's own words from the text or original abstract and summaries (when they were available) so that readers of this report have a sense of the author's vocabulary and writing style.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 26, 29, 32, 33, 41, 43, 45, 48, 49, 50, 52, 53, 55, 56, 57, 58, 59, 61, 67, 68, 70, 74, 75, 76, 78, 79, 80, 82, 83, 84, 85, 89

The abstracts for the following entries are a modified version of the article's own abstract, summary or introduction. These abstracts are often somewhat shorter than the original abstract and in some cases include verbatim text from the article which is relevant to the topic of urban agriculture and health. In some cases I have also added a few comments about the structure of the article or book and directed the reader to sections which deal with health issues.

17, 25, 28, 35, 36, 39, 42, 44, 46, 51, 54, 60, 62, 66, 69, 71, 72, 73, 77, 87

The abstracts for the following entries are the original abstracts included with the article.

27, 30, 31, 34, 37, 38, 40, 47, 63, 64, 65, 81, 86, 88

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Glossary****

agro-chemicals	Chemicals used in agricultural industry such as fertilizer, pesticides and weed killers
anthrax	A bacterial disease caused by the organism <i>Bacillus anthracis</i>
arthropod	An animal group including insects, ticks, mites
bilharzia	<i>see</i> schistosomiasis
brucellosis	A bacterial infection of animals causing abortion. It can be transmitted to [humans] via direct contact or ingestion of dairy products resulting in recurrent or chronic fever. Also called undulant fever
carcinogenic	A substance that induces the development of cancer
Chagas	A disease in South America affecting the heart, liver, spleen and colon due to infection with the parasite <i>Trypanosoma</i>
coliforms	A group of bacteria. Some of them, faecal coliforms, are normally found in human and animal faeces
congenital	Dating from birth. Referring to a disease or deformity caused by defective or inoperative genes
dengue	An acute tropical fever caused by a virus, occasionally fatal; also known as break-bone fever. The vectors are mosquitoes of the <i>Aedes</i> genus
[echinococcosis]	[<i>see</i> hydatid disease]

**** Except where indicated, definitions come from: Birley, M. H., and K. Lock. A Review of the Health Impacts of Peri-Urban Natural Resource Development. International Health Impact Assessment Research Group, University School of Tropical Medicine, Draft 1998; updated by M. Birley 2/2/1999. 14/5/1999
<<http://www.liv.ac.uk/~mhb/publicat/Periurban/Start.html>>.

effluent	Liquid industrial and agricultural waste; outflowing sewage during purification
excreta	Faeces and urine
filariasis	A disease caused by the presence of filarial worms in the blood and lymph nodes. The vector is the mosquito
helminth	A parasitic worm
hydatid disease	Infection [in humans and ungulates] with the larval stages of the dog tapeworm <i>Echinococcus granulosus</i> . Infection is acquired through faecal-oral contact and the larvae may migrate to any organ of the body
leishmaniasis	A disease caused by a parasitic protozoa of the genus <i>Leishmania</i> that is transmitted from person to person by sandflies; also known as Kala-azar and Oriental sore
leptospirosis	A disease caused by bacteria of the species <i>Leptospira</i> . It is transmitted to people by: contact with animals, moist soil, recreational, accidental and occupational immersion in water or vegetation contaminated with urine of infected animals such as pets and rodents
malaria	A mosquito-borne disease caused by <i>Plasmodium</i> parasites
mutagenic	Inducing genetic mutation(s) or increasing the mutation rate
nightsoil	A euphemism for human excreta stored in containers which are not connected to sewers. The containers are usually emptied at night and the partially decomposed matter may be used as a fertilizer
parasite	An organism that lives on or in another organism termed the host, and draws nourishment from it (Adjective - parasitic)
pathogen	An organism that causes disease. Most pathogens are microscopic in size

phytotoxin	A substance poisonous or injurious to plants (from: <u>Oxford Canadian Dictionary</u> 1998)
protozoan	A simple single celled animal e.g. <i>Entamoeba histolytica</i>
q fever	An acute febrile illness, usually respiratory, caused by <i>Coxiella burnetii</i> . Humans acquire the disease through contact with infected animals by inhalation (from hides), consuming infected milk or tick bite
respiratory	Pertaining to the lungs and the breathing apparatus of the body
sandfly	A common name for flies of the group phlebotomine including the genus <i>Phlebotomus</i> . Sometimes vectors of leishmaniasis
schistosomiasis	A disease, caused by infestation of the human body by the trematode worms of <i>Schistosoma</i> , characterized by the passing of blood in the urine or stool. Also called bilharzia
sewage	Human excreta and wastewater flushed along a sewer pipe
sullage	Domestic dirty water not containing excreta; also called grey water
toxoplasmosis	A common infection with the protozoan <i>Toxoplasma gondii</i> , an intracellular parasite of cats and other hosts which is transmitted to humans by ingestion or transplacentally from mother to foetus
trematodes	Flat worms including parasitic worms called flukes e.g. clonorchiasis, fasciolopsiasis
trypanosomiasis	A disease of animals and humans caused by a <i>Trypanosoma</i> parasite; called sleeping sickness in Africa and Chagas disease in South America
tuberculosis	A chronic and disabling disease of the lungs, and less frequently other parts of the body, which is fatal if not treated

vector	An animal - often and insect - transmitting infection from person to person or from infected animals
virus	A very small parasitic organism which can only reproduce inside the animal or plant cells of a host, but can survive elsewhere
yellow fever	An acute arbovirus infection transmitted by mosquitoes for which there is no treatment
zero grazing	A grazing system in which grass (or other fodder) is cut daily and taken to cattle kept in a yard or small exercise paddock near the buildings. (from: <u>Black's Agricultural Dictionary 2nd Ed.</u> 1985)
zoonosis	An infectious disease transmissible under natural conditions from animals to human