



Urban Environment Management

Developing a Global
Research Agenda

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INTRODUCTION

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PERPSECTIVE

The Urban Environment Management or URB Program, housed in the Environment and Natural Resources or ENR Division, IDRC, was developed in 1992. It originated from a working group created in February 1992 and was confirmed in early 1993, a corporate decision to devote more systematic support to selected urban development problems, which various sectors of the Centre had addressed throughout the 1980s. The URB working group is currently composed of some 17 professional staff from various areas of expertise and various Centre Divisions, distributed roughly equally between IDRC's Ottawa headquarters and its regional offices. Its yearly budget for new research support is about 1 million CAD. Research activities can also be funded jointly with other Centre Divisions working on urban issues.

Between February and December 1992 an URB Program statement was drafted and revised many times by more than 30 specialists, from various Divisions of IDRC, and by external readers. It was discussed with each IDRC regional director in June 1992, then disseminated at corporate assemblies and shared with other external support agency representatives in meetings in Washington, New York, Stockholm, London, Nairobi and San José, Costa Rica.

Along with this in-house consultation, we believed we needed to do two things to ascertain and specify the URB Program's objectives and approach.

IDRC PROJECT REVIEW

Firstly, in September 1992 we commissioned a systematic analysis of selected IDRC project literature on those issues retained by the URB Program at that time (urban water and urban waste management, urban agriculture, and urban environmental hazards); a list of descriptors was set up and revised, in consultation with IDRC staff in Ottawa and in the regions. This led us to identify, with IDRC Library's assistance, some 120 relevant projects (co)funded by IDRC since 1980. Project synopses were then scrutinised to come up with a shortlist of 30 projects most indicative of new URB Program directions. This list was revised by staff in Ottawa and in the regions. The project literature was evaluated for its contributions and challenges to the proposed URB program approach and objectives. (Appendix II reproduces the December 1992 version of the URB Program statement which served as the basis for this review and the subsequent program development workshop.)

A January 1993 draft report was circulated for review by Program staff and finalised in February 1993. This report will be reproduced for in-Centre distribution. This project review also enabled us to update and expand our directory of individuals and institutions with an IDRC track record, currently engaged in research on URB Program issues.

THE OTTAWA WORKSHOP

The second action was to submit the URB Program statement to a systematic critique by the Canadian and southern research communities, as well as by interested external support agencies. This was to identify and specify a narrower and more operational set of research challenges and collaboration mechanisms to inform and influence problem-solving strategies over the next few years.

We identified and invited some 25 specialists from Latin America, Africa and Asia to assess the URB Program statement on three counts: (a) identify strengths and weaknesses of their region's research record on specific Program issues; (b) appraise relevant institutional capacities in their region; and (c) propose new ideas for future research. Between January 1993 and April 1993 the papers were written, submitted, reviewed both by URB Program staff and Canadian specialists.

Both review papers and related comments set the stage for a Program development workshop in Ottawa on 4-6 May 1993. During three full days some 53 participants (Appendix I) debated research needs and collaboration mechanisms in thematic and regional rounds of working groups. The participants represented a wide range of disciplines, private and public universities and research centres, governmental departments and non-governmental development organisations, bi and multilateral agencies (WB, UNCHS, UNDP, UNICEF, CIDA, IDRC), in 17 countries of North, Central and South America, West, Eastern and Southern Africa, the Middle East, South Asia, East and Southeast Asia. Group moderators shared in plenary their working group proceedings. A panel of representatives of external support agencies reacted to these reports and made substantive contributions to individual working group discussions.

THE REVIEW PAPERS AND WORKSHOP PROCEEDINGS

This publication reproduces, under standardised format and with some editing, the papers commissioned and retained for rapid dissemination. Authors were given two weeks after the workshop to remit revised versions of their papers.

Review Paper Summaries

Seven papers were produced on urban agriculture:

Rev. Camillus Sawio just completed a doctoral dissertation on the subject and in his paper thoroughly reviews the research record and available expertise in Central and Eastern Africa; new studies should focus on small-scale methods and techniques for small-scale producers to better select crops and sites, to improve multi-food production systems in intra and peri-urban areas, as well as on legal and policy changes required to better support and control UA, on developing organic recycling systems to reuse waste and on solutions to related health risks.

To this, Davinder Lamba, of the Mazingira Institute, adds research to inform gender and ethnic empowerment, promote credit assistance, and to rigorously assess the fungibility benefits of UA.

Also supporting more thorough cost-benefit analyses of UA, Wekwete, recommends a careful examination of UA's economic significance as a land use and employer, of its productivity, returns and multiple impacts on household well-being.

In Chimhowu and Gumbo's well-documented review on Southern Africa, research on UA evolved from baseline and descriptive studies on land use aspects, to studies stressing UA as a survival strategy, finally to hybrid, more holistic analyses, still with scant attention to some countries. More research is needed to show how land use zoning systems can accommodate urban agriculture, to ascertain actual production levels, to reconcile inimical and promote enabling legislation for broadening support to UA, and to exploit UA as an effective and productive way of recycling and reusing urban wastes.

Diallo's West African overview highlights geographers' dominant contribution to UA studies in this subregion, a general need for clarifying terms and concepts, the neglect by current research of urban animal husbandry and of the synergy, competition and complementarity between UA and other land uses; specific research is needed on the nutritional impact of UA among low-income groups, with pre- and post-UA comparisons. Increasing producers' access to land and improving crop security are fundamental to enabling technological progress in the field and creative initiatives in Zaire and Nigeria need to be better understood and disseminated.

Yeung's detailed survey on research substance, expertise and institutional capacity in East Asia shows that technical developments here testify to human creativity in very high-density urban settings. Contrasts within the subregion are marked however and a

major challenge is to develop means and ways of making integrated and productive systems more accessible to low-income groups and countries.

In Latin America, Prudencio's review shows an organisational scene for UA which is more promising than often thought. NGOs are main promoters, encouraging UA often as part of food aid programs, jointly with specialised agencies. International cooperation agencies finance UA, with little technical expertise though and hardly any research promotion. So far, support has been less forthcoming from national governments but many regional authorities are dependable collaborators. Remarkably however, we have yet to produce a systematic account of what is happening in UA in Central and South America and the Caribbean.

Six papers were submitted on urban waste management:

Bushra shows that North Africa and the Middle East, Egypt in particular, have implemented innovative approaches to the collection and re-use of municipal waste by the informal sector, as well as appropriate technologies for solid waste composting. Still, the region lacks baseline information; an excessive reliance on management systems highly dependent on expensive, inappropriate equipment, has kept attentions away from alternatives making the best use of low-cost technologies and maximising waste reutilisation.

Syagga's account of Central and East Africa displays a broad range of disciplinary expertise and strong links between research and government institutions. He points to the lack of research on privatisation, on the industrial and economic significance of recycling, gender and basic needs dimension of waste management, and the persisting insistence, as in North Africa and the Middle East, on deficient organisational and technological models. It will be important for donors to complement each other's role in this subregion.

Tevera's detailed and abundantly documented assessment of Eastern and Southern Africa shows that, in contrast with Latin America, little research has involved or dealt with the role of local communities in urban waste management, a major challenge.

Diop's reading of West Africa's experience emphasises what other papers imply, that management strategies within cities must be differentiated in space and over time. We also need research to explain why, despite technical research advances, so little progress has been achieved on solving waste water problems on the ground.

Khyaju, Tuladhar and Shrestha's survey of South Asia reveals an impressive technical research capacity (36 institutions in seven countries) and a wide range of relevant expertise, sectors and levels of government involved. Regional strengths include risk assessment of disposal, siting rehabilitation, reuse and composting of municipal waste, biogas production; future research efforts should emphasise organisational more than technological development.

In Latin America Rodriguez, through a network of social researchers, assembled an extensive overview; some innovative management experiences include inter-municipal consortia, NGO achievements in the areas of community participation and cooperation between municipal and informal sectors. PNUD-Habitat and Ford have funded projects.

As regards urban water management, again six papers were delivered:

Mostafa and Helmi's assessment of North Africa and the Middle East is supported by regional data for the 1973-92 period and shows a rapidly growing concern over urban water problems in this subregion. While technical and economic research capacities are very good, integrated approaches have been disregarded so far, as in Latin America. Despite common use of groundwater throughout local history, research on conservation and protection remains scant. Community participation and public-private communication are weak and studies very limited, on sound management techniques, water harvesting, reuse and recycling.

Materu's review of Eastern and Central Africa echoes some of Mostafa and Helmi's concerns; we need to document the range of models and strategies involving communities in the region, including evaluations of IDWSS actions and the status of urban rainwater harvesting. On water pricing and cost recovery, Materu's paper implies that beyond conventional piped networks, a much broader range of technical and institutional options needs to be exploited for more prompt and effective provision. In order to do this we need to know more about people's valuation of clean water, their requirements for water of varying quality for different purposes, the strategies they currently use to satisfy those needs.

Biemi and Jouba's survey suggests that West Africa's technical capacity and expertise has been used well below its potential and needs to be complemented with social expertise. Research and training have made little impact on treatment and reuse of water, despite technologies at hand.

Yong's paper on South East Asia stresses that, increasingly people are perceiving a strong link between water management and waste management; institutional changes

underway favor research to explore this link more fully, before realistic urban water management plans can be developed. Training needs are greater in waste management but a very large institutional capacity can be mobilised. A proposed research approach for decision-making could inspire new initiatives.

Varghese's comprehensive paper on South Asia (India) shares with others the need for a differentiated approach to water management within metro areas: 30 percent of the Indian urban system's supply is now drawn from groundwater sources. She recommends research on ways to augment and protect supplies from conventional sources, including rainwater harvesting, efficient use of groundwater, improved leakage detection and repair, supply restrictions, regressively graded tariffs, waste water recycling) and innovative revenue-recovery mechanisms for community-based systems. Both Varghese and Alam stress the role of women as water managers.

As in North Africa and South East Asia, Panario recognises that Latin America has considerable technical and economic capacity and expertise; however, supply sources are better known or studied when these can be tapped by centralised systems, while others are not. Social aspects are neglected, there is little capacity to monitor drainage and to research renewability. Quality monitoring is insufficient and results hardly disseminated. He makes a case for research of superficial aquifers for non-potable domestic water uses, the rehabilitation and protection of water sources in ways involving local populations.

The theme of urban disaster prevention and mitigation was covered in four papers.

Towfighi's general assessment points to the lack of an integrated framework to deal with all aspects of disasters, particularly the behavioral and economic dimensions. We cannot avoid complex planning and management systems if we want to adequately understand behavior and to identify foci of attention. Such systems should focus primarily on the role of communities within these systems. In developing countries, new research is not needed primarily on specialised technological and hard-science knowledge, but rather should emphasise the more soft-core capacity-building. Collaborative efforts are proposed on community-based models for awareness-raising and vulnerability assessment, as well as participation in action programs.

Mubvami and Musandu-Nyamayaro's paper on Eastern and Southern Africa is very useful because many mitigative measures adopted or in the making are potentially relevant to non-drought situations as well, where the insufficiency of water supplies, their quality, reliability and affordability are increasingly problematic. Links between the various URB issues are well perceived; the need for recycling seems central not only to mitigating droughts but also to reinforcing longterm urban food security. The

study of drought impacts on urban resources merges disaster management concerns with solutions to other URB issues.

This view is also shared by Khondker, who recommends the systematic study of drought effects on urban supplies of water, energy and food, and related response strategies by urban groups most affected.

Lavell's paper on Latin America is particularly instructive; the basic conditions it lists which should frame action-oriented research on urban disasters also apply to initiatives on other URB issues. The comparative economic costing of laissez-faire and prevention/mitigation policies can well apply to urban vulnerability to water and food shortages.

Finally, Alam's paper looks at all URB issues in South Asia and is usefully referenced; although the human resource base seems limited, areas highly and lowly researched or ignored are listed, as well as those which should be given priority.

BUILDING ON WORKSHOP RESULTS

This series is meant to be a source-book for building partnerships. It assembles recent numbers and references on major urban challenges in some of the less well-documented parts of the world. More importantly, most regional assessments of institutional capacities, professional expertise and current research activities, will greatly assist both national organisations and external support agencies in the North and South in their identifying and coordinating efforts among groups sharing common interests. Some regional surveys are quite revealing of often unsuspected capacities in many regions; more attest to the need of our coordinating energies within and across regions.

IDRC has already begun to follow up, with other donors, some challenging ideas put forth in papers and working groups. We hope this menu of resources and ideas (over 50 propositions contained in the 24 papers) will also contribute, along with other efforts, to more articulated interventions on the unfolding urban agenda in both the North and the South.

URB Program's current reading of recommendations found in review papers and moderators' reports, in terms of issue foci and research modalities under specific themes and regions, is as follows.

Urban Agriculture

Urban agriculture is clearly not an invention of researchers, who have been observing it and try to explain it, Davinder Lamba reminded the audience of a panel in Toronto, subsequent to the Ottawa workshop.

There has been some favorable policy response to growing evidence on the significance of UA, though progress remains limited. A belief is still widespread that UA is not feasible, meets only survival needs, or entails health and other risks. This has tended to spring from and entertain constraining urban management policies, restrictive and punitive legislation, zoning codes, building standards, and the denial of readily available and critical institutional support to UA. Other constraints include gender and ethnic discrimination, adverse cultural attitudes and misunderstood and under-recognised linkages among food, fuel and energy needs.

As with squatter housing in the 1960s and informal urban employment in the 1970s, social research in LDCs defeated the invisibility of UA in the 1980s. This contribution must urgently be tapped and enriched by other disciplines' attention to the place of UA in urban planning and service delivery, the distinct technological needs of UA, the costs and benefits of UA to households, communities and cities, as a resource recovering and generating activity, as a value-adding use of certain urban water and land areas, as an employment multiplier, and as part of better urban food security and gender empowerment strategies. Hard facts must be documented across the wide spectrum of distinct UA settings, in terms of the afore impacts.

The intervention-oriented research modality, including selected policy-concerned surveys, is deemed best in the short term. This should allow all stakeholders to participate, with special emphasis on the underprivileged. Some of the key policy concerns should be: to document the real health risks and benefits of UA, in its production, distribution and consumption phases; to promote equity aspects, a levelling of the playing field for the urban poor; to devise planning strategies which accommodate UA differently within and between cities of different sizes; to research and adapt alternatives to centralised water and waste management systems that will strengthen their interface with UA and communities' control over these resources.

Institutional arrangements for this research modality must involve NGOs and CBOs, in order for strategies to enable the poor and the disadvantaged to survive and develop their full potential; the building of coalitions and networks nationally and internationally; the pooling of research funds and other needed resources.

Urban Waste Management

Waste may not contaminate, can give work, be a resource, the political base for clientelist processes, a tool to distribute or concentrate wealth, stated Alfredo Rodrigues.

Waste management must be promoted as a community-based resource-generating activity which also enables local people to take control of and improve their living environment.

Agreed information needs are: people's perception, concern and valuation of urban waste problems and solutions, the technical, social and environmental impacts of performance by current systems, institutional arrangements for increasing collection and disposal efficiency, the consequences of organised recycling alternatives on the informal waste economy.

Recommended research modalities include: participatory research on waste audits, calling for and informing fora on how to establish priorities, negotiate solutions on tension points and devise action plans, adopt and implement pilot projects. The fora can initiate a dialogue to build consensus among different actors on how to best share responsibilities. To be more efficient and sustainable, management approaches must address linkages between urban waste, water and UA among others. People's conception of wastes and their degree of concern must be clarified; action plans must include environmental educational programs on urban waste, so that people can develop values, attitudes, knowledge, skills which empower them as responsible actors in their own environment. The fundamentals of turning waste management to the private sector must be carefully revisited, based on recent and ongoing experiences.

Urban Water Management

In many cities water is becoming more a life-threatening than a life-supporting commodity, warned Dr. Raymond Yong.

We must assess systematically and support the development and adaptation of alternatives to centralised water management systems so as to make more efficient use of high-quality water and extend and protect (groundwater) supplies.

Urban community-based water systems clearly are a research frontier. Centralised systems for managing water (and waste) are often blamed for being expensive, vulnerable, with insufficient human resources support, maintenance problems,

technological dependence, inappropriate for marginal locations, monopolistic markets and exposed to politics and corruption. On the other hand, decentralised systems allegedly afford reliable multiple-source water supply, encourage community development, integrate more easily waste management at the local level (UA included); they may make it possible to act on water demand directly, specific technologies can be developed and applied which make use of local knowledge and skills; they could suit better the diversity of settings within and between large urban centres.

The hard truth is that we still know very little about decentralised water management systems. These must be documented and assessed through comparing strengths and weaknesses of centralised and decentralised systems in specific settings. Why should we prefer a decentralised over a centralised solution? If so, which type, where and for how long? Decentralised systems should be tailored so as to keep options open for subsequent adjustments, connection to, or replacement by centralised solutions, when and where this becomes feasible and desirable.

To design and run decentralised systems we need information on demand types and control, protection and renewal of supplies, real costing of interventions. Cost-benefit analyses must be refined to consider environmental spillover valuation, risk assessment, distributional effects and alternative institutional arrangements, as well as the economics of water reuse (production and disposal).

Urban Disaster Prevention and Mitigation

This issue was retained by URB originally; given the need agreed in December 1992 for the Centre to concentrate its activities in fewer areas, URB accepted to rapidly disengage from supporting new research on natural disasters per se over the next years. Still, for workshop purposes we kept on schedule the papers already commissioned, invited their authors to the workshop and accommodated a working group on the issue, for three reasons. Firstly, a few major IDRC (co)funded collaborative and/or network projects on the issue will remain active over the next 2-5 years; this workshop would enable project leaders to adjust upcoming work so as to account as much as possible for the evolving contents of the funding IDRC Program. Secondly, paper authors pertain to research teams which have accumulated experience with urban community development (e.g. Lavell's paper) or Canadian collaboration and GIS expertise (John Rogge), both highly relevant to future initiatives on other URB issues. Thirdly, local action-research components of these projects will inevitably confront water and waste issues, when not UA itself; disaster experts stood to benefit much from exchanging with other specialists; many of the latter had already

granted much attention to the risk dimension in papers submitted (and would later do so in group and plenary discussions).

Regional Differences

In Africa and the Middle East, research must concentrate on how to integrate urban water management with urban waste management, with a view to increase urban water and food security. Many challenges which cities around the world will have to cope with in the future, as traditional sources of urban water decline both in volume and quality, have been reality for some time in arid and semi-arid urban areas of Africa and the Middle East. In the short term research must prioritise key information constraints and bottlenecks to positive institutional and behavioural changes. Challenges include appropriate technologies for cost-effective and safe water management which incorporate the recycling, re-use and disposal of waste, the assessment of the true value of water, the optimisation of water collection (rain harvesting) and uses, hard facts on linkages between UA and food security, self-reliance, employment, gender empowerment, environmental sustainability (health risks and disaster reduction).

The research modality favored is to carry out diagnoses and use these to instruct appropriate responses, in terms of technologies, tools and methods. The research process must account for stakeholders' concerns and responsibilities so as to develop solutions through partnerships between public, private and community sectors. Initiatives must, to the extent possible, build bridges and use existing networks of urban expertise in the region.

In Asia, research is needed on the close links between water and land management, including waste management. Although technical capabilities are reasonably good in part of the Region, very little research has been conducted on surface water contamination and conjunctive water use (surface-subsurface), land-use based hydrologic models, water supply and demand management models and GIS-based decision-making tools combining all the preceding.

We need practical research on how to involve local communities into water/waste management strategies and on what communities can possibly do to improve the general urban environment. A short-term action plan stresses well-developed case studies at specific localities with common methodologies and objectives for comparative purposes.

In Latin America, as metropolitan growth tapers off in the Region, an opportunity must be seized to try and intervene more effectively in the larger centers while

beginning to address the needs of rapidly growing mid-sized cities. The waste water management - urban agriculture interface requires urgent attention. The two components and their relationship have externalities which must be identified and quantified from an economic efficiency and environmental sustainability viewpoint.

We need to develop a common framework to establish a typology of urban settings, and a common methodology to document typical cases on the importance of UA for family income and food security; on perceptions, attitudes and expectations of people regarding waste and water problems (willingness to pay for different solutions), risk assessment and public acceptability, decision-making and implementation processes of community-based solutions with multiple-stakeholder participation.

Following the Ottawa workshop, consultations within the various regions will further assist, where required, in developing specific research proposals to ensure that these account for regional interests and capacities.

GENERAL CONCLUSIONS

Both the thematic and regional working groups recognised an urgent need to frame research in intervention-oriented processes and for action-guiding research to explore more fully the linkages between water, waste management and urban agriculture.

A consensus emerged that management systems need to be made more adaptive and flexible, in order to respond better to local constraints and opportunities, within and between major urban centers. Systems should be composed of locally differentiated subsystems which can evolve as urbanisation proceeds.

There is a widespread recognition that prevailing biases in management approaches owe much to the dominant, yet insufficient, role played by particular groups of disciplines, as well as to the still limited, when not minor, involvement of most stakeholders concerned.

Central to making the right decisions in any setting is the need to consider the externalities of particular technologies or institutional arrangements.

A major challenge for research resides in that, although centralised systems have well-recognised limits, we still know little on decentralised strategies currently at work on the ground, much less so on their potential; there are signs however that these often may be more equitable, manageable and affordable for very large segments of developing-city populations, at the same time that they could turn into more effective multipliers of urban development.

ACKNOWLEDGEMENTS

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At the workshop, Duncan Ellison, Environment Canada, and Christine Furedy, York University, issued challenging key-note addresses. My colleague Panduka Wijeyaratne volunteered a much appreciated opening talk on health dimensions of urban environmental problems. Drs. Jac Smit, Regional and Community Development Consultants, Jean-François Léonard, University of Québec in Montréal, Pierre Gélinas, University of Laval, and John Rogge, University of Winnipeg, reviewed background papers, skilfully steered group discussions and made much appreciated comments on their conclusions.

Denis Massé greatly helped me with the editing of these proceedings. David Brooks made useful suggestions to a draft of this Introduction. Radha Jagai corrected and formatted their final version, for publication under Bill Carman's supervision.

Ottawa, July 1993

URBAN AGRICULTURE: LATIN AMERICA*

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1. REGIONAL RESEARCH RECORD

1.1. Overall diagnosis

A review of existing bibliography on UA experiences in Latin America shows that:

(a) The most researched, tested with and widespread production system in Latin American cities is the family, school or community/group vegetable garden. Vegetable gardens can consist of greenhouses, microclimatic tunnels (organic beds) and open air plots (solar gardens).

(b) Main produce grown are: vegetables (tomatoes, squash, broad beans, lettuce, onions, radishes, etc.); forest production (for reforestation and ornamental purposes) including flowers and medicinal plants; and some fruits¹, although to a lesser degree.

(c) The second fairly well developed activity is the breeding/raising of small livestock (pigs, chickens, hens, rabbits, etc.), fed with vegetal production residues and mainly carried out by family units.

(d) Most family vegetable gardens are for self-consumption. Although output is not large, it affords diversification and a supplement to the basic diet. One aim is also to increase family income and create employment. Vacant urban lands are put to use, transportation costs are reduced, food quality are improved, and energy/caloric supply are increased.

Communal vegetable gardens are attempting to grow products for marketing and generate income for the organization and its family members. They are faced with a series of difficulties: high production costs, lack of resources to gain access to markets (transportation, storage, refrigeration, etc.); poor management, low productivity (due to soil exhaustion, lack of water and seed), scarce technical counselling. The main objective of the school vegetable gardens is to supplement the diet of school children, complemented by education and training in farming activities and practices.

Editor's note: This document was translated from Spanish.

Most beneficiaries of urban agriculture are low-income families living in suburban or marginal city areas. As a rule, practitioners do not have permanent employment, nor agricultural ability or knowledge. Women are the main garden workers and beneficiaries followed by other family members (spouses, older daughters, grandmothers), school children (between 6 and 12 years old) and teachers. People practising this activity tend to be migrants from old urban settlements, as opposed to recent migrants from rural areas. The latter feel this is a typical agrarian activity, and they wish to adopt city ways and activities which supposedly improve their cultural status. Most vegetable gardens worked by low-income beneficiaries do not benefit from adequate technical guidance or orientation. There is no sewage treatment nor use of excreta as fertilizer. There is no production of biogas (from wastes) nor residual processing, or any type of efficient complement with other activities.

There is a scarce technological adaptation emanating from a few European NGOs; traditional technology is used in many of the vegetable gardens.

The situation for urban farmers with more resources and knowledge is somewhat different, as these have more resources; they work with improved seeds, drip irrigation, use fertilizers and pesticides, in addition to having more suitable lands and other advantages.

The support received by urban vegetable gardening systems in the majority of Latin American cities where it is practised can be summarized as follows:

- Nongovernmental organizations (NGOs) usually are the main promoters of these activities, they support the construction and spread of family and community vegetable gardens, implement technical and educational training workshops (in conjunction with other specialized government agencies), and support training in administration (although with many weaknesses) and accounting.
- NGOs also promote reforestation and vegetable production through the distribution of donated food (CARITAS - Adventist Churches, etc.) with little support for marketing, conservation and product distribution.
- International cooperation agencies (UNICEF - Technical Cooperation with Governments, PNUD, etc.) also finance NGOs' urban agricultural projects, although rarely offer the support of technical specialists in the field or promote research (use of organic wastes, water recycling, etc.). Some agencies finance urban and rural reforestation programs for erosion control.
- National governments offer very little support. In some countries, specialized organisms cooperate in agricultural technical training (Argentina), or in a better utilization of

water resources (Chile). In others, support is limited to health and education campaigns in supplementary nutrition, using products from the schools' vegetable gardens.

- Regional autonomous governments (such as municipalities or prefectures) collaborate the most in agricultural activities taking place within the informal economy. In general, they undertake campaigns for the collection of seeds and native seedlings used in forestation programmes of desertic urban areas and for public ornamental purposes (parks, squares, etc.). They also finance programmes for the purchase of forest trees, flowers, etc. although in a limited way.
- The rest of public and private institutions do not exert a major impact upon urban agriculture, although there are a few exceptions as in the case of Brazil's electricity utilities.

1.2. Some experiences contributing to urban agriculture

There are a few experiences relating to urban agriculture which must be mentioned, both for their contribution towards improving agricultural systems and for the overall successes achieved. Some of the experiences occurring in the Latin American countries are being disseminated; these experiences refer to the relationship between urban agriculture and solid and liquid residues recycling, biogas production treatment, reclaiming of fertile lands and other facets.

- a) For instance, we have the case of the PROGRESAR Cooperative in Colombia which is implementing a garbage collection programme through a cleaning and garbage collection contract in urban developments in exchange for the exclusive rights to the waste, or the recollection of refuse in hospitals in exchange for free health services to pregnant women (members of the programme) and newly born children. PROGRESAR also has contracts with large companies which buy these materials (glass, cardboard, etc.) for recycling.
- b) A very important experience with hydroponics production in Colombia should be underscored, which at the present time is not well known throughout Latin America (although this is not the case in Central America). It is based on low capital input and is labour-intensive (contrary to what has been achieved in Europe, the U.S. and other countries where hydroponics is practised); it is also based on the reduction of production costs, minimal land requirement, and the absence of problems with contaminated water.
- c) In Peru, CIPUR (Research and Urban and Rural Projects Centre) has created solid waste domiciliary collection projects in those human settlements which are in a critical situation.

Many peripheral urban areas are affected by adverse geographical conditions (sand pits with high inclination gradient or slope and narrow streets) which render completely ineffective the use of conventional domestic solid waste collection methods. Therefore, a micro-enterprise system was created (groups of approximately twenty workers, associated as a legally constituted business enterprise with limited liability) offering services with wheelbarrows, brooms, rakes, sound devices, and proper attire. Two workers collect and transport the refuse to so-called *collection centres* from where it is subsequently carried to sanitary landfill sites.

Whereas the CIPUR is in charge of the promotion, selection, training and equipment of the micro-enterprise personnel, the municipality of the district is in charge of collecting payment for the services rendered. The success of the system rests on the management capabilities of the micro-enterprise workers and on the harmonious relationship with the population and the local government.

d) Another NGO, the ALTERNATIVA Social Research and Popular Education Centre, has also established refuse collection systems through regional cleaning cooperatives and it is preparing projects for compost production and sanitary manual micro-landfills.

The objective of the Compost Elaboration Plant is to offer to municipalities an alternative system of management and treatment of commercial organic waste, as well as to induce the creation of a micro-enterprise which would be in charge of the compost plant, thus bringing profit to the different local markets and, at the same time, treating approximately 7.5 tonnes of organic waste daily (from which 2.5 tonnes of compost, useful to fertilize and enrich soils, will be obtained).

The aim of the Manual Sanitary Micro-landfills Project is to give final treatment to the wastes of different neighbourhoods (separating inorganic elements suitable for industrial recycling, marketed to intermediaries) thus reducing transport costs, generating employment and saving time to broaden the services provided.

e) There are also some experiences in Brazil which should be underscored given their relationship with urban agriculture activities.

o In the city of Londrina, in Southern Brazil, the members of a small neighbourhood organization (called Democracia y Libertad [Democracy and Freedom]) started communal work on vegetable production not only due to the scantness of financial resources and the lack of permanent employment, but mainly due to the scarcity of available land belonging to them. They started the communal work on vegetable production after encountering many problems in order to obtain available space for the production intended.

o The electricity utility (CESP) of Sao Paulo, Brazil, has been working, during the last few years, on the construction and testing of small digesters -for the improvement of organic fertilizers and the utilization, as well, of biogas and bio-fertilizers) which can be easily managed by rural and urban agriculturists, and thus contribute to ease agricultural work.

f) There are also many experiences in Argentina, as is the case of the improvement of nonfertile soils through household wastes used as manure and fertilizer, carried out in Buenos Aires (Argentine) through an institution called the Club de Hornero which has succeeded in accounting for both technical and agronomic aspects.

g) The last topic to be addressed refers to the interinstitutional degree of coordination and networking obtainable within the different facets of urban agriculture. Such is the case of the INTA (Instituto Nacional de Tecnología Agropecuaria or National Institute for Agricultural and Livestock Technology) in Argentina, where it was successfully obtained, for the production of vegetables, the cooperation and involvement of various specialized organizations (governmental and nongovernmental) such as universities, technical schools, Ministry of Agriculture, Ministry of Health, different municipalities and others, in the training and technical education of low-income families involved in vegetable production. At the present time, this work has benefited over 75,887 people, out of which there were 7,366 living in communities, 17,720 school children and 50,831 family members. Twenty per cent of the beneficiaries are employees, 34 % are self-employed, 8 % are small producers, 5 % are workmen, 20 % are journeymen, and the rest (9 %) are retired people and unemployed. There is a total of 10,414 family vegetable gardens, 673 school vegetable gardens and 180 communal ones distributed through 12 provinces in Argentina.

To conclude, there is scant or limited publication of experiences on urban work and there is almost nonexistent linkage and coordination between these works. In general, the scope of the work is limited to its region or vicinity without the experience reaching beyond. One of the reasons contributing to this problem is the lack of systematization of the results obtained and its dissemination through publications, workshops, etc.

1.3. Underscoring some aspects

From the analysis so far, we can say that:

- a) Urban agricultural systems implemented for the most part in Latin American countries, are usually activities undertaken by populations of scarce economic resources, characterized by not having permanent employment or agricultural training.
- b) These activities represent some support to family consumption/nutrition, and a relatively significant level of economic backing to the overall family income.

- c) Most of the cases studied involved specialized activities related to the production of small volumes of certain products (thus increasing production costs). They have not achieved sufficient product diversification, needed to compete in a marketplace characterized by a high supply-demand competition and free determination of prices.
- d) Problems are also encountered with the marketing of the agricultural products, because deliveries are not made at specified times, there are no refrigeration systems, and the transportation prices represent a very high cost in the overall selling prices.
- e) Also, there are also problems related to suitable agricultural lands, given that urban congestion, in some cases, and the incorrect use of available lands, preclude their use.
- f) There are problems with the availability of water suitable for irrigation purposes, due to their high contamination levels.
- g) There is no technological package suitable for each medium or region, which the beneficiaries could manage by themselves.
- h) As a general rule, the agricultural systems of the vegetable gardens accumulate an excessive number of beneficiaries with the corresponding dilution of the benefits obtained.
- i) The training provided to the beneficiaries, with some exceptions, is not comprehensive, as it does not touch upon subjects such as accounting, administration, marketing, etc. all of which impinge on the final results.
- j) The overall support provided to these activities is very limited, and, in general, it is provided by NGOs, with little participation by the state, and with practically no credit facilities, technological transfer, etc. For this reason, these activities ought to be handled not as isolated projects but as a broad and comprehensive programme, in which national and international organizations could participate.
- k) Experiences regarding work on waste recycling are almost nonexistent or very localized, the theory and practice behind this principle not having been widely disseminated.
- l) Several Latin American experiences could be extrapolated and suggested for the African situation, but two of them figure very prominently because of their greater applicability:

- 1) Firstly, to carry out work in **COORDINATION** with other institutions or organisms:
 - o With government agencies, to technically support the use of fertilizers, seeds, amelioration of the water infrastructure, the mobilization of popular organizations and training campaigns for dissemination of information and financing of these activities.
 - o With municipal governments, to logistically support the securing of resources, such as available land and water, to carry out experiments in the marketing of products, the legal defense of communal lands used in urban agriculture and the creation and implementation of an environmental defense code.
 - o With international cooperation agencies, to obtain not only the necessary financing but also to have access to all other opportunities they create, A very clear example is the one referring to charitable organizations belonging to churches which have popular soup kitchens; these soup kitchens could buy urban agricultural products as they would from a regular supply source. Also, there should be coordination with those agencies which distribute donated food: through internal monetization programmes, the agencies buy nationally produced food to distribute it as donated victuals.
 - o Lastly, with the various national and international NGO's, to avoid the repetition of experiences already carried out or avert committing the same mistakes; to exchange information, establish major contacts, transfer appropriate technologies, etc..
- 2) It is necessary to search for the greatest **DIVERSIFICATION** possible in the agricultural production carried out in urban agriculture works; the objective of this production would be to obtain the largest possible monetary earnings for the beneficiaries, but also the aim should be to **MINIMIZE** production **RISKS** and demand market price instability.
- 3) Production **QUALITY** must be emphasized because this will determine the market demand of urban agricultural products in the ensuing competition with the rural agricultural production.
- 4) Finally, Agricultural techniques which are **LABOUR-INTENSIVE** should be stressed, since African and Latin American countries are characterized by great unemployment and a work force with little training, as well as by scant

financial support; there is need for greater training-technification of the work force and lower financial costs since capital is the lesser available resource.

2. APPRAISAL OF RESEARCH CAPACITY

2.1. Institutions directly committed

The following is a short list of organizations and institutions carrying out activities related to urban agriculture in Latin America. Most probably, it is incomplete, although we believe it includes some of the more important entities.

ARGENTINA

- **CENTRO DE ESTUDIOS URBANOS Y REGIONALES (CEUR)**
(Centre for Urban and Regional Studies)
Av. Corrientes 2835 Cuerpo "A" 7° piso
1193. Buenos Aires.

CEUR performs social analysis and research, issues publications and it has contacts with local and national authorities. **Contact:** Pablo Gutman

- **CLUB DEL HORNERO**
(Baker Bird's Club)
Av. Corrientes 2835 Cuerpo "A" 6° Piso
1193 Buenos Aires

The Baker Bird's Club works on studies to improve infertile soils by means of household wastes. **Contact:** Jaime Nisnovich

- **VERDE ESPERANZA**
(Green Hope)
Virrey Arredondo 2652
Capital Federal

Operates vegetable gardens worked on by youths and children.
Contact: Ángela Alvarez

- **CIPES**
Calle Zobaly N° 2677
Buenos Aires

This organization works on biological food production and supplements it with popular education and technical assistance. **Contact:** Luis Rigal

- INSTITUTO NACIONAL DE TECNOLOGIA AGROPECUARIA (INTA)
(National Institute for Agricultural and Livestock Technology)
(PRO VEGETABLE GARDEN Integrated Project)
Alsina 1407, 2° Piso, Of. 621
1088 Buenos Aires

INTA works in vegetable production through community, school and family vegetable gardens, providing also technical training and counselling. It also works in coordination with several government and private institutions.
Contact: Daniel N. Diaz, P.Eng.

BOLIVIA

- ENDA - BOLIVIA
(Comprehensive Program - Youth of the Street)
Casilla Correo 9772
FAX (591) (2) (81.14.46)
La Paz

ENDA Bolivia carries out organic wastes recycling work and also works through community vegetable gardens. **Contact:** Michel Gregoire, P. Eng.

- SOLIDARIDAD LTDA. (Solidarity Ltd.)
(Agricultural and Marketing Cooperative)
Calle Escalon Aguero 547 (Zona Villa Tejada)
EL ALTO
FAX (591) (2) (35.63.22)
LA PAZ

Solidarity Ltd. works with greenhouses, microclimate tunnels and open air vegetable gardens with low-income families from the urban periphery.
Contact: Prof. Ernesto Valdes

- "GREGORIA APAZA" Centre for the Promotion of Women
Calle Eulert 215 - Villa 16 de Julio
Casilla 12571 - LA PAZ (El Alto)

The organization "Gregoria Apaza" basically works with women of the city's marginal areas. The community vegetable gardens are outstanding among the different activities carried out by this organization.

Contact: Lic. Diana Urioste (Director)

- CENTRO DE INFORMACION Y DESARROLLO DE LA MUJER (CIDEM)
(Women Information and Development Centre)
Calle Aspiazu 736
Casilla Correo 14036
FAX (591) (2) (37.42.61)
LA PAZ

CIDEM basically works with women in different work areas, one of which is forestry production and vegetable gardens. **Contact:** Ximena Machicado

CHILE

- CORPORACION DE DESARROLLO SOLIDARIO (CODESOL)
(Corporation for Solidary Development)
SANTIAGO - Chile

CODESOL works in support of the production of hydro-vegetable gardens in the poor districts of Santiago, providing technological support. It maintains links with the Catholic University, La Serena University and the Ministry of Agriculture.

- CENTRO PARA LA GESTION TECNOLOGICA POPULAR (CETEP)
(Centre for Popular Technology Management)
Venezuela (Barquismeto)

CETEP supports popular organizations in the search for and application of simple and appropriate technologies as to improve the quality of life of poor families.

- PROGRAMA DE ECONOMIA DEL TRABAJO (PET)
(Work Economics Program)
Academia del Humanismo Cristiano
Catedral 1063 - 6° Piso
Santiago - Chile

PET works in socioeconomic research and also provides technical training to marginal and impoverished sectors. **Contact:** Mariana Schkilnik

PERU

- CIUDAD (City)
Bronino 119- of 301, San Borja - Lima
Telephone 37.65.25
Fax 42.17.66

This is an NGO which works on projects dealing with urban vegetable gardens and wastes recycling. **Contact:** Jorge Burga

- ALTERNATIVA (Alternative)
Emeterio Perez 348 Urb.Ingeniería
San Martin de Porres - Lima
Telephone 81.58.01
Fax: 81.68.26

ALTERNATIVE works in the field of vegetable gardens and solid and liquid wastes recycling. **Contact:** Josefina Huamán (Director)

- CIPUR
Baltazar La Torre 570 - Lima 27
Telephone 40.91.61
Fax: 40.79.82

CIPUR is another NGO working in the fields of urban agriculture and wastes recycling in Peru. **Contact:** Jorge Ruiz de Sommocurcio (Director)

- GUAMAN POMA
Apartado 627 - Cuzco
Telephone: 23.59.31
Fax: 22.55.52

Guamán Poma is a NGO working in the Cuzco region in community vegetable gardens and in wastes recycling. **Contact:** José María Gómez G. (Director)

MEXICO

- GRUPO DE ALTERNATIVAS TECNOLOGICAS (GAT)
(Technological Alternatives Group)

GAT is an institution providing advisory services and technological training to families of scant economic means in the field of growing vegetables.

- PROMOCION DEL DESARROLLO POPULAR A.C. (PDP)
(Promotion of Popular Development)
Tlaloc 40 - 3
11370 Mexico, D.F.

PDP supports the socioeconomic development of marginal population sectors, through productive and self-building projects. **Contact:** Luis Lopez Ll.

COLOMBIA

- ENDA - COLOMBIA
A.A. 091369 Bogotá

ENDA supports harvesting and energy generation in marginal neighbourhoods. **Contact:** Jean Jacques Guibbert.

- ASOCIACION DE PRODUCTORAS DE HIDROVERDURAS DE JERUSALEN
(APROHIJE) (Hydroponic Producers' Association of Jerusalem)

APROHIJE is the foremost Latin American institution devoted to the development of small-scale hydroponics based on commercial fertilizers and chemicals. It has carried out projects in close cooperation with the Municipality of Bogota and the Social Foundation of Colombia.

BRAZIL

- DEMOCRACIA Y LIBERTAD
(Democracy and Freedom)
Zona de Cambé - Ciudad de Londrina
(City located in Southern Brazil)

Democracy and Freedom is a neighbourhood organization, which at the beginning worked with one community vegetable garden; today, it has extended its activities to 14 additional vegetable gardens to grow produce. It also works on the recovery of municipal lands and in water use and recycling (sources and lagoons). This neighbourhood group receives support from the municipality and UNICEF.

2.2. Possible institutions/organizations linked to urban agriculture

ARGENTINA

- CARITAS ARGENTINA (social assistance)
- MUNICIPALITIES Buenos Aires, Río Negro, Rosario (logistical support)
- Ministry of Education (education)
- Ministry of Agriculture (technical training)
- Ministry of Health and Social Action (education)
- NGO - MADRE TIERRA (Mother Earth)
- RETURN TO THE LAND PROGRAMME (In Mendoza)
- Agronomic University of Buenos Aires (technical support)
- National Technical Education School (In San Juan) (technical support)

BOLIVIA

- CARITAS BOLIVIA (social assistance)
- ADRA - OFASA (social assistance)
- Bolivian Centre for Information and Educational Action (CEBIAE) (technical support and training)
- Ministry of Health and Social Welfare (health support and nutrition)
- Ministry of Education and Culture (education)
- UNICEF (technical and financial support)
- Honorables Municipalities (forestral technical support)
- RICCERCA COOPERAZIONE (technical Assistance)
- Promotion and Education Experiences Association (AIPE) (nutritional institutions)
- Environmental Fund (technical support)

CHILE

- University of Chile (technical support)
- Catholic University (technical support)
- PNUD (technical and financial support)
- Solidarity & Social Investment Fund (FOSIS) (financial support)
- La Serena University (technical research)
- Ministry of Agriculture and Irrigation Directorate

PERU

- CELADEC (NGO) (training support)
- International Potato Centre (technical support)

COLOMBIA

- Apprenticeship National Service (SENA) (training)
- Social Welfare Department of Bogota (nutritional health)

3. FUTURE RESEARCH OPPORTUNITIES

Brief comments

The Latin American experiences in popular hydroponics, solid waste recycling, water treatment, rural digester and biogas and bio-fertilizers utilization are widely scattered regionally, and have been supported, encouraged and sponsored by different institutions at various times.

Popular Hydroponics have been initially implemented in Bogota, Colombia, with the technical support of a PNUD (Regional Project for Surmounting Poverty). This project demonstrated the Popular Hydroponics possibilities in water, air and substrates as applied in those social sectors of low economic means. Popular Hydroponics were mainly administered by women (90 % of the total); hydroponic is a low investment economic activity with low input costs, which does not require large spaces, heavy nutrients or concentrated input, but which does necessitates continuous technical support.

Although this is an activity demanding individual responsibility, it unifies the family since parents and children participate equally in the production process. Hydroponic production has not only increased and diversified food consumption but has also generated income through the marketing of products.

Solid waste recycling has been vigorously experimented in the Lima, Peru, suburban areas, by the ALTERNATIVA and CIPUR institutions. This work has been described. It receives some modest support from a few national institutions (municipalities, universities, churches), plus some financial assistance from Dutch NGO's, such as CEBEMO, which back this type of work.

The Planta de Celulosa Forestal e Industrial de Santa Fé (the Santa Fe Forestal and Industrial Cellulose Plant) in Santiago de Chile, is one of the greatest success stories in water

treatment. The Bío-Bío river, from the river-head to its sea embouchure, runs over 300 km through human settlements, small mining buddles, industrial complexes and other areas which discharge all types of contaminants and refuse in ever increasing proportions. To make the cellulose plant located at the river watershed of the Bío-Bío compatible with the use of its waters, the Santa Fe Plan has entered into an agreement with the University of Concepción to baseline study the contamination, assess future impacts, monitor these and make appropriate recommendations.

The results of this study are forcing the company to carry out further studies in the design and construction of a water treatment system (effluent neutralization and subsequent fibre decantation in a clarifier) to guarantee the appropriate minimum quality conditions for water use.

There are very few studies and research on the impact of urban agriculture on urban families; this impact has been studied by some research centres, such as UNITAS en La Paz, Bolivia (see the studies carried out by Julio Prudencio), CEUR in Buenos Aires, Argentina (see particularly the work carried out by S. Finquievelich) and, to a lesser extent, the work of Luz Cereceda and Max Cifuentes in Chile (specially the paper: *What do the poor eat? Eating patterns, shopping strategies and survival mechanisms*). These studies were carried out from different viewpoints: type, survival strategies of poor families, women, energy and environment.

Sectors involved in the different processes mentioned (water recycling, hydroponic production, etc.) are different actors (researchers, NGO's, private enterprises, international organizations and even state-owned companies) and, support is provided by various organizations, such as the PNUD-NNUU, the Dutch government through Dutch NGO's, etc..

Any intervention on the different aspects of urban agriculture (organic waste recycling for fertilizer use, water treatment, hydroponic production, improvement of infertile soils, etc.) should seek the collaboration of sponsoring financial and technical institutions (PNUD, Dutch cooperation agencies, etc.), government organisms such as municipalities, prefectures and, if possible, ministries in the relevant technical expertise/jurisdiction.

From the analysis of experiences, situations and challenges of urban agriculture implemented by low-income populations of different Latin American countries, some points emerge which should be considered in future urban agricultural applied research.

3.1. Water recycling systems.

Research problem:

Many Latin American cities have, characteristically, a series of underground² and above ground creeks and rivers (for example, Lima, La Paz, Santiago) which crisscross the whole city carrying waters that are utilized for different purposes, whether to carry solid wastes, garbage or even dead animals; these waters are not only used in the urban production of vegetables and other products grown through urban agriculture, but for the self-construction of homes, to wash laundry (as an occupation in which housewives engage to obtain some economic revenue) and even for direct human consumption, or in preparing meals, or as drinking water for the different animals these low-income families raise.

This situation, common to several Latin American cities, is the causal agent of permanent cholera breakups, and confirms that most of the sewage waters carried by rivers passing through most of those cities are carriers of the *Vibrio colerae*.

Faced with this situation, governments have developed some courses of action to control these epidemics and eliminate contaminants, in view of the impact these have upon the nutritional health of the population, on the production of fresh produce and even upon their export trade.

In just a few days, many hectares of agricultural lands in several Latin American cities, which until then had been traditionally worked by urban farmers or by farmers exploiting their fields in the periphery of urban areas, and who had been irrigating with waters from contaminated rivers, have been either destroyed or taken out of production. Similarly, many people have died from cholera and hundreds of thousands are under intensive care, all of them contaminated by the consumption of agricultural produce.

Despite the ongoing programs to sensitize the population to the dangers of using these contaminated waters, nothing has been achieved until now because there has not been an alteration of the situation since no structural solutions are offered, and, above all, because the low-income population lack material resources which would enable them not to use or to stop using contaminated waters or to consume products irrigated with them.

Objective:

a) research, analyze and build water treatment systems to recycle water to make it fit for human consumption, for the preparation of meals, and for urban agricultural production;

b) subsequently, research, analyze and build monitoring systems for the conditions of rivers to satisfactorily ascertain water status.

Implementation:

Several steps must be taken in order to implement the previously stated objective. Firstly, preliminary analysis must be undertaken on the actual contamination of rivers, not only in points where tributaries discharge their waters, but in areas of eventual dissemination of pollutants, as well as in the areas preceding the said discharges. This will enable to determine the basic level of pollutants carried by rivers and their impact upon wildlife so as to monitor and correct any critical situation. Also, basic contamination parameters and projections of their future impact should be developed. A water treatment plant system for subsequent fibre decantation in a classifier should be built.

The second step, following a monitoring period, will be useful for treatment according to the needs detected after relevant monitoring.

Urban agriculture can fulfil a significant role in the recycling of organic residues from the water, as these residues are good fertilizers once the pathogens are removed. However, research must be undertaken to define the level and type of solution which is admissible, bearing in mind the type of urban produce grown.

3.2. Popular hydroponics³

Research problem:

One of the main obstacles affecting urban agriculture as practised by low-income families in Latin American countries is water contamination; this problem has been explained in depth in the previous section. Other problems include: scarcity of land or spaces suitable for urban agriculture (due to increasing rural-urban migration, urban congestion and high demographic density), exhaustion or waste of current agricultural urban lands (due to overexploitation), or to the long distances where other suitable, not utilized, farming lands are located.

Objectives:

a) to determine the social, economic, agronomic and marketing feasibility of producing vegetables, either as a group of products or individually, by popular hydroponic principles applied by low-income population in urban and semi-urban areas;

b) to formulate a Popular Regional/National Hydroponics Program able to articulate, support and promote over the long term the efforts and activities of the different institutions which are participating in the said programme.

Implementation:

Hydroponics is a farming method based on aerated water or substrates saturated with nutrient solutions, requiring several steps for its correct implementation.

- Education and training in hydroponics techniques, together with reference material and measuring devices.
- Training in adapting the technology to the physical and climatic conditions of each city/region where the project would be installed, and to the characteristics of products consumed at each locality.
- To promote in each region a minimum basic knowledge to motivate the interest of urban farmers in the hydroponics technique to then be able to detect and formulate specific projects.
- Preparation of massive dissemination popular hydroponics programs (by establishing demonstration vegetable gardens at the institutional and group levels) basically leading to the alimentary self-sufficiency of low-income families.
- Support and follow-up experiences based on models adapted from other countries.
- Joint work among international institutions (PNUD), governments, NGOs and associations of producers to achieve better operational results.

In synthesis, it can be said that to become an efficient hydroponics producer requires knowledge on the part of the user, technical assistance enabling to identify optimum nutrients (inputs), to adapt traditional products to the hydroponics technique, and to identify solutions to physiological, environmental, health and other problems.

Similarly, hydroponics is an activity in which all members of low-income families can participate, without requiring large free spaces, and with definite nutritional and economic benefits for the household should some of the products be sold, with the added possibility of feeding (with food wastes) small domestic animals raised in the household. Water recycling and popular hydroponics constitute mere suggestions for applied research programs are closely interconnected with improving the environment and with achieving a real sustainable development.

3.3. Impact of urban agriculture upon the urban family

To supplement the applied research on waste and water treatment and Popular Hydroponics, socioeconomic research is suggested on the impact of urban agriculture at the

micro family level. Although this activity has been broadly disseminated in the cities⁴, particularly among low-income families, there is a series of questions to which no answer has been forthcoming, namely:

- What urban agricultural system is the most advantageous for the families?
- When implementing urban agriculture, what are the main problems?
 - in marketing the products?
 - in organization/administration?
 - in production?
 - in availability of technology?
 - in training?
- What are the benefits of urban agriculture for the family?
 - in terms of consumption/nutrition?
 - in terms of contributing to the alimentary sufficiency of the family?
 - in terms of income-expenditures of the family?
 - in agronomic terms?
 - in social terms?
 - in terms of time invested?
- What productivity levels are achievable with urban agriculture?
- What recycling levels of solid and liquid wastes are achieved?
- What support is given to this activity in terms of credits, technical assistance, technological transfer, etc. from NGOs, state institutions and international institutions?

Socioeconomic research can be undertaken in several Latin American cities, considering different agricultural production systems used by low-income families, to accurately determine real impact upon the family in terms of consumption/nutrition, income and expenditures, use of family labour (especially the role played by women); supplies to urban food markets, and yields achieved in the cities.

The elaboration of common research protocol for a multiple-country study is recommended; this would ensure comparable results, and a method to specific areas requiring more support than others.

NOTES

1. Although there are other more sophisticated products, such as mushrooms, broccoli, strawberries and others, these are produced by farmers with greater technical knowledge and economic means (water, land, etc.).
2. For example, the city of La Paz is crisscrossed North-South and East-West by more than 200 underground creeks and rivers.
3. Although hydroponics is known throughout the world, it is not generally known or practised in Latin America, with the exception of Colombia and some small regions in Central America where it is being promoted with excellent results.
4. There are several studies on this topic, although with different approaches and perspectives.

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