

# **Urban Agriculture in India:**

**A survey of expertise,  
capacities and recent  
experience**

**By:**

**Gisele Yasmeen, Ph.D**



Cities Feeding People Series  
Report 32

CFP Report 32

**Urban Agriculture in India:**  
A Survey of Expertise, Capacities and Recent  
Experience

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## Summary

"How will South Asian cities be fed?" is an important question demanding attention due to the rapidly growing urban population of the sub-continent. Urban and peri-urban agriculture (UPA) is one set of activities resulting in greater food production, improved livelihood opportunities for urbanites and the enhanced environmental quality of cities. This report provides an overview of existing UPA resources and activities in India with particular emphasis on Delhi and Bangalore though many examples from other Indian cities are also presented.

Documentation on UPA in India is extensive, particularly concerning composting initiatives, advances in dairying in urban and peri-urban areas and horticultural activities in cities. In other sectors as well, such as peri-urban aquaculture (particularly around Calcutta), the rest of the world has a tremendous amount to gain by paying attention to what has been taking place in India.

Key research issues and challenges with respect to UPA in India and the rest of the sub-continent involve recognising and building the innovative activities already taking place there. This includes dissemination of information and fostering the extension and replication of experiments and local schemes in other parts of the region. Other challenges involve gathering more information about less documented areas of UPA including animal husbandry, food processing and safety/health issues and connecting India to the larger UPA world.

IDRC's "Cities Feeding People" program initiative has resulted in the Centre becoming one of the world's foremost authorities on urban agriculture and a prominent repository for information on UPA. The release of this report signals a growing interest at the Centre on UPA issues in Asia, the world's most rapidly urbanising mega-region. IDRC's South Asia Regional Office is in a position to become actively engaged in the CFP program. Suggestions for this involvement are highlighted in the conclusion and consist of playing a crucial role in the dissemination of information on UPA in the sub-continent. Linking the agents identified in this report through information and communication technologies (ICT) and serving as a clearinghouse for this information will be pivotal. The Centre should also draw attention to the link between improved UPA, poverty alleviation, effective post-harvest technologies, distribution and marketing. IDRC can produce and fund more research on UPA in the South Asian region, particularly participatory, action-based research.

Extensive appendices accompany this document. The first lists more than 100 individuals, institutions and private sector organisations involved in UPA in India and their full contact information including e-mail where available. The second major appendix is a comprehensive, though certainly not exhaustive, bibliography of almost 120 documents. Links to relevant websites are also included.

## **Acknowledgements**

Many individuals and organisations have devoted their time to helping me compile this report. First, I am grateful to Dr. Madhav Karki and Liz Fajber for bringing the possibility of this contract to my attention when I visited the IDRC office in New Delhi in January 2000. My heartfelt thanks go out to Damandeep Singh and Dr. Mridul Salgame who helped provide baseline information for the report including numerous contacts, references and "stock knowledge" related to urban agriculture. The project would not have been completed without them.

Angela Tindyebwa did most of the data entry for the MS Access database - consisting of contacts and bibliographic references - that accompanies this report. Her help in this project was invaluable given the volumes of information on UA and related activities in India and the need to organise the information. Peter Maria helped work out various "glitches" as a result of my lack of experience with MS Access. Cyndia Pilkington's meticulous copyedits were indispensable. BrendaLee Wilson provided useful editorial suggestions for the published version.

I would, in addition, like to acknowledge a debt of gratitude to Mike Levenston (Executive Director of CityFarmer), Dr. Christine Furedy of York University, Rachel Nugent of the FAO in Rome, and Henk de Zeeuw and Wietse Bruinsma of ETC Netherlands for their help in accessing needed data. In India, Dr. R.T. Doshi and Mr. Asim Kumar Sen were particularly generous in sharing information.

Finally, I am grateful to the many other contacts listed in the appendix of this report who were kind enough to respond to our requests for information.

Gisele Yasmeen, Ph.D.  
Vancouver, Canada

May 8, 2001

## Key Urban Agriculture in India Contacts by Place

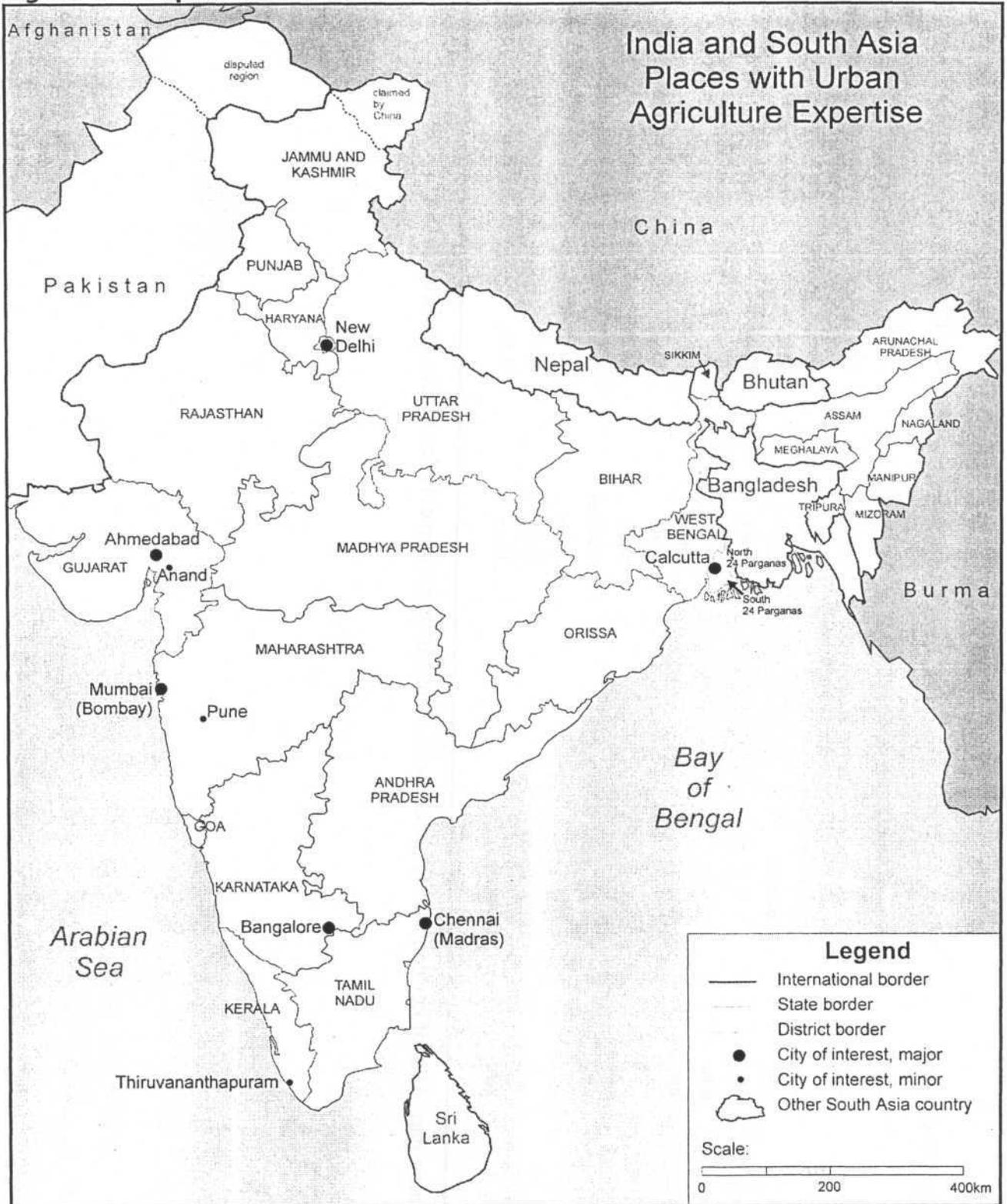
City / Municipality	Country	CompanyName	LastName	FirstName	Keywords
Anand	India	Gujarat Cooperative Milk Marketing Federation			Dairying
Bangalore	India	Waste Wise	Rosario	Anselm	Waste Management Composting
Bangalore	India	FRESH	Salgame	Mridul	Food Safety and Hygiene
Bangalore	India	Karnataka Meat and Poultry Marketing Corporation	Kumar	D.L. Shantha	Meat & Poultry Processing
Bangalore	India	HOPCOMS	Sudhakar	M. Amruth	Horticulture
Bangalore	India	Karnataka Compost Development Corporation	Reddy	Govinda	Compost Waste Management
Bangalore	India	Agriculture Man Ecology (AME)	Lanting	Mans	Organic Produce Marketing
Bangalore	India	Agricultural & Processed Food Products Export Development (APEDA)	Ravindra	R.	Food Processing
Bangalore	India	Khoday Group of Industries	Rao	C.B. Jagannatha	Technology Vermicompost manufacturer
Bangalore	India	Centre for Environment Education (CEE)	Raveendranath	Shylaja	Environmental Sustainability
Bangalore	India	IMO Control Private Limited			Organic Agriculture Water Management
Bangalore	India	Technology Informatics Design Endeavour (TIDE)	Bhogle	Svati	Food Processing, Dehydration
Bangalore	India	Multiplex Kamataka Agrochemicals	Reddy	A.N. Yellapa	Horticulture UA General
Bangalore	India	Bangalore Metropolitan Reg. Development Authority (BMRDA) ECONET	Lai	Batan	Urban Planning
Bangalore	India	Terra Firma Biotechnologies Ltd.	Ganesha	R.	Vermicomposting
Bangalore	India	University of Agricultural Sciences	Kale	Radha D.	Vermiculture
Bhubaneswar	India	Central Institute of Freshwater Aquaculture	Saha	D.	Aquaculture
Calcutta	India		Sen	Asim Kumar	Wastewater Aquaculture and Horticulture
Calcutta	India	Centre for Built Environment	Ghosh	Santosh	UA General
Calcutta	India	Environmental Improvement Programme	Ghosh	Dhribajyoti	Aquaculture

City / Municipality	Country	CompanyName	LastName	FirstName	Keywords
Calcutta	India	Mudialy Fisherman's Co-operative Society	Chowdhury	Muket Roy	Aquaculture
Calcutta	India	Calcutta Metropolitan Development Authority	Som	Nisit	Urban Planning
Chennai	India	Institute for Research in Soil Biology & Biotechnology	Ismail	Sultan	Vermiwash
Chennai	India	Exnora International	Ramkumar	T.K.	Waste Management, Composting, Rooftop UA General
Chennai	India	Academy for Management Excellence	Ganapathy	R.S.	UA General, Environmental Issues Vegetable Marketing
Delhi	India		Singh	Damandeep	
Delhi	India	University of Delhi	Bhupal	D.S.	
Howrah	India		Das	Pradip	Pearl Culture
Karjat	India	Independent Consultant	Savara	Mira	Food Agriculture
Karnal	India	National Dairy Research Institute	Rajorhia	G.S.	Dairying & Peri-urban
Mapusa	India	Other India Press	Alvares	Claude	Organic Agriculture Dairying
Mumbai	India	Green Cross Society & Save Our Selves	Shenai	Shantu	UA General Vermiculture Ecotechnology UA General
Mumbai	India	Indian Institute of Technology - Mumbai	Seshachalam	Chamarthy	UA General
Mumbai	India	Agricultural Finance Corporation Ltd.	Dikshit	A.P.	UA General
Mumbai	India	PRAKRUTI	Mehta	Kisan	Sustainable Agriculture
Mumbai	India	Urban Development Institute			
Mumbai	India	Institute of Natural Organic Agriculture (INORA)	Doshi	R.T.	Horticulture Vermiculture
Mysore	India	CFTRI	Prakash	V.	Food Technology
New Delhi	India	Shristi	Agarwal	Ravi	Composting Waste Management Medicinal Plants
New Delhi	India	International Development Research Centre	Karki	Madhav	
New Delhi	India	Centre for Science and Environment (CSE)	Agarwal	Anil	Sustainable Development
New Delhi	India	Yardi and Sorrée	Sorrée	Hay	
North 24 Parganas	India	Central Institute of Fresh Water Aquaculture			Aquaculture
North 24 Parganas	India	Rahara Waste Water Aquaculture Division	Das	C.R.	Aquaculture
North 24 Parganas	India	Waste Water Aquaculture Division	Datta	Anup Kumar	Aquaculture
P.O. Bangalore	India	Indian Institute of Horticultural Research	Reddy	P.P.	Horticulture
P.O. Bangalore	India	Centre for Processed Foods	Prakash	R.	Food Processing

City / Municipality	Country	CompanyName	LastName	FirstName	Keywords
Pune	India	Institute of Natural Organic Agriculture (INORA)	Tamhamkar	Vaishali	Organic Agriculture,
Pune	India	Bhawalkar Earthworm Research Institute (BERI)	Bhawalkar	Uday S.	Vermiculture Ecotechnology
Pune	India	NRG Tech Consultants	Babar	Rahul	Vermiculture
Pune	India	Kalpavriksh	Rao	Sunita	Organic Produce
South 24 Parganas	India		Ghosh	Bhabanath	Aquaculture, Dairying
South 24 Parganas	India		Mondal	Bholanath	Fruit Orchards
South 24 Parganas	India		Mondal	Md. Jabbar Ali	Fruit Orchards
South 24 Parganas	India		Naskar	Kanai	Fruit Orchards
South 24 Parganas	India		Ghosh	Mridul	Aquaculture
South 24 Parganas	India		Mukherjee	K.D.	Apiculture, Aquaculture
Trichy	India	CARE	Maheen	Kunjappa	
Trichy	India	LEISA Network	Quintal	Oswald	Sustainable Agriculture
Trivandrum	India	Landpeople	Joseph	K.J.	Hydroponics

This represents a partial list of key contacts. Other contacts, including those from outside of India, are listed in the Appendix.

**Figure 1 – Map of India and South Asia**



## **Introduction**

The International Food Policy Research Institute in Washington, DC summarises some of the reasons urban agriculture is a fundamental issue to be examined.

In some cities, urban agriculture is an important coping strategy for households. Because women often have the responsibility for food procurement for the household, they are frequently involved in urban agricultural production and sales. Urban agriculture presents a number of challenges, including competition for scarce land, degradation of soils, and pollution. At the same time, urban agriculture offers new potential for recycling urban wastes, saving on marketing-transport costs and providing the poor with employment (Ruel *et al*, 2000, p. 2).

This report reviews and summarises the extent of research, existing resources and key activities related to urban and peri-urban agriculture (UPA) in India. Urban and peri-urban agriculture (UPA), is defined as "an activity that produces, processes, and markets food and other products, on land and water in urban and peri-urban areas, applying intensive production methods, and (re) using natural resources and urban wastes" (IDRC 2000, [www.idrc.ca/cfp](http://www.idrc.ca/cfp)).

Research was focused primarily on gathering secondary data in Delhi and Bangalore, but a significant amount of information was also garnered with respect to Mumbai. Other parts of India are referred to where information was available. The result is the creation of a "map" or scoping document which provides information on the individuals, organisations and agencies involved in UPA as well as brief summaries of their activities and projects.

A concise review of the key issues with respect to UPA in the sub-continent more generally introduces each section of the report. The report also lists existing on-line resources such as websites and databases both interspersed within the main text and toward the end of the document and also includes an annotated bibliography of published and other material.

The conclusion summarises the main findings of the reports and points to lacunae where further research may be undertaken. It also suggests areas where IDRC and others might consider getting involved in future projects.

### ***Definitional & Methodological Issues***

In any context, defining what is meant as a "city" can be complex. While there are very well delineated legal boundaries, which separate, say, urban from rural districts, these borders can change regularly depending on fluctuating socio-economic and

demographic conditions. In Asia in particular, defining "urban", "peri-urban" and "rural" is especially challenging where high population densities can result in "rural" areas being more populated per square metre than, say, Canadian and American cities. In addition, the well-documented trend of "rural industrialisation" has resulted in a further questioning of what is meant by urban versus rural and a blurring of boundaries between activities related to these ostensibly distinct types of places.<sup>1</sup> For the purposes of this report, urban and peri-urban have been based on simple legal and geographical definitions, which identify certain *talukas*<sup>2</sup> as urban, and the rural (or peri-urban) districts immediately surrounding these cities. At times, some information may be included for what are clearly thought of as rural areas in India. These data have been included because they are deemed to have relevance in one way or another to urban and peri-urban agriculture and related activities.

Another difficulty involves deciding what exact range of activities are to be included in a report on Urban Agriculture capacity. This is beyond substantive concerns such as whether to include dairying and animal husbandry but refers to how many and what type of "upstream" and "downstream" activities - in addition to the production of food and other agricultural products - are to be included. For example, to what extent should related activities such as suppliers providing inputs such as fertiliser, seeds, composting and technology be included in the inventory? The same applies to downstream services such as those pertaining to the marketing and distribution of urban agricultural products as well as associations representing city farmers (such as the All-India Kitchen Garden Association). The approach used for this report was a broadminded one that includes references to individuals and organisations working in a myriad of upstream or downstream activities directly connected with UA.

A final note about constraints involved in collecting information on UA in India. My assistants and I were dependent on the goodwill and co-operation of various contacts in order to complete this study. While many resource persons and organisations generously gave of their time to respond to our questions, others did not provide information (perhaps due to an incorrect address, contact person or lack of time on the part of the person/organisation concerned). All contacts we came across through word of mouth, on the internet or through existing compendia - whether they directly answered our queries or not - are included in this scoping document.

## **General Work on Urban Agriculture in India**

In terms of a comprehensive, citizen-driven approach to agriculture in an urban setting, the example of Mumbai stands out first and foremost in India. Perhaps due to the fact that it is the most highly urbanised "concrete jungle" of the sub-continent combined with a lack of space for waste disposal the right type of environment has emerged for the creative cultivation of plants and waste reduction through compost

<sup>1</sup> McGee, T.G., and Robinson, I. eds. 1995. *The Mega-Urban Regions of Southeast Asia*. Vancouver: University of British Columbia.

<sup>2</sup> *Talukas* are municipal-level administrative units in India.

development in a dense urban environment. Some of the key actors of Mumbai in UA - particularly Dr. R.T. Doshi and Kisan Mehta of Prakruti - will be introduced later in this report.

The most comprehensive scholarly study of UA with respect to a specific Indian metropolis concerns the forward-looking policies and experiments undertaken in Ahmedabad, Gujarat, particularly while Keshav Varma was Municipal Commissioner.<sup>3</sup> The city is known for progressive UA policies with respect to urban horticulture, forestry and solid waste initiatives (Furedy, 1999 - comment on [www.cityfarmer.org](http://www.cityfarmer.org)).

### **Box 1: The City of Ahmedabad**

Professor Suganda Ganapathy of the Indian Institute of Management, Ahmedabad was conducting an extensive research project in the early 1980s. In his report entitled "Urban Agriculture, Urban Planning and the Ahmedabad Experience" (1984) he concentrates extensively but not exclusively on horticulture and traces the historical trends and future potential for UA in the metropolitan area.

Professor Ganapathy concludes that while there has been a decrease in subsistence agricultural activities in the metro area, there exists great potential for greater vegetable and fruit cultivation in the urban area and peri-urban fringe. Similarly, though there was, at the time, a decrease in garden land available, market gardens and home gardens were found in all the villages of the Ahmedabad metropolitan region. Increased peri-urban production was responding to the demand of the growing middle and higher-income groups. At the same time, the author points to an increase in home gardens for the middle and higher income groups, which reflect aesthetic and recreational considerations rather than food or income security concerns.

Professor Ganapathy provided details on the link between co-operatives and UA. The Ahmedabad Co-operative Vegetable and Fruit Growers Association had 2000 members in the mid-1980s. At the time, municipal hospitals were buying produce exclusively from this supplier. Finally, the report explains the Ahmedabad Municipal Corporation's "Kitchen Garden Scheme" of 1983/84 to encourage the production of food in urban areas.

The Centre for Built Environment ("A non-profit Society for Architecture, Human Settlement and Environment") based in Calcutta, organised a major international workshop on urban agriculture in December, 1995. Unfortunately, no publications issued from the conference due to a lack of funds. However, this event yielded a number of interesting resource persons on UA in India more generally. These persons and the results of the 1995 international workshop might be used as a baseline for future activities in the sub-continent on UA.

<sup>3</sup> Mr. Varma, now at the World Bank, was known for his progressive urban policies in general and specifically for his issuance of a municipal bond to improve urban planning and infrastructure.

Two other general studies pertaining to UA in South Asia exist, but it has been difficult to obtain information about the findings reported in these documents. One, by Sandhiya Chatterjee entitled "A preliminary study of Urban Agriculture in New Delhi" was completed for ETC's India office in 1993. A second consists of the results of a workshop on UA in Dhaka hosted by Proshika, one of Bangladesh's largest non-governmental organisations, in 1997. Further research would be needed to obtain details about the findings of these two projects.

### ***Pollution & Health Hazards Associated with UA in India***

As Kathleen Flynn has observed, the health hazards associated with UA have "traditionally been understudied" (LaBond, 2000). However, with the rapid growth of cities internationally, sustainability and related health concerns have come to the forefront. South Asia is similarly plagued by the ills of unharnessed urban growth and concomitant hazards such as deteriorating air, water and soil quality - all fundamentally related to the health urbanites as well as of flora and fauna found in cities (Cf. SDRI, 1998 & 1999). Some hazards "are a direct result of farming practices" such as the high density of livestock in a specific location (LaBond, 2000). Given the important presence of goats, sheep and particularly cattle in Indian cities, this point warrants great emphasis and the work summarised in the next section (with the exception of remarks made with respect to aquaculture) does not adequately address this issue.

The only work that, to our knowledge, systematically addresses one of the health hazards associated with UA in India is a two-phased project managed by Dr. Fiona Marshall of the T.H. Huxley School at Imperial College. The project, is entitled "The Impacts and Policy Implications of Air Pollution on Agriculture in Urban and Peri-urban Areas of India." It is mostly funded by the Department for International Development (DFID) and has been focused in and around Delhi and Varanasi (formerly Banaras) over the past five years (Marshall, personal communication, 2000). Project partners include:

- Banaras Hindu University, Varanasi
- Jawaharlal Nehru University, Delhi
- Dr. Neela Mukherjee, PRA consultant in collaboration with Action Aid India and others
- Delhi University
- Indian Council of Agricultural Research, and
- Local NGOs including SHRISTI & SEEDS.

Project goals include assessing the quantitative and qualitative impacts of air pollution on agriculture in and around these two Indian cities and improving the capacity of local partners to reduce impacts principally by influencing policy makers

to reduce the problem at the source.

## **Specific Areas of Capacity**

There is a great deal of information on a few key areas of UA in India, particularly composting, which consists of aerobic composting and vermicomposting (i.e. using worms) and the cultivation of the worms themselves (vermiculture), horticulture and aquaculture. Calcutta is known internationally for urban and peri-urban waste fed aquaculture in the extensive wetland areas near the city. These areas are under threat of redevelopment which, depending on the outcome, may have serious repercussions for food-security, livelihoods, waste management and environmental quality in the Primate City of West Bengal. Since the advances in dairying in peri-urban areas have made international headlines over the past several years and are therefore quite well documented, this report simply highlights some of the main case studies and literature related to that topic.

Comparatively less is known about animal husbandry, apart from dairying, in urban and peri-urban areas of India. Certainly, the raising of livestock in cities of the sub-continent is a well-known fact but little appears to be associated with the mainstream literature on UA. I have included relevant examples and contact persons in these sub-sections.

Finally, a section entitled "other" is a repository of disparate information concerning lesser-explored aspects of UA including sericulture (silkworm rearing), apiculture (bee-keeping and honey production), the raising of medicinal herbs and plants and the cultivation of ornamental plants, trees and shrubs.

### ***Composting & Vermiculture***

*"Love Garbage. It is a great wealth generating resource. "*  
- Dr. R.T. Doshi, *Community City Farming.*

Aristotle apparently referred to earthworms as the "intestines of the earth" (Kale and Mardan, 1999 p. 15). Though composting of organic waste can take place without worms, a practice known as aerobic composting (Furedy 2000) the presence of these small creatures - particularly certain varieties - greatly expedites composting and improves the conversion of waste into nutrient-rich soil conditioner. However, there may be hazards associated with worm composting and the added expense may not make the resulting product commercially viable.

The development and implementation of both types of composting is well documented in India, and the use of composting has attracted a great deal of attention from those outside the South Asian region. Reliance on composting is perhaps a case

of necessity being the mother of invention. Indian cities, particularly megacities, are fraught with the challenge of dealing with increasing reams of garbage. Kitchen waste, as well as organic waste from industry (food service, hotels, and slaughterhouses) is being composted in schemes of various scales throughout the country though there is certainly potential to further the practice, given India's vast amounts of organic waste<sup>4</sup>. The nutrient rich compost is then used to grow fruits and vegetables - much of it being sold to farmers in rural areas and peri-urban areas. It is unknown to what extent compost is being purchased by urban householders for their own gardens, but it is clear that many city farmers, such as Dr. R.T. Doshi, are producing compost for their own use. Composting can therefore potentially be a significant livelihood activity for urbanites. Currently, all types of composting appear to be well developed in *rural* India (Furedy 2000)<sup>5</sup>.

Examples from Mumbai, Pune and Bangalore are the most prominent places for various types of composting activities. A special issue of the *Worm Digest* ([www.wormdigest.org](http://www.wormdigest.org)) published in Oregon, details many vermicomposting initiatives in a short, accessible and easy to read format.

### Government Agencies

There is one arm of government that needs to be profiled here. The very existence of the Karnataka Compost Development Corporation is a testimony to the importance of vermiculture within the state. The KCDC manufactures compost from city waste. They supply compost in the city for kitchen gardens through a mobile unit and they also have dealers in the city and other nurseries that sell their compost.

In a recent publication by Inge Lardinois and Rogier Marchand (in Bidlingmaier *et.al.*1999) it was found that KCDC's plant on the outskirts of Bangalore was producing 27 tonnes of compost per day. Despite this remarkable figure, the KCDC's output only accounts for 1.5% of organic waste composted in and around Bangalore.

### Civil Society Organisations

There are a number of prominent civil society organisations that have advanced the cause of promoting worm composting in urban areas. In Mumbai the work of Prakruti and the Institute for Natural and Organic Agriculture has drawn widespread

<sup>4</sup> Dr. Christine Furedy, an expert on SWM in Asian cities, suggests that further research needs to adequately determine the scale and nature of compost production in urban India as well as the affordability of compost to consumers. She reports that several municipalities have abandoned their composting plants in recent years. Dr. Furedy also notes that vermicomposting appears to have been of recurring interest in India but is unsure of whether it is simply a fad at the moment. She also has concerns about vermin being attracted to worms in urban composting schemes (Furedy 2000). This report only amalgamates secondary sources of information and does not evaluate the information and schemes discussed.

<sup>5</sup> Dr. Furedy suggests contacting Dr. Satyawati Sharma ([satyawatis@hotmail.com](mailto:satyawatis@hotmail.com)) in New Delhi who specialises in rural vermicomposting research.

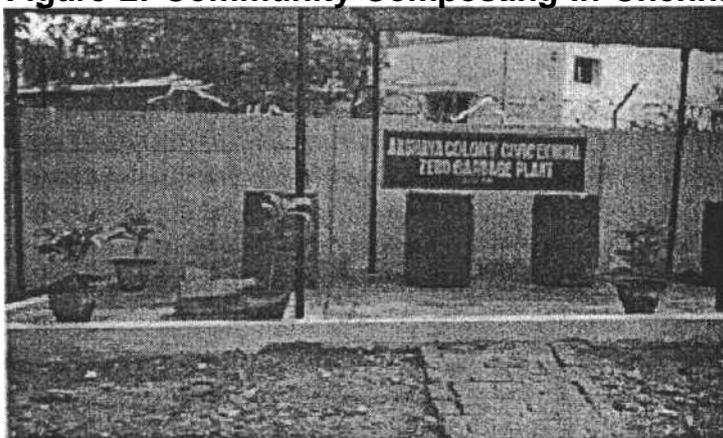
attention, as have the relentless efforts of Shantu Shenai of the Green Cross Society and SOS (Save Our Selves).

In Bangalore, the work of Waste Wise, led by Anselm Rosario and Agriculture Man Ecology (in consort with ETC Netherlands) are examples of civil society organisations active in waste management in general and composting in particular. Swabhimana and Civic are other prominent examples of community-based organisations working to promote urban sustainability through effective waste-management.

Exnora (an acronym of Excellent, NOvel and RAdical Ideas) was founded in 1989. The organisation has been extensively involved in promoting effective solid waste management at the community level. All their schemes revolve around extensive public participation in community-ownership. There are now more than 3000 community-based Exnora "chapters", known as Civic Exnoras, which promote integrated SWM involving rag pickers (scavengers), separation at source and extensive composting of organic waste.

Figure 2, below, depicts the composting activities of Civic Exnora in Akshaya Colony, Chennai.<sup>6</sup>

**Figure 2: Community Composting in Chennai**



Ref: <http://indiaa.com/exnora/swm.html>

According to Exnora:

The households in this street have formed a Civic Exnora. Every house segregates their waste at source. The Civic Exnoras has distributed a green colour basket to every household, into which the residents store organic wastes. The street beautifier collects these wastes in one compartment of his tricycle, and the other inorganic recyclable waste in another. The organic wastes are converted to manure through aerobic composting, which is used in their own gardens. The street beautifier separates inorganic waste, sells it to

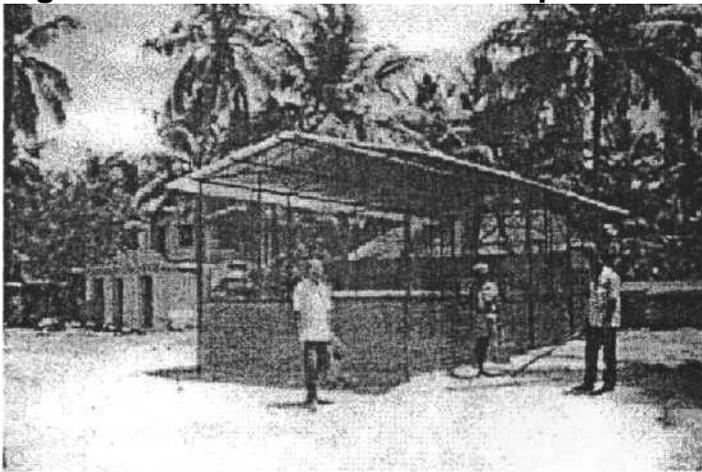
Chennai was formerly known as Madras.

waste buyers and earns an additional income. A small quantity of waste that cannot be recovered is transported to secondary collection points for collection by the Municipal authorities. (Quoted from <http://indiaa.com/exnora/swm.html>)

Exnora is also involved in a program in Cochin (Kotchi) the largest city in the State of Kerala. This SWM program is a joint project of the Corporation of Cochin, Greater Cochin Development Authority (GCDA), Institutions of Engineers, Rotary and Exnora with the support of Indian Express and Mathru Bhumi. The scheme involves separation at source (i.e. the household level), the development of a municipal composting facility resulting in the construction of a three-chambered compost shed depicted in Figure 3 (see <http://indiaa.com/exnora/cochin.html> for details on the Cochin project).

The composting process in the shed takes about 20 days<sup>7</sup> and involves "inoculation of organic waste by a bacterium called 'garbactum' by spraying, or by mixing with bio-dung" (<http://indiaa.com/exnora/swm.html>). The process does not generate foul odors and the resulting soil conditioner is given to local farmers, gardeners and other agriculturists.

**Figure 3: Three-Chambered Compost Shed in Cochin**



Ref: <http://indiaa.com/exnora/swm.html>

With respect to all of the civil society initiatives described above, there is a need for further research to quantify how much are they producing, how much waste are they processing, their selling price, and who the buyers of the compost are. Also, the effectiveness of the above schemes needs to be fully evaluated.<sup>8</sup>

<sup>7</sup> An unusually short period given that most composting activity usually takes a minimum of six weeks according to Christine Furedy.

<sup>8</sup> I would like to thank Dr. Christine Furedy for making this very important remark.

## Universities & Research Institutes

On the more academic front, there are a number of prominent university and institute-based researchers dealing with vermiculture. Dr. Radha Kale, Zoology Professor in the University of Agricultural Sciences has published extensively on vermicomposting since the early 1970s. In addition to her strictly academic work, Professor Kale has provided information and extension services for the farming community and has collaborated on a number of government led initiatives related to municipal solid waste management. In addition, she frequently provides media commentary on vermiculture and composting. Dr. Kale's work, however, is mostly oriented toward rural areas.

Dr. Christine Furedy of York University has spent many years studying waste management in India and has recently focused a great deal of effort studying the municipal composting schemes. Dr. Furedy is a faculty member in the Department of Urban Studies and is joint and contributing editor of UNEP's International Source Book on Environmentally-Sound Technologies for Solid Waste Management (1996). She has written numerous books and articles dealing with the social aspects of waste recovery (primarily in Asian cities), and of the link with larger urban sustainability issues. Her most recent work on India includes co-editing a book on waste management in Asia for WASTE (1999), a chapter contributed to *For Hunger-Proof Cities* (Koc *et. al* 1999), and a chapter on Asian municipal solid waste reduction. The United Nations Centre published the latter for Human Settlements (Savage and Ray 1999). Dr. Furedy is one of, if not the primary, link between Canada and South Asia in the field of urban solid waste management.

### **Box 2: A Hubli-Dharwad Study on Urban SWM**

Dr. Fiona Nunan of the School of Public Policy at the University of Birmingham has been co-ordinating a research project on urban solid waste management in Hubli-Dharwad in the state of Karnataka. The Department has funded the project for International Development and several reports are available.<sup>9</sup>

The main aim of this research was to explore how the collection, disposal and treatment of urban waste can better meet the needs of farmers, particularly small farmers, in the peri-urban areas of Hubli-Dharwad, India. Within the twin-city of Hubli-Dharwad, MSW has been purchased from the two dumpsites, one in Hubli and the other in Dharwad, for many years. The waste is now purchased from the dumpsites by tractor loads. Until 1997, decomposing MSW was sold from the Dharwad dumpsite via an annual auction system managed by the Hubli-Dharwad Municipal Corporation (HDMC), selling waste by the pit load. The auction system stopped because of the lack of staff at the dumpsite to prepare pits for auction and to manage the auction process.

The main conclusions from the research include:

<sup>9</sup> Dr. Fiona Nunan, personal communication, September, 2000.

- An integrated approach to urban waste management, currently absent, is needed to improve the use of urban waste. Such an approach should recognise the roles of livestock keepers and farmers, incorporate approaches to segregate waste materials, manage the waste in an environmentally sustainable way and consider effective ways to market waste.
- Declining quality of MSW was the most often cited reason given by farmers for not using MSW. Segregation of waste materials is a key issue, but it is a very difficult problem to solve in a cost-effective manner. The involvement of a range of stakeholders is needed, as is perseverance in raising awareness.
- There is a range of options that could be considered to maintain access to MSW by near-urban farmers. These options include subsidising composts produced by the private sector, producing a range of composts at different prices and maintaining access for farmers and the private sector.
- Marketing the waste does not appear to be the most important issue in Hubli-Dharwad. The main problem is to improve the quality of the MSW (principally by removing contaminants);
- Transport of MSW from the point of collection to the farm was also identified as a significant constraint for small farmers wishing to utilise this resource.

The research concluded that MSW plays a useful role as a soil amendment, but problems with quality and access have to be addressed if the use of urban waste by near-urban farmers is to be encouraged.

Other institutes and individuals which deserve mentioning in this section on vermiculture/composting is the Bhawalkar Earthworm Research Institute (BERI) based in Pune. Dr. Uday Bhawalkar has developed a particular method of vermiculture ecotechnology that "provides a complete ecosystem in which earthworms, beneficial soil bacteria, the roots of living plants and even several pests (as crisis managers) act in their natural symbiotic relationship" (White 1997). Dr. Bhawalkar and BERI's work is well known in vermiculture and composting circles and was described in detail in issue 15 of the *Worm Digest*. The uniqueness of the BV technology (as it is known) is the use of deep burrowing earthworms.

The above issue also profiled the work of another prominent Pune-based vermiculturist, Ms. Vaishali Tamhankar of the Institute of Natural Organic Agriculture (INORA). "INORA has developed worm compost technology using the surface dwelling earthworm (red worm) species *Eisenia foetida* and *Eudrilus euginae*, which they have found to be very efficient for organic waste management" (White 1997b). It is unclear to what extent the two Pune institutes deal with urban as opposed to rural vermiculture and related composting initiatives.

Two individuals based in the state of Karnataka warrant mention. Dr. V.R. Ramakrishna Parama is a soil scientist in the College of Agriculture of the University of Agricultural Sciences. His areas of expertise are:

- 1) Motivation of urbanities in participatory appraisal of managing urban

- wastes;
- 2) Urban and peri-urban agriculture;
  - 3) Technology development for managing urban wastes, and;
  - 4) Utilisation of agricultural and industrial wastes to benefit peri-urban agriculture

Dr. Krishna Moorthy Varanashi, of the Varanashi Research Foundation in Adyanadkha, taps agro-industrial wastes such as coir pith, saw dust, rice mill waste, coffee husk, areca husk and leaf sheaths to make compost. The Foundation advocates that this technology can cut the costs of manure and strengthen soil and plant health.

Finally, the well-known Sulabh International Institute of Technical Research and Training (SIITRAT) has become internationally renowned for its work in waste management, biogas technology and low-cost sanitation.<sup>10</sup>

## Private Sector

In the private sector, there are a number of firms making inroads in the fields of vermiculture and composting.

Terra Firma Biotechnologies is a Bangalore-based company involved in the manufacturing and sale of compost using organic and agricultural wastes. It has three main products: "Ralli Gold" vermicompost; "Bhoojevan" organic compost; and Liquid Foliar Stimulant Spray. For commercial farmers in peri-urban areas, Terra Firma is providing a viable alternative to chemical fertilisers. Terra Firma sells its products through Rallis India Ltd. throughout the country and caters to most of the urban farmers in and around Bangalore. A recent study by Lardinois and Marchand (1999) indicates that the Terra Firma plant was producing nine tonnes of compost per day accounting for 3.5% of the compost produced in Bangalore.

Finally, there are several other small and medium-sized firms based in Bangalore that manufacture compost. Examples include Agritech, a subsidiary of the Centre for Technology Development, Sri Balaji Farms and the Khoday group of industries. As well, several individuals listed in the compendium of contacts operate as private consultants in the field of composting technology.

## Horticulture

*"I still remember my gasp of wonderment as we came out of the staircase and stepped on to the roof of Dr. Dabholkar's modest house. Vegetables in pots. On one side, corn stalks five feet high. In another, sugarcane. In one pot*

<sup>10</sup> While close to finalising this report, Gisele Yasmeen learned that a project on vermicomposting is taking place in Hyderabad, A.P. It involves Dr. Isa Baud ([I.S.A.Baud@frw.uva.nl](mailto:I.S.A.Baud@frw.uva.nl)) of the Netherlands, Dr. Galab and Sudhakar Reddy (Furedy 2000).

—just a small 12" pot - a mango plant with a mango larger than my hand. A layer of soil made from vegetable waste, from leaves and the rest. Dr. Dabholkar would lean down, and pluck from under the surface ginger, garlic, even potatoes."

- Arun Shourie Column, "One who has in fact wrought a revolution".<sup>11</sup>

A few general remarks need to be made about the nature and important role of horticulture in Indian cities. First, there is a great deal of household as well as commercial horticulture taking place in urban and peri-urban areas of India. Not necessarily all of these horticultural activities are "organic" and, indeed, there are several examples pointing to the extensive use of chemical fertilisers, pesticides and herbicides in both private gardens and commercial market gardens. Finally, extensive vegetable gardening fed on uncomposted organic waste is practised in Calcutta. This outstanding case was profiled in the UNDP's *Urban Agriculture: Food, Jobs and Sustainable Cities* (1996) and shall therefore not be repeated in this report<sup>12</sup>

The box below profiles the commercial aspects of peri-urban agriculture in the capital city of Delhi.

### **Box 3: Vegetable Cultivation and Marketing in Delhi**

Two helpful publications, which shed light on peri-urban agriculture, concern vegetable marketing in the Union Territory of Delhi (Bhupal, 1989 & 1999). "The study finds that the economic indicators, demand for vegetables and overall profitability of vegetable cultivation, compared with other competing crops are favourable for the promotion of vegetable cultivation...around Delhi" (Bhupal 1989, i & iv). Given the fact that the capital city has the highest per capita income in the country, vegetable cultivation and distribution can be a very profitable activity (Bhupal 1999, 1).

In the earlier study, Bhupal explained that local producers "mainly cultivate in the Yamunabed and in outer North-West Delhi from Teekri Border to Najafgarh" (1989, 4). At the time, he explained that almost two-thirds of the total area in Delhi fell under the classification of rural Delhi. Most vegetables were grown in Alipur, Nangloi and Shahadra and were linked to the main wholesale market in Azadpur by *pukka*<sup>13</sup> roads ranging in length from 11-35 kilometres (Ibid.).

Ten years later, due to the tremendous growth of the city, the author identified the peri-urban hinterland where vegetables are produced as expanding to six districts in two neighbouring states. Haryana (Gurgaon, Sonapat, Faridabad, and Rohtak) and two districts in the state of Uttar Pradesh (Meerut and Gaziabad) were included (Bhupal 1999, 4). He also established a typology of major actors in the market, which helps the reader put commercialised UPA activities into the larger perspective of the urban food distribution system.

<sup>11</sup> Available at <http://boorner.anu.edu.au/community/hindutemple/articles/asQ50797.htm>.

<sup>12</sup> See Case 7.7 on page 188.

<sup>13</sup> A *pukka* road is a hard paved road as opposed to a gravel road.

In both studies, Bhupal describes the nature of farming activities on the outskirts of Delhi. First, there are the large commercial farms employing expensive agriculture inputs and cheap migrant labour. These farmers benefit from economies of scale and all have cold storage facilities, technology, financing and extension services at their disposal. This is a stark contrast to the peri-urban agriculture being conducted by poor and marginal farmers who employ family labour, rent their land and even their bullocks thus reducing their profitability and long term livelihood prospects in UPA. "Around Delhi, because of an assured market even the landless are engaged in this profession and are somehow able to subsist, which in remote areas of the country may be unthinkable for them" (1989, 11).

In 1989, Bhupal argued for land reform and policies that favoured the distribution of vegetables through co-operatives - such as Super Bazar and Mother Dairy - and government agencies. This has indeed taken place, but farmers do not seem to have benefited as a result though the quality of vegetables has increased and waste has been reduced due to improvements in storage and distribution.

As far as the promotion of "alternative"<sup>14</sup> urban horticulture is concerned, the work of the Institute of Natural and Organic Agriculture (INORA), and specifically the contribution of Dr. Ramesh T. Doshi stands out in Mumbai as a lead in the area of urban horticulture (see Box 1). In India in general, there is a lot of interest in alternative agriculture and its link with integrated resources management and social sustainability perhaps due to the success of the well-known Ralegan Siddhi transformation.<sup>15</sup>

Claude Alvares, of Other India Press, recently edited *The Organic Farming Source Book* (1996) which documents:

Hundreds of innovative and pioneering organic farmers who have deserted the green revolution and its barbaric technology bare their hearts, their knowledge and their experiences in this remarkable book which went into a second edition within a month of publication. The Source Book also provides addresses of green shops, manufacturers of organic fertilisers and suppliers of earthworms, in addition to a history of organic farming in India and the rest of the world a complete and comprehensive handbook of India's efforts to revert to sustainable agriculture (from [http://www.mnet.fr/aiindex/i\\_oibs/OIBS.html#start](http://www.mnet.fr/aiindex/i_oibs/OIBS.html#start)).

<sup>14</sup> By "alternative" we are referring to methods which promote organic or at least semi-organic techniques as well as a concern for environmental sustainability - such as using "greywater" (household waste water) to water gardens and plants. These experiments are also often undertaken in the spirit of greening the city and enhancing community food security as opposed to simply engaging in a commercial activity.

<sup>15</sup> This village located in Maharashtra between Mumbai and Pune was a dry, barren "moonscape" twenty years ago and, through various methods which primarily include alternative agriculture and resources management, has become a fruit and vegetable exporting area (Ralegan Siddhi brochure,

The natural and organic farming movement in India has been inspired very much by the ideas of Masanobo Fukuoka as expounded in *The One-Straw Revolution*<sup>16</sup>. Also influential are the pioneering efforts of Professor S. A. Dabholkar who, through "experimental forums" (*prayog parivars*) leads farmers to master "scientific knowledge" (Doshi, no date, *City Farming: Great Potential Creative Pleasure, Health, Friendly Environment, Profit*). Dr. Dabholkar recently completed a book about his experiments entitled *Plenty for All - Prayog Parivar Methodology* (Kolhapur: Mehta Publishing House).<sup>17</sup>

#### **Box 4: Dr. R.T. Doshi's City Farming Initiative: Bandra, Mumbai**

*Padmashree* recipient, Dr. Ramesh T. Doshi, an economist by training and one of the founders of the Institute for Management Development & Research (IMDR) in Pune, was associated for many years with the marketing of NPK products which included nitrogen, fertilisers, organic manure and other agricultural inputs. After retirement, he began working on his farm near Pune and became aware of the many challenges associated with subsistence agriculture — particularly low returns, high labour input and low profitability. At the same time, he began to reflect on the high cost of food in the cities and the need to produce more food in urban areas. Urban agriculture also lessens the need for the use of toxic chemicals as fertilisers and pesticides.

Hence, Dr. Doshi began experimenting with food production on the terrace of his bungalow in Mumbai after retiring at the age of 61. He has perfected a method of growing fruits and vegetables for domestic consumption, which involves relatively low labour input, organic production methods and very high yields. "Dr. Doshi today grows vegetables, pulses, fruits and cereals... and has raised mango, fig and guava plants and also harvested bananas and sugarcane." (*City Farming Innovations, 2000*). His methods have been adopted throughout Mumbai and also in neighbouring cities, such as Pune "leading to a profusion of city vegetable gardens, and improving local environments, family nutrition and public health overall" (*Ibid.*).

The "Doshi method" involves planting in polyethylene bags or 45 gallon drums with the bottoms stuffed with biomass, such as sugarcane stocks from sugarcane juice vendors (something that normally goes to waste). One quarter of the bag is then filled with compost and the remainder with soil. Dr. R.T. Doshi attributes his success to the ideas of Shripal Achyut Dabholkar from Kolhapur who set up an institution called "Prayog Parivar" devoted to "natural" farming based on indigenous practices with a community focus.

In Bangalore, the work of Agriculture Man Ecology (AME), with the support of the Netherlands administered by ETC Netherlands, is actively promoting organic

<sup>16</sup> Ammaus: Rodale Press, 1978 (edited by Larry Korn and translated from the Japanese by Chris Pearce, Taune Kurosawa and Larry Korn).

<sup>17</sup> I am unsure of the date of publication of this tome which was referred to in the Arun Shourie column and in a web document authored by Claude Alvares (<http://192J24.42J5/tcdc/bestprac/social/cases/12-city%20farming.htm>).

farming and "Low External Input Sustainable Agriculture" (LEISA) in conjunction with 30 NGOs in the states of Karnataka, Andhra Pradesh and Tamil Nadu. Mans Lanting, Dutch agronomist and Director of AME estimates that "at least 15 per cent of all farmers around Bangalore are small scale ones and can easily go organic" (Daksha Hathi, 1999). "Seventy per cent of farmers with whom we have dealings are women belonging to self-help groups, and they are motivated," adds Lanting (R.J. Rajendra Prasad, 2000).

Having recently published a manual on organic farming, AME is now working with small-scale farmers, home gardeners and medium-scale farmers in Bangalore, Dharwad, Coorg, Hubli, Chitradurga and Mysore. These efforts have resulted in organic vegetables becoming available to consumers in five outlets in Bangalore (Daksha Hathi, 1999). In addition, AME publishes the LEISA India Newsletter and has had generous coverage by the media in India resulting in broad dissemination of information on their work.

There are several other not-for-profit agencies, public or private enterprises and individuals that can be mentioned in this section on urban horticulture. The following play a supportive role in the fostering of fruit and vegetable cultivation in cities and their immediate hinterlands.

1. Agricultural Technologies & Services Private Limited (AGRITECH) "seeks to assist and commercialise selected research technologies in the field of Agriculture".<sup>18</sup> AGRITECH was established by the Centre for Technology Development (Bangalore) in 1989 and has been involved in a variety of research activities that might be extended to UPA. Examples include:
  - Improvement of potato production by using True Potato Seeds Technology;
  - Systematic grafting using elite trees;
  - Use of greenhouses and development of low-cost greenhouses for the farmers;
  - Tissue culture methods for plant propagation;
  - Mass multiplication and cultivation of medicinal plants;
  - Development and mass production of special virus free citrus plants;
  - Mushroom cultivation methods;
  - Production of trichoderma.<sup>19</sup>
2. The Indian Institute of Horticultural Research (IIHR) on the outskirts of Bangalore provides advanced training, consulting services and is a "store house" of advanced technology in horticulture" (IIHR Extension Folder 75). It is a Centre of Excellence in Horticulture recognised by the UNDP and an Advanced Centre for Research in Post Harvest Technology recognised by USAID. As well, the Institute is an advanced training centre for the World Bank and a post-

<sup>18</sup> Personal communication, Mr. P.R. Rao, Director, AGRITECH, July 5, 2000.

<sup>19</sup> P.R. Rao, *Ibid*.

graduate centre used by many universities. The IIHR is an importance repository of knowledge for all aspects of horticulture.

3. ECONET is mainly involved in Ecological Agriculture. It is a non-profit organisation with the aim of sensitising the public to the increasingly dangerous trend of consuming chemically grown food. It is simultaneously seeking alternatives to Industrial Agriculture. ECONET presents alternatives to the products of mass production and their attendant non-degradable materials.
4. IMO Control Private in Bangalore is a Swiss subsidiary ([www.imo.ch](http://www.imo.ch)). IMO specialises in the inspection and certification of organic agricultural products. IMO is officially registered as an accredited control and certification body and certifies projects to meet these standards and market regulations as defined by EU Regulation 2092/91. IMO's office in Bangalore is active in the inspection and certification of organic produce.

Exnora has recently become involved in the promotion and organisation of rooftop gardening in cities. It has decided to propagate rooftop vegetable gardens to encourage composting in that compost generated by each household can be used in the rooftop garden and valuable vegetables obtained.

The important aspects of the new program are:

- developing the rooftop garden in lightweight containers often made of natural materials like baskets.
- using more of leaf litter/humus/organic compost rather than heavy soil
- planting several saplings, which would develop different root lengths into the same container so that planting density, can be increased without compromising the sufficiency of nutrients for the plants.
- concentrating more on vegetables and fruits so that the utility of the roof top garden can be increased.
- propagating cost effective measures and teaching people to develop their own rooftop garden rather than setting it up for them.<sup>20</sup>

Similarly, reference has been made to the existence of an "All-India Kitchen Garden Association,"<sup>21</sup> but no contact information was obtained. Future research will certainly uncover detailed information on both of these organisation's urban horticultural activities.

Finally, several individuals serve as consultants in the field of UPA organic horticulture, and details about them may be found in the appendices accompanying this report.

<sup>20</sup> Mr. T.K. Ramkumar, Exnora International, personal communication, September, 2000.

<sup>21</sup> Referred to in a link to ETC's activities available on the City Farmer website.

## ***Dairying***

Entire books have been devoted to the "white revolution" that has taken place in India over the past few decades (Candler and Kumar, 1998; Chen *et.al*, 1986; Doornobos and Nair, 1990; Kurien, 1992, 1997). India's transformation from a situation of grave milk scarcity in the 1940s and 1950s to becoming the world's number one milk producer in the 1990s is a well-known success story. The most celebrated figure associated with "Operation Flood" - the official name of the program designed to increase milk production while keeping power in the hands of typical milk producers - is Dr. Verghese Kurien, India's "milkman" and recipient of the World Food Prize (1989) among many other honours. Dr. Kurien is now nearly 80 years old and still active in the communities he has nurtured over the past fifty years.

In 1998-99, India surpassed the USA in terms of dairy production making it the world's largest milk producer (NDDDB, 1999). However, unlike the North American strategy of "modernising" the dairy industry, India has not sacrificed its small milk producer. Instead, India's white revolution has been based on organising the country's traditional milk producers - most of whom are women who only own and tend to one or two cows or buffaloes - into federated co-operatives which then sell the milk to modern chilling and distribution centres. The most well-known of these co-operatives is the Anand Milk Union Limited, or AMUL, India's largest food products marketing organisation. It comprises 10,183 village societies for a total of 1.95 million producer members ([www.amul.com/gcmmf.html](http://www.amul.com/gcmmf.html)). AMUL supplies milk and dairy products, such as butter and curd, throughout the country. AMUL's success has resulted in it often being referred to as simply the "Anand model" based on co-operatives and the ownership and control of small-scale women dairy farmers.

As a result of Dr. Kurien's efforts with the first fledgling milk co-operative in the late 1940s and 1950s, the National Dairy Development Board (NDDDB) was created by then Prime Minister of India Lal Bahadur Shastri in 1965. When Operation Flood was launched in 1970 to replicate the Anand Model, only 278 thousand farmers were involved in the program producing 190 tons of milk. Eighteen years later, over six million dairy producers in 50,000 co-operatives were producing three million tons of milk per year reaching more than 500 cities and towns throughout India. Though some of these dairy producers are located in what are firmly considered to be rural areas in the Indian context, many more are located in peri-urban areas so that they can more easily supply the large number of urban consumers.

With the growing rate of urbanisation in India, there are increased opportunities for dairy producers to supply value-added dairy products such as butter, curd (yoghurt) and *ghee* due to increased demand and urban women's changing roles. Whereas, traditionally, even city-dwelling women would make their own butter and *ghee*, today, few young women have the time, skills and desire to do so.

The white revolution has spawned a series of independent livelihood initiatives to encourage women to form co-operatives and take up dairying as a livelihood. One example is the work of Sampark, a Bangalore-based NGO, which has helped form women's dairy co-operatives in several peri-urban areas of Karnataka, notably the Kolar district on the outskirts of Bangalore and Muddhaballi, near Hospet.

From the perspective of UPA however, there are important questions of institutional regulation. For example, dairying is illegal in most metropolitan areas but is widely practised nevertheless. The legalities surrounding UPA activities in general need to be thoroughly researched and monitored.

### **Aquaculture**

The only information that was obtained on urban aquaculture in India pertains to West Bengal. This is apart from general works on aquaculture (Giriappa, 1999; Shiva and Karir, 1996; Srivastava, 1993). In particular, the Salt Lake area of Calcutta is internationally renowned for the harvesting of fish and other food products in a wetland fed by urban waste and rainwater. (Prof. CK Varshney, personal communication, 2000). Bengalis, being a fresh-water fish eating population, have a long and distinguished history of creating and managing fishponds in both urban and rural areas.

In Ghosh's 1993 piece entitled "Towards the wise use of wetlands," the author argues for the retention of Calcutta's wetlands "as a means of providing food, sanitation, additional employment and open spaces." In particular he outlines how:

- 'garbage gardens' provide an average of 150 tonnes of fresh vegetables daily for the city of Calcutta, while the fisheries provide 8,000 tonnes of fish per year. Better management systems would see this figure rise to about 16,000 tonnes/year.
- the city's sewage output amounts to some 680,000,000 litres per day. At present, no more than a third of this sewage reaches the fishponds that help to treat the waste and act as stabilisation tanks. A new treatment plan for the city would cost about US \$4.5 million.
- the wetland region provides year-round employment at the rate of two people/ha. Any plan to establish an alternative land use in the region would have to include relocation of approximately 20,000 families (p. 2).

The Salt Lake marsh is an "internationally important wetland [being] the world's largest and oldest integrated resource recovery system, in which both agriculture and aquaculture use wastewater nutrients". It is also, Ghosh argues, an effective form of waste management provided it is managed properly. Unfortunately, the author points to the diminishing level of local skills when it comes to traditional wetland management in West Bengal due to the rapid disappearance of such habitats.

The Calcutta experience with aquaculture was also profiled in the UNDP study produced by Jac Smit, Joe Nasr and Annu Ratta entitled *Urban Agriculture: Food, Jobs and Sustainable Cities* (1996). The authors explain how approximately 4,000 families operate the fisheries - most of whom migrated in the 1950s from what is now Bangladesh. These fisherfolk lease the land from landlords who hold long-term leases on the land from the municipality. Most of those engaged in the aquacultural activities are organised into co-operatives. "The West Bengal State Fishermen's Co-operative Federation, Ltd., a state-level organisation, helps in the management of the co-operative societies and arranges supply of inputs and finance" (UNDP 1996, 65). The fish farming taking place here supplies one fifth of greater Calcutta's fish. "The city sewage that feeds the ponds is appropriately treated through methods developed by the fishermen over the years. The fish have been found for more than 20 years to be safer for consumption than river-produced fish" (*Ibid.*).

Another case on safe use of sewage for aquaculture is profiled in Box 5 below:

### **Box 5: Sewage-fed aquaculture in Bangladesh**

Jacky Foo (Coordinator-IBSnet) documents three cases regarding the safe use of sewage to fertilise fishpond water. One of the cases, profiled below, concerns Bangladesh. All three areas are available at <http://segate.sunet.se/archives/et-w1.html>.

#### Case Study 1: Mirzapur Farm, Bangladesh (since 1985).

Three stabilisation ponds from a failed project for treating sewage were converted into fishponds. Raw sewage (125-270 m<sup>3</sup> / day) from a community of about 3,000 inhabitants, collects at a sedimentation pond before the wastewater (containing 45,700 cfu/ml total coliform) is pumped into a plug-flow canal covered with duckweed. It takes 22 days to reach the outlet of the canal and the effluent has less than 100 cfu total coliforms per ml (within the World Health Organisation (WHO) standard for water quality of water to be discharged into receiving body). The resulting sludge and water used for growing bananas.<sup>22</sup>

Ref: <http://www.ias.unu.edu/proceedings/icibs/ibs/ibsnet/e-sem-rose.html>

However, as per the earlier section on pollution and other hazards associated with the pattern and extent of Indian urbanisation, there are still a number of challenges with respect to urban aquaculture. One of the primary issues is keeping food safe particularly in the case of fish, which spoils quickly in a warm environment. Also, can current aquacultural methods be sustained in rapidly growing cities that produce more and new types of waste? Fortunately, since Indians typically cook fish before consuming it, a higher coliform count is more permissible than that which is acceptable in, say, Japan or Korea where raw fish is consumed. Though the available literature does not emphasise it, another matter of great concern is also heavy metal contamination as a result of air and waterborne pollution.

<sup>22</sup> The original text has been edited for grammar and style.

## ***Animal Husbandry***

Apart from the information on dairying, it is surprising how little information there is about animal husbandry in urban and peri-urban areas in India given the ubiquitous proliferation of livestock in South Asian cities. The preponderance of cattle in the country's urban areas is already well known. According to Dr. Saket Bhusan, "India ranks first among the countries of the world in goat population." (Bhusan 1999b, 17). The same author documents the popularity of pig rearing among both urban and rural dwellers of the state of Mizoram, in the Northeast, where he is lecturer in Animal Husbandry at Pachhunga University College.

### **Box 6: Pig Farming in Urban Mizoram**

"Pig farming is the most popular enterprise among rural and urban Mizos. It is said that if you visit even a minister's house, you will find a small pigyard in his compound! Mizos are known for their expertise in pig rearing. Farmers rear five to ten animals each for their own consumption or for sale. Many rural farmers avoid going to town because of the problem of transportation. So they can't place the product in the market when the demand is high. An urban farmer, on the other hand, can hire a taxi to the market for just Rs. 20-30" ...

"Most producers choose to sell their hogs during Christmas week when the demand is heavy and prices are high... Despite the high consumption of pork and pork products in Mizoram, there is no organised market, no bacon industry, no proper slaughterhouse or packing plant in the state. Even breeding stock of pigs comes from other states... [Hygienic market conditions and development of the processing industry would definitely increase the consumption of pork... A good marketing system for the products of Mizoram's pig farmers is therefore an urgent need" (Bhusan 1999a, 7<sup>23</sup>).

Only two other references can be made to existing literature on the topic of urban and peri-urban animal husbandry:

1. R.S.Ganapathy, in his study of Ahmedabad in the mid-1980s documented a rise in the population of milch cows, sheep, goats and pigs due to increasing consumer demand for meat, dairy and milk products. The trend has no doubt continued. Ganapathy also reported the keeping of animals for their waste consumption activities such as sheep and swine (Ganapathy 1984).
2. The Centre for Poultry Science of the University of Agricultural Sciences in Bangalore has conducted research on poultry rearing for two decades. However, the Centre does not appear preoccupied with small-scale urban activities and

<sup>23</sup> The Karnataka Meat and Poultry Marketing Corporation may have useful models for smaller states like Mizoram to adopt and modify to suit their local needs.

seems to be more oriented toward the industrialised poultry production that is currently the norm in northern industrialised economies.

### *Other Areas*

This final section on areas of expertise groups together remaining sub-areas of UPA in India on which there is either little or no information. It also includes supporting aspects of UPA such as marketing, distribution, pest-management and research as well as health and safety.

### Ornamental Trees, Shrubs & Plants

With respect to Ahmedabad, R.S. Ganapathy alluded to the planting of trees and shrubs by the Ahmedabad Municipal Corporation's Parks and Gardens Department whereby a scheme was developed to provide free saplings to urbanites. This initiative was part of a government-led urban afforestation program. Marulanda (2000) provides an update in the first issue of the new RUAF *Urban Agriculture Magazine*.

Kholsa and Randhawa (1996) have written about horticulture in their monograph entitled *Ecofriendly Trees and Urban Beautification*. As well, Tewari published a book in 1995 on *Forests, Gardens, Parks and Urban Environment*. Apart from these sources, information on the cultivation of trees, shrubs and plants in urban India is scanty.

### **Box 7: A.N. Yellappa Reddy**

A.N. Yellappa Reddy, based in Bangalore, is Former Secretary of the Department of Environment and Ecology, Government of Karnataka. He is also Former Chief Conservator of Forests, of the same state. Sri Yellappa Reddy has been involved in eco-restoration, created several multipurpose orchards, urban landscaping, rainwater harvesting systems, lake restoration systems, wetland technology for sewage water treatment, development and establishment of sacred and herbal gardens, and developed bio-park for Bangalore University.

A.N. Yellappa Reddy has authored several books and produced several policy papers for government at various levels and several educational institutions. As chairman of a task force, he brought out the *Recommendations of the Task Force on Green Belt Review Policy for Bangalore* published in 1993. He authored a book on *Sacred Plants* published by the Karnataka Forest Department in 1988.<sup>24</sup>

The M.S. Swaminathan Research Foundation (MSSRF) estimated that there is a great potential for flower cultivation, especially orchids, in urban and peri-urban parts of India. At a workshop on women and food security, this type of

<sup>24</sup> Mridul Salgame, Bangalore, Personal Communication, July 2000.

microenterprise development was identified as a potentially profitable source of income for women (MSSRF 2000, Annexure 2b).

## Sericulture

The only information obtained on sericulture in India pertains to West Bengal (Mookherjee, 1992). The study is general and does not focus on urban and peri-urban sericulture activities. For neighbouring Bangladesh, Chowdhury documented the sericulture activities of the well-known Bangladesh Rural Advancement Committee (BRAC) published in 1990.

## Medicinal, Aromatic & Ornamental Plants

Dr. Madhav Karki, is Regional Program Co-ordinator of the Medicinal and Aromatic Plants Program in Asia (MAPPA) based at IDRC (c.f. Karki and Johari 1999a&b). As far as I know, this work remains general and does not yet have an urban/peri-urban focus. The only other source found on this subject area is *Medicinal Plants and their Cultivation* by Akhtar Hussain (1993).

Dr. Chhanda Mondal, a botanist in Calcutta, was also contacted over the course of the study. In her words:

The principal aim of my work is to generate interest among the people to conserve valuable traditional medicinal plants. This eventually can reduce the health hazards among the urban population especially for the poor at a low cost (Chhanda Mondal, personal communication, September 2000).

In addition to publishing articles, Dr. Mondal has publicised her research through All India Radio and Calcutta Television (Doordarshan).

Overall, there is little information concerning the urban cultivation of medicinal and aromatic plants.

## Food Processing

The processing of UPA products is of utmost importance in India given the high rate of spoilage of perishables. It is estimated that 30 to 40 per cent of India's fruit and vegetable production is wasted and never makes it to market due to lack of post-harvest technologies and ineffective distribution systems (Bhogle, Personal Communication, 2000). "According to the Ministry of Food and Civil Supplies, 10

per cent of India's total foodgrain production, that is 20 million tonnes, is lost to rodents and insects because of bad and inadequate storage facilities."<sup>25</sup>

As D.S. Bhupal writes for Delhi: "The high degree of perishability of vegetables, in absence of adequate and scientific storage, also causes instability in the supply of vegetables and consequently their prices. The defective distribution system of vegetables in Delhi, i.e., the inefficient marketing network also causes unwarranted hikes in the prices" (Bhupal 1999, p. 1).

The Centre for Processed Foods, based in Bangalore, "is an organisation with a mission to promote the development of a strong and modern food processing industry in India."<sup>26</sup> The Centre promotes the growth and development of food processing industries as well as the production and marketing of foods more generally. The Centre is run as a consulting organisation and provides guidance for investment opportunities, develops and manages a number of databases on food products, processing, manufacturing equipment and so on and provides a number of other related services such as help arranging financing and advice on legal issues. The CPF has collaborated in all of the aforementioned areas with numerous local, national and international agencies by providing technical guidance and by organising seminars, workshops and training.

### **Box 8: TIDE'S Biomass-fuelled Drying Schemes**

The Technology Informatics Design Endeavour (TIDE) based in Bangalore is funded by the India-Canada Environmental Facility (ICEF) in "Project Biomass" (Diffusion of Efficient Biomass Utilisation Technologies in Non-Formal Industries in Karnataka and Kerala). One of the aspects of the Project directly related to UPA is the introduction of biomass-fuelled vegetable dryers. In the state of Karnataka, the dryers have been used to dehydrate tobacco and areca nuts and in neighbouring Kerala the drying technology has been used in Ayurvedic medicine preparation as well as cardamom and areca nut production.

In March 1998 TIDE initiated a project focused on women's small-scale entrepreneurship through the dehydration of fruits and vegetables. Curry leaves, onions, garlic and green chillis are being successfully dried and marketed. "Preliminary investigation showed that sale of dried products in retail outlets was very limited. However, there is a great demand for dried products by big food processors and exporters" (*TIDE Annual Report* 1999, p. 11). Drying protocols already exist for tomatoes, ginger, mint, spinach, potatoes, bananas and jackfruit. Though TIDE'S activities have been focused in rural areas, there is ample potential to expand into urban and peri-urban areas.

Dr. Mira Savara, a food researcher and consultant based in Pune and Mumbai, reported that the Centre for Decentralised Industries was also engaging in the dehydration of vegetables to promote women's enterprises (Personal

<sup>25</sup> Arundhati Roy, "The Cost of Living," *Frontline*, February 18, 2000, p. 67-68.

<sup>26</sup> Letter from R. Prakash, General Manager, Centre for Processed Foods, June 29, 2000.

Communication, 2000). In mountainous areas of India, she explained, indigenous populations have a tradition of drying a wide range of vegetables, including cauliflower. Similarly the Bhaba Atomic Research Centre (BARC) has developed a simple solar dryer for vegetables.

## Marketing & Distribution

Effective and efficient marketing and distribution of UPA perishables is as important as developing food processing industries and other post-harvest technologies. This section profiles a number of food marketing and distribution initiatives, which are or might be potentially related to UPA in India.

Agricultural and Processed Food Products Export Development Authority (APEDA) is part of the Ministry of Commerce, Government of India. APEDA aims to develop India's agricultural commodities and processed foods. Its goals are to maximise foreign exchange earnings through increased agricultural exports, provide better income to farmers through higher unit-value realisation and to create employment opportunities in rural areas by encouraging value-added exports of farm produce. The Authority could potentially be involved in a large-scale scheme to effectively promote the export of certain urban and peri-urban agricultural products particularly high-value items.

Agriculture Man Ecology (AME), previously mentioned in the section on horticulture, has forayed into the marketing of organic produce. AME unwittingly became involved in this "downstream" activity while attending discussions about recycling organic waste in Bangalore. There, AME staff had contact with citizen and consumer groups interested in purchasing and marketing organic fruit and vegetables (LEISA Newsletter, 1998). Through a long and rather complicated chain of events, AME became responsible for the marketing and distribution of organic produce. The LEISA India Supplement published by AME provides extensive information on the technical aspects of organic farming and LEISA, but also documents the organisation's more recent turn toward marketing and distribution which is the cornerstone to the long term success of organic farming.<sup>27</sup>

The Horticultural Producers' Co-operative Marketing & Processing Society, Ltd. (HOPCOMS) in Bangalore is involved in the marketing of fruits and vegetables as well as the processing, and particularly the production, of fruit juices. It also supplies chemicals, fertilisers and garden implements to farmers. HOPCOMS' serves seven districts of Karnataka including Bangalore-Rural and neighbouring Kolar, Tumkur, Mandya, Mysore and South Canara. In addition to the functions specified above, the co-operative society offers training and technical advice to its members. It also provides cold storage facilities and conducts research when needed. More recently,

<sup>27</sup> Former ETC-India employee, Hay Soiree, is based in Delhi and now runs an organic food company called Yardi & Sorree.

HOPCOMS has ventured into subsidising canteens and providing accommodation and banking facilities to its member farmers.

## Research & Training

The Central Food Technological Research Institute (CFTRI), with headquarters in Mysore and six regional centres across India, is a central node in the country for all aspects of food technology. The Institute houses "over 350 scientists, technologists and engineers and about 450 technicians, skilled workers and administrative personnel" (*CFTRI Brochure*, 1994). CFTRI, in partnership with the University of Mysore, trains Indian and numerous international students at the M.Sc. and Ph.D. levels. The Institute also provides consulting services and its facilities are open to user industries and government agencies. Finally and perhaps most importantly, CFTRI plays an important role in extension services and community outreach by publishing newsletters and informational literature not only in English, but also in Hindi and Kannada.

The Indian Institute of Horticultural Research (IIHR) conducts research as well as training on numerous aspects of horticulture including pests, fertilisers, nutrients and water management. The Institute is based in Hesaraghatta, Bangalore and also provides consulting services for various clients.

## Pest Management

The Project Directorate of Biological Control (PDBC) in Bangalore is a member of the Indian Councils of Agricultural Research (ICAR). The Directorate has been striving to disseminate information and impart training on the latest technologies of biological control in pest management. The goal of the coming decades is to ultimately achieve chemical-free food production (PDBC *Biocontrol Newsletter*, 1999).

## Safety & Hygiene

The Foundation of Food Research and Enterprise for Safety & Hygiene (FRESH) is a non-profit organisation "with the sole objective of creating awareness on food safety and improving the hygiene and sanitation levels among the personnel from food industries and food-service establishments" (FRESH background document, 2000). Director, Dr. Mridul Salgame and all members of the Board have extensive experience and interest not only in food safety and hygiene but also in food security, processing, nutrition and other related areas.

The Centre for Food Processing (CFP) is also highly involved in technologies related

to food safety with respect to processing.

## **Conclusions**

This report and its accompanying appendices contain a great deal of information which, to our knowledge, has never been compiled and released in a detailed and integrated way. The conclusion is divided into four sections. The first part summarises the substantive findings (i.e. according to topic area) and points to trends in the major areas reviewed.

The second section focuses on structural issues surrounding UPA in India - for example - the way in which dairying around Indian cities is organised into small-scale women's co-operatives. This section concludes with comments on the strengths and weaknesses of the ways in which the UPA system - if one might call it that - is currently structured and how it might evolve in the future.

Following this, section three highlights indigenous technical knowledge related to UPA that might be appropriately disseminated throughout India to other parts of the South Asian region and indeed to other parts of the world.

Finally, we make suggestions to IDRC to possibly guide its role in UPA activities in India and the sub-continent.

## ***Substantive Findings***

The first section of this report has clearly demonstrated India's documented activities in all types of composting: both aerobic composting and vermicomposting, which indicate creative, participatory ways of addressing solid waste management (SWM). However, there are still many unanswered questions when it comes to composting. For example, are centralised schemes - as exemplified by the Karnataka Compost Development Corporation (KCDC) - more efficient than decentralised community-based initiatives?<sup>28</sup> Likewise, what are the advantages or disadvantages of vermicomposting versus simple aerobic methods?

The subsequent section on horticulture profiled a number of schemes, especially in Mumbai, which employ highly productive and ecological city farming methods. The success of dairying in peri-urban areas of India is already well known. Finally, aquaculture in the fishponds on the outskirts of Calcutta is world-renown though with rapid population growth there are bound to be concerns related to the health and safety of sewage-fed aquaculture and horticulture as exemplified in West Bengal.

<sup>28</sup> Christine Furedy, "Decentralized Composting: Tradition as Technique for Solid Waste Management?" published in the Newsletter of the Asian Society for Environmental Protection (1999).

The first obvious suggestion for any planned UPA interventions in the sub-continent would be to enhance the capacity of activities already taking place. This would involve financing initiatives to help the agents involved act more efficiently and effectively diffuse their findings. From a geographical standpoint, it also implies improving the capacity of the agents identified in this report to become aware of the global UPA movement and interact with their counterparts in other parts of Asia, Africa and Latin America as well as the North.<sup>29</sup> On a domestic and regional scale, some of the activities described in this report, such as fish farming in West Bengal, can be replicated in other states. From a practical standpoint, it would be important to know what the sources of funding might be at the moment for various UPA projects? Also, what sort of training is available to private sector firms and civil society organisations that want to explore various aspects of UPA?

The second substantive suggestion would be to gather more information and initiate projects in what seem to be relatively underdeveloped, small-scale, yet potentially profitable UPA ventures. For example, Dr. Christine Furedy suggests looking in detail at the scale and nature of different types of composting schemes and their commercial viability. With respect to the previous example of aquaculture, there is a potential for the development of small-scale industries related to algae and seaweed cultivation/harvesting for both international and domestic markets. Mycology and mushrooms cultivation would be another example. A recent visit (February 2000) to the Weikfield mushroom production plant in Pune made it very clear to me what a lucrative export market there is for mushrooms. The existence of the National Centre for Mushroom Research in Solan makes this highly feasible.

### *Structural Issues*

There are three primary structural issues we would like to underline as attributing to the potential to further enhance UPA activities in India. These are:

- 1) institutional and policy issues;
- 2) the presence of well-developed civil society organisations; and
- 3) the important role of women in the Indian food-system.

### *Institutional and Policy Issues*

There are several institutional and policy issues that need to be researched and documented with respect to UPA in India. For example, there is a need to clearly establish the role and nature of government policy as it deals with urban agricultural

<sup>29</sup> Gisele Yasmien participated in an electronic conference on UPA in September 2000, while finalising this report. She and one other participant (seemingly an expatriate based in India) were the only participants who made contributions directly related to India. This clearly shows the need to improve the capacity of UPA agents in India to forge direct links with the greater UPA world.

activities particularly as far as regulation is concerned. As well, the various roles and responsibilities of various scales of government need to be clearly understood.

Beyond the general references to certain private sector and civil society organisations in this report, there is a need to clearly establish the business and social opportunities available to business and non-governmental / non-profit organisations. Their differentiated responsibilities, roles and regulations vis-a-vis the public sector also merit further investigation.

There is, however, one firmer conclusion that can be made regarding institutional UPA frameworks in India. The success of producer co-operatives in dairying and some aspects of horticultural produce marketing is a model which might be followed to both stimulate more extensive UPA as well as foster the effective marketing and distribution of the products which result from these activities. This must be explored with caution as many of India's successful co-operatives are now suffering from bureaucratic problems similar to those of large, publicly-owned corporations.

### Civil Society Organisations

India, as this report has amply illustrated, is the home of thousands of well-developed civil society organisations (CSOs) which have played a key role in mobilising society, changing citizen behaviour and pressuring government at various levels. The high degree of social capital in India as exemplified by the extensive presence of these organisations provides the wherewithal to develop an All-India grassroots UPA movement. CSOs and community-based organisations (CBOs), and non-governmental organisations in general, can and in some ways already do provide a good institutional framework for UPA activities throughout the country. Nevertheless, as P. Sainath so eloquently wrote in *Everybody Loves a Good Drought*, civil society organisations are rife with problems as well, including some evidence of corruption from time to time. This makes transparency and accountability of NGOs as important as that of government.

### The Role of Women in UPA and Food Security

Finally, it is clear that women play a key role in food production, processing and distribution in India and this holds true for UPA. The MS Swaminathan Research Foundation (MSSRF) organised a symposium on the topic of women and food security this past February. The seminar was jointly organised by World Food Program and MSSRF and had a rural focus, but a similar forum on urban and peri-urban agriculture and food production/processing/distribution would be needed. It is clear from the extensive literature that women are the backbone of dairying and

therefore much of animal husbandry.<sup>30</sup> Though their roles in agriculture are acknowledged, it is important to clearly document and establish their roles in UPA and examine their work as leaders and the need for further leadership training in this area.

### ***Indigenous Technical Knowledge***

India is clearly a world leader in composting and vermicomposting eco-technology. Even young Canadians have been going to places like Bhawalkar Earthworm Research Institute (BERI) to learn more and are now diffusing this knowledge in North America and other regions of the world. This indigenous technical knowledge points to the possibility of further diffusing Indian composting know-how on both a South-South and South-North axis rather than the typical, colonial model of North-South technology transfer.

The above can also be suggested for India's well-ensconced and unique technologies with respect to urban and peri-urban horticulture and waste-water fed aquaculture and the small-scale federated co-operative production and distribution systems typified by the revolutionised dairying industry.

There is the largely unanswered question of to what extent traditional farmers are paving the way with respect to UPA. In the case of peri-urban agriculture, as illustrated by the work of D.S. Bhupal for Delhi, the way is rather being paved by and toward the farmers as cities in South Asia grow exponentially thereby encompassing formerly rural areas. The same might be said for the wastewater fed aquaculture and horticulture in the districts outside of Calcutta, for example, 24 Parganas. Here, farmers from what became Bangladesh settled after partition and developed the waste water fisheries in their new homes outside of the Bengali megacity. In concrete jungles such as Mumbai, however, city farming appears to be led by very urbane intellectuals such as Dr. R.T. Doshi, former academic and industrialist and politicised activists such as Shantu Shenai and Kisan Mehta. Still, the activities and related publications of the LEISA network, managed and produced by Agriculture Man Ecology (AME), indicate that many farmers are supplementing their activities by foraying into research and community activism. The same holds true for some of the contacts provided for peri-urban aquaculture in West Bengal who are referred to as "farmer-cum-researcher" or vice-versa ("researcher-cum-farmer").

Inaugural address at the MSSRF symposium by Thiru A.P. Muthuswamy, IAS. Chief Secretary, Gov't of Tamil Nadu. Feb. 10<sup>th</sup>, 2000.

## Suggestions for IDRC

This final section outlines suggestions for IDRC to guide the South Asia Regional Office (SARO) in its effort to become more directly involved in the Cities Feeding People (CFP) Program Initiative (PI). As the first part of the conclusion has indicated, it is clear that there are many UPA activities taking place in India and that all planned interventions need to think in terms of capacity-building rather than starting a new set of activities. From 2000-2004 the CFP PI will be entering its second phase and IDRC intends to tap on Asian experience in UA.

This final section divides remarks pertaining to IDRC's potential involvement in UPA in South Asia into three sub-sections:

- the first, outlining how a SARO CFP initiative might be defined as and integrate with existing poverty alleviation measures;
- the second, suggesting that attention be paid to post-harvest technologies, food processing/marketing and distribution issues;
- and finally creating a network of identified, and yet to be discovered, UPA contacts using the well-developed information and communication technologies available in India.

### UPA as a Poverty Alleviation Scheme

The MS Swaminathan Research Foundation reports that profitability in the food sector is high accounting for 60% of total profits in the country. The food sector is second only to Information Technology (IT) in India in terms of profitability. If micro-enterprises are added, this figure increases to 75% (MSSRF 2000, Annexure 2b). Therefore, in terms of income-generation, there is tremendous potential within the food sector to create a greater number of viable enterprises.

DS Bhupal writes, "at a time when there is so much emphasis on poverty alleviation... if financial, technical and organisational help is provided for vegetable cultivation around urban centres by slightly diverting the funds earmarked for the above purpose, it will perhaps be more fruitful and useful in achieving the twin objectives of poverty alleviation and employment generation" (Bhupal 1989, p. 11).

Following Bhupal, planned interventions concerning UPA ought to focus on providing needed financial, technical and organisational assistance. Research should be participatory and action-oriented in order to achieve these objectives. An IDRC CFP program in India might be combined with existing poverty-alleviation schemes such as the "Development of Women and Children in Urban Areas" (DWCUA) schemes developed by the Government of India.

It goes almost without saying that there are linkages between urban and peri-urban agriculture and health: primarily with respect to food security and environmental health in the sense of bio-diversity. As well, as the sections early on in this report show, there is a clear link between urban agriculture and the nexus between human and environmental health. There are concerns about the levels of toxic chemicals in food grown in and around cities that certainly must be taken into account. However, a concerted UPA development program can enhance the quality of the urban environment by leading to the greening of cities and through efforts to steer urban planning toward a more sustainable path.

### Investing in Post-Harvest Technologies & Processing/Distribution

This report has already firmly established that significant proportions of agricultural output in India are lost due to spoilage. The same holds true for commercial agriculture on the urban periphery. D.S. Bhupal clearly established the problems faced by potato and tomato producers in Delhi and its surrounding areas, particularly in the summer. The result, in addition to losses absorbed by farmers, is the difficulty for urban consumers to obtain fresh quality vegetables at reasonable prices. Investments in proper cold storage facilities and distribution infrastructure would result in price stabilisation for both producers and consumers.

At present, MSSRF estimates that only two percent of food production in India is processed. Great potential exists for processed foods such as tomato puree. The ability to develop markets for processed foods requires post-harvest technologies and effective marketing and distribution that will, in turn, increase the viability of urban and peri-urban agriculture. IDRC ought to direct part of its CFP programming in India to examining and promoting effective and appropriate post-harvest technologies and processing/distribution mechanisms to support UPA.

### Create a Network Using Information & Communication Technologies

A final remark with respect to IDRC-SARO's potential involvement in CFP concerns the need for an effective networking mechanism to bring together UPA agents in the country and enable them to interact more efficiently with one another and internationally.

At present, there is a great disparity with respect to the use of new Information and Communication Technologies (ICT) among identified UPA contacts in India. There is a clear "digital divide" which separates those who are using the Internet and those who are still making use of a manual typewriter! Leaders in the Indian UPA movement are, for the most part, literate, English-speaking, well-educated individuals, but technology is not necessarily made use of either due to lack of funds, training or comfort. A further divide exists between the use of ICT by UPA leaders and their grassroots constituencies.

Given its extensive international network and its use of ICTs in development (*Friends of IDRC*, Summer 2000), IDRC is in an excellent position to promote new technologies to connect the major individuals, agencies and institutions referred to in this document.

In the interest of providing enhanced food-security and income-generating activities within a framework of promoting sustainable cities, IDRC-SARO is in a unique position to bolster UPA activities in India, South Asia and internationally.