FACILITATING NEGOTIATIONS OVER WATER CONFLICTS IN PERI-URBAN CATCHMENTS (NEGOWAT)

INCEPTION REPORT

prepared by

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This project is supported by the UK Department for International Development (DFID). Project R8324.

EXECUTIVE SUMMARY

Peri-urban zones are dynamic areas of opportunity and change. Creations of urban development and expansion, these areas provide new opportunities linked to easier access to urban markets, services and jobs. But frequently these benefits are outweighed for many by problems linked to land use change, pollution and rapid exploitation of natural resources. Pressures on peri-urban water resources include the expanding footprints of cities desperate to secure new industrial and domestic water supplies for growing populations, and that are increasingly in conflict with farming communities determined to protect their water rights and livelihoods. Aquifers and rivers are often threatened by pollution from industry and residential areas with poor sanitation. These pressures, and the institutional vacuum or policy 'mis-fit' that is often associated with the management of natural resources in peri-urban areas, leads to competition, contestation and conflicts over water in these zones.

In Chennai, India and Cochabamba, Bolivia, the NEGOWAT project is focused on developing tools to better understand water-related competition and conflicts and to help facilitate negotiations between stakeholders in these areas. These include the application of visioning, scenario development and modelling tools in integrated water resources management (IWRM) such as Bayesian networks, role game playing, and multi-agent systems.

In Chennai, India the project will focus on problems linked to increasing exploitation of water resources in peri-urban zones to meet the domestic water needs of the city, concentrating on the River Palar catchment area. Chennai has some of the most serious problems in domestic water supply throughout urban India, and as well as urgently needing to improve infrastructure and services, has to routinely cope with severe water shortages in summer. Currently, large volumes of water are tankered into the city. Public and private tanker operators purchase water from farmers in the peri-urban areas, and concerns are developing about the sustainability of abstraction (from peri-urban aquifers) and the impacts of developing water markets upon other farmers and water users. These include domestic water consumers in the peri-urban areas. Other serious problems include sand mining, and pollution from textile and leather industries. In the River Palar catchment these concerns have led to the development of a stakeholder forum by civil society groups, and the research project will support negotiations linked to this forum.

In Cochabamba, Bolivia, the research will focus on negotiation processes linked to the development of water and sanitation services, concentrating on two peri-urban municipalities, Tiquipaya and Colcapirhua. Cochabamba is a rapidly expanding city and basic services in the peri-urban areas need to be improved. However, in Tiquipaya and Colcapirhua a major water and sanitation infrastructure project has been strongly contested with many protests and demonstrations held. Objections of some groups include a lack of information and consultation, a perceived loss of control and community involvement, the high cost of the project and associated loans, concerns about proposals that involved privatisation, and the high water and sewerage charges that could be levied as a result. Other contested issues in Tiquipaya/Colcapirhua include concerns about changing land use and rates of urbanisation, management of the flood plain currently used for solid waste disposal, and sharing of montane water resources between irrigators and domestic water supply agencies.

The NEGOWAT project is partially supported by the European Commission (EC) Inco-Dev programme for research in Bolivia (and also work in Sao Paulo, Brasil). The DFID research project provides matching funds for some of the research in Bolivia, but principally supports the research activities focused on Chennai. This report summarise the main activities and findings of the inception phase of the project, focusing to a greater extent upon the wholly DFID-supported activities in Chennai, India. A summary is also included of project activities in Bolivia, with links to further related documents and reports on this research.

As part of the inception phase, activities since December 2003 in Chennai have included the recruitment of a research team, preliminary fieldwork and an inception workshop where a large range of stakeholders were represented and the project proposal was presented, discussed and developed. Contractual arrangements have also been finalised between the project partners.

Activities commenced earlier in Cochabamba, as part of the EC-supported research. These have included a kick-off meeting, two subsequent progress workshops and five joint visits between UK and Bolivian researchers. Work to date has concentrated on collecting baseline data, training in modelling methods, and planning a strategy to engage within rapidly-moving negotiation processes. Currently research is focused on participating within an officially-sanctioned forum to address concerns raised by communities over the planned water and sanitation project. A draft methodology for engagement in negotiation processes has been developed.

The inception phase has confirmed the commitment of project partners and key stakeholders in both Chennai and Cochabamba to the research, and relatively few changes are proposed. A full research team is in place, and all contractual arrangements have been finalised. One key proposed modification is to shift back the workplan and completion date by 3 months, due to delays in commencing research activities in India.

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1. INTRODUCTION

1.1. Background

In our rapidly urbanising world, cities rely on the mobilisation of water resources far beyond their hinterlands, and urban water users (for domestic use, urban agriculture, formal and informal sector industries and services) increasingly compete with other needs such as irrigation or environmental use. The problems created by the increasing 'water footprint' of cities and related competition for water, often associated with a competition for the access to land, are most severe in peri-urban zones and tend to be exacerbated by the rapid growth of industry, informal settlements with inadequate sanitation arrangements and high levels of pollution. Peri-urban areas are particularly affected as they often rely upon sources that are shared with irrigators and other upstream users, and are located closest to the high-profile demands of cities. Typically these zones experience rapid, unplanned growth driven by rural urban migration, which in turn makes planning for service provision or resource management more difficult.

Many metropolitan centres and their rural hinterlands are now faced by increasing, and often critical, water problems faced. Due to the depletion of water resources and their degradation by pollution, the tensions caused by these problems lead to contestation and conflict that needs to be better prevented and managed, particularly to minimise the impacts on the poor. The peri-urban interface, the transition zone between land in cities and areas in predominantly agricultural use, is home to some of the poorest people in developing countries.

Box 1 Appropriate management tools

The project will develop, adapt, test and disseminate appropriate decision-support tools such as checklists for negotiation processes, modelling methods including Bayesian networks and agent-based systems, role game playing, and scenario development techniques.

The NEGOWAT project was planned to address these problems by developing approaches to facilitate more inclusive and effective negotiations to water-related conflicts in peri-urban areas.

1.2. Goal, purpose and outputs of the project

The original logframe (from the project proposal) is included at Annex 1.

The project **goal** was: *Improved assessment, development and management of water resources*

The project **purpose** was: *More inclusive and pro-poor management arrangements to facilitate the avoidance and resolution of conflicts over access to water resources in peri-urban areas.*

Three **outputs** were planned:

1) Appropriate management tools (Box 1) and institutional structures for improved, stakeholder-led Integrated Water Resource Management (IWRM (see Boxes 2 and 3) encompassing peri-urban zones and the adjoining urban and rural catchment areas).
2) Improved capacity of resource centres to support and facilitate stakeholder led IWRM in peri-urban contexts
3) Widely disseminated approaches that are and accepted as a basis for good practice

Box 2 Integrated water resources management (IWRM)

IWRM involves the coordinated planning and management of land, water and other environmental resources for their equitable, efficient and sustainable use (Calder, 1999). It is widely accepted that Integrated Water Resource Management (IWRM) is the most effective paradigm for managing scarce water resources. The NEGOWATY provide is developing practical tools that will support IWRM implementation in peri-urban areas and their catchments.

Activities were planned to focus on two cities: Chennai (previously Madras) in India, and Cochabamba in Bolivia. The project is based upon 9 sets of activities/ work packages:

1) Inception phase
2) Literature/ knowledge review
3) Resource audits in pilot catchments
4) Development of stakeholder platforms, and Agent-based models and/or Bayesian networks
5) Development of decision support support systems integrating the water resource audit compiled in GIS and agent-based model or BN
6) Identification of favoured scenarios and support in development of management plans in stakeholder forums
7) Development of guidelines and training materials based upon findings
8) Dissemination of results and of guidelines
9) Management, process monitoring and evaluation

Further information is included in the log-frame at Annex 1.

1.3. European Commission support for the project

NEGOWAT research in Cochabamba, Bolivia (and also Sao Paulo, Brasil) is supported by the European Commission INCO-DEV programme (Contract No. ICA2002-10061). This project, coordinated by the *Centre de Coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD), France, has a total value of €1,774,008, of which €1,170,033 is supported by the EC including 50% of the costs of the Natural Resources Institute's costs of research in Bolivia, and the rest is contributed from other sources including DFID. The DFID research project supports the remaining 50% of the Natural Resources Institute's costs of research in Bolivia, and extension of

Box 3 Multi-stakeholder processes and platforms

In many countries, including India and Bolivia, effective water resources legislation and regulation is lacking. An alternative, at least at local levels, is stakeholder-based water resource management and IWRM based on the application of key principles to sub-sectoral activities. The challenge is to bring together diverse groups of stakeholders with often competing interests to effectively negotiate shared use of water resources.
See Moriarty *et al*. (2004) for further discussion.

the project (all partners' costs) to Chennai, India.

1.3.1. Structure of work packages, EC project

The EC project (Bolivia and Brasil) is structured following a series of six work-packages which together will enable the above outputs to be achieved (in Cochabamba, Bolivia). These are slightly differently structured to the DFID project, but cover broadly the same activities. The work packages are:

1) *Preparation for modelling:* includes training on modelling, bibliographic surveys, mapping land and water issues with stakeholders, land use analysis using GIS, and training/ exposure visits.
2) *Model design and development:* using modelling methods to develop a conceptual framework that represents processes of urbanisation and related conflicts
3) *Collecting complementary data*: on hydrology, land and water use etc.
4) *Development and testing of a 'negotiation' methodology*: the design and testing of a methodology to support negotiations over land and water conflicts.
5) *Validation of methodologies and training*: includes testing the methodology in other catchments and the development of training materials
6) *Coordination of activities*: addresses management, reporting, publications and dissemination activities.

1.4. The inception phase and this report

DFID-supported research effectively started in December 2003, 3 months behind the planned start date in September 2003, due to delays in contracting and mobilising staff. Activities in Cochabamba, Bolivia commenced earlier (in January 2003) supported by EC funding. Research findings in Bolivia are reported upon separately to the EC, and in this report, only a brief summary is given with links made to further reports and information. This report focuses on the inception phase activities in Chennai, India between December 2003 and June 2004. Key issues to be addressed during the inception phase were:

- Contractual arrangements to be finalised between the Natural Resources Institute (NRI), IRC International Water and Sanitation Centre and the Madras Institute of Development Studies (MIDS)
- PhD student and research assistants recruited by MIDS, equipped and trained
- Identification of focus areas, poverty analysis, stakeholder analysis at different levels, explanation of process to key stakeholders and methodological development

2. INITIAL ACTIVITIES AND FINDINGS: CHENNAI, INDIA

Activities to date in Chennai, India have included: agreement of subcontracts and recruitment of research assistants, preliminary fieldwork, an inception workshop, knowledge review, stakeholder analysis, and other activities.

2.1. Agreement of subcontracts and recruitment of research team

MIDS will lead the project research activities in Chennai, with backstopping support provided by IRC and to a lesser extent, NRI who also provide overall coordination with activities in Bolivia. Sub-contracts are now in place between NRI and MIDs and between NRI and IRC. MIDS have also recruited research assistants and a strong research team is now in place (see section 4.3 for further details). MIDS have purchased additional necessary computing equipment and software.

2.2. Preliminary fieldwork

India is projected to be more than 50% urban by 2020. While the absolute number of people living in rural areas will continue to grow, urban areas will grow far faster, creating huge demands on water supply and sanitation infrastructure and water resources. As a result of the above shift, there will be increasing pressure to transfer water out of agriculture to meet the needs of urban areas. While agricultural interests may resist pressure to transfer water, it will be very difficult to sustain such resistance in the face of the `power' that is centralized in urban areas.

One such area where these tensions are apparent is the Basin of the River Palar, one of the major sources of water for the city of Chennai, capital of Tamilnadu state and home to over 4 million people (in 2001). To investigate issues in the peri-urban areas of Chennai, preliminary 'scoping' fieldwork was carried out during March and April 2004. This fieldwork investigated and developed an initial picture of the nature and intensity of water-related problems in Chennai and its rural hinterland, specifically those related to the rapidly developing water markets that provide water from peri-urban areas for augmentation of the city's domestic water supply. Visits were made to the principal corridors into Chennai city where water is pumped or purchased from farmers and then tinkered. These investigated the terms and conditions of water sales between the Chennai Metro Water Board and farmers, the various agencies involved, and impacts and conflicts associated with such transactions.

Chennai faces severe water scarcity. The Government of Tamilnadu has invested heavily in augmenting water supplies to the city but the problem still persists. The per capita water supply in Chennai (76 lpcd) is lower than any other major city in India, is uncertain and unreliable. Even during years with good rainfall, water is generally supplied for only three hours per day and many local water sources are saline due to groundwater intrusion linked to over-abstraction. During dry periods, most people rely upon collection from freshwater supplies that are tankered into the city, and storage tanks where the municipal tankers unload, are found along most streets. In addition, many households and institutions purchase privately tankered water supplies.

As a result of such problems, peri-urban water markets are emerging adjacent to both large urban areas such as Chennai and intermediate sized towns. The markets typically involve the sale of water by well owners (generally farmers) either directly to industries or to tanker companies who then deliver supplies to end-users (smaller industries, commercial establishments and households) or to the Metro Water Board. The impact of transfers on agricultural users is probably the most controversial issue in the debate over these water markets, due to the serious impacts it can have on rural farming systems and the livelihoods of the people who rely on them (both land owners and agricultural labourers). As well as being controversial and the locus of potential conflict, this type of market has been, in comparison to rural water markets, the subject of less research and is therefore less well understood.

The fieldwork centred on the principal supply corridors into Chennai city, which were mapped with a view to locating the various well fields from where water is transported. These well fields are found all around the city with the most prominent among them being:

To the South (Lower Palar region)

- the Palur area which extends over a stretch of 11 km along the River Palar on the Chengalpattu–Kancheepuram road. Water is extracted from 82 bore wells, which lie on the Palar river bank, from where it is transported to the city by tanker trucks,
- the Palayaseevaram area where water is sold from 13 bore wells,
- the Nallathur area from where water is pumped from 12 bore wells to feed the atomic power station and adjoining residential colonies,

To the West

- on the Chennai-Poonamallee road, water is pumped from more than 50 bore wells,
- Thirumamizhai, Thiruvallore, Kadambathur, Karanai, and Poondi regions from where water is pumped from more than 100 bore wells,

To the North

- water from this corridor is being pumped since the late 70's and 80's. The main clusters of villages are Minjur, Naalur, Panchetty, Kanigaiper, Sothuperumbedu and nearby areas.

Water is generally transported from these wells by tanker trucks. We estimated that almost 18,000 tanker loads are delivered to the city each day. On average, farmers (the water sellers) receive a price of Rs. 40 per tanker load of 12,000 litres (£1 = Rs 85). In some places, especially in the western well fields, purchased water is conveyed to the city through pipelines.

In many villages, (other) farmers and activists have protested about water sales, because of the impact upon groundwater levels and the availability of water to farmers who are not selling water, and to village drinking water supplies. Communities and activists believe that agriculture is declining due to reduced water availability (declining groundwater levels) citing as evidence a shift in the cropping pattern from water intensive crops to dry crops and tree crops. Related impacts and linked issues include an increase in unemployment in agricultural areas, migration of small farmers and landless agricultural labourers to the city, and the purchase of agricultural lands by real estate dealers and industrial owners. Traditional water bodies such as irrigation tanks, spring channels, and ponds are either in a state of total neglect or have been encroached for urban use.

In the Lower Palar, we estimated that 40 million litres per day (Ml/d) is transported to the city for industrial and domestic uses, pumped round the clock from the riverbed aquifer. Individual sellers enter into contracts with buyers for water knowing that their bore-well will become dry sooner or later due to non-stop pumping, but often making a substantial income while the water lasts. Individuals prefer to sell water for two main reasons: firstly, because income from water sales is greater than (and less risky than) returns from agriculture; and secondly, because if even if they do not sell water, they know their neighbours will and they will loose out anyway (due to reduced groundwater levels and availability of water in the future).

In summary, it is important to underline that there are winners and losers in the water selling business. The winners are those land-owners (farmers) with reliable well fields, close to the main roads leading into Chennai. The losers are farmers without either high yielding wells or easy access for tankers; the large numbers of landless labourers who's livelihood is completely destroyed when farmers stop cultivating and become water merchants; and villages where the domestic water supply is threatened.

Illegal sand mining from the riverbed is also a major issue in this part of the basin, leading to reduced capacity in the riverbed aquifer and affecting the intakes of irrigation schemes. Both pumping from the riverbed and sand mining, have contributed significantly to seawater intrusion in the coastal areas of the basin; up to 10 km inland in some areas. In addition, overexploitation of the riverbed aquifers has resulted in the drying up of some spring channels, tanks and even entire aquifers, that hitherto have contributed quite significantly to the overall prosperity of the region and to agricultural stability in particular.

The problem is particularly severe in the Lower Palar due to its proximity to the city. This area is actually peri-urban but in an institutional limbo attracting the attention of neither the local Panchayat nor the city administration. There is in fact an *institutional vacuum.* The capacity of local institutions to exercise control over changes in the peri-urban area of this basin is weak and they find it difficult to take actions against illegal encroachments of wetlands, pumping from the riverbed, illegal sand mining and unauthorised water transportation.

A good deal of groundwater is pumped from agricultural wells and transported into the city everyday from peri-urban areas (other than the lower Palar basin) close to the Chennai city. Currently over 100 Ml/d of groundwater is drawn from these basins to supplement the drinking water needs of the city population. Notable well fields in these river basins are Minjur (about 120 agricultural wells have been converted into water selling wells), Thamaraippakkam (over 50 agricultural wells) Panjetty (over 100 agricultural wells), Kanigapper (60 agricultural wells) and Poondi-Kadambathur (80 agricultural wells). It was apparent from our preliminary field visits to these areas that many agricultural wells and many other wells that were supplying water to Chennai city have become dry. Moreover, due to nearness to the sea, seawater intrusion has already reduced the quality of groundwater in these areas.

In several places, farmers and local people have agitated over round-the-clock pumping of groundwater from agricultural wells to meet the city needs. In fact, women's organizations in two villages in the Panjatty – Minjur area have successfully stopped sales of water to the Metro Water Board. But we were informed that the officials invoke an emotional argument while searching for water sellers: *that if you cannot supply water to your own people in Chennai, how can we ask for water for our farmers from Karnataka*? (there is currently a trans-state dispute between Tamilnadu and Karnataka over water from the River Cauvery).

Taken together these problems lead to severe impacts on the livelihoods of communities in peri-urban areas. The preliminary fieldwork confirms that the sustainable development of peri-urban water supplies to meet the city's domestic water needs (especially the urban poor), trucking of this water into the city, and the negotiations linked to these issues are the key areas that should be addressed by the project.

2.3. Inception workshop

A two-day inception workshop was organised in Chennai from 20-21 April 2004. The main objective of the workshop was to discuss and develop the proposed research activities with different stakeholders. Altogether there were about 100 participants over the two days including researchers, NGO staff, government officials, the media, local politicians (from peri-urban areas), farmers and rural activists, and the whole research team (MIDS, IRC and NRI).

On the first day of the workshop, ten papers were presented on various urban and peri-urban water issues, including: the extent and implications of water transport from peri-urban areas to Chennai city, ongoing schemes of the Government to augment the city's water supply, pollution and other environmental problems, and stakeholder participation and dialogue. The second day was devoted entirely to dialogue and debate with a broad group of stakeholders, although being held just prior to state elections where water supplies were a major political issue, not all government-linked agencies were able to attend. The workshop successfully enabled the project to further develop contacts with stakeholders and some government officials, and to collaboratively develop the planned activities. Copies of the papers presented are available (and will be posted on the project website) and a synthesis of the workshop proceedings is included at Annex 2.

The government officials who made presentations indicated that indiscriminate groundwater extraction has resulted in seawater intrusion in the coastal areas and emphasized the need for rainwater harvesting techniques to improve the quantity and quality of water. Direct discharge of sewage into the rivers should also be avoided, they said. They also suggested that all temple tanks in the city should be renovated and treated as prominent rainwater harvesting structures. Hydro-geologists also made presentations in the workshop and indicated that a proper understanding of the groundwater regime and the inter-relationship of various recharge and discharge parameters is essential for development of strategies for judicious and sustainable management of water resources for Chennai city.

The farmers who participated in the workshop narrated the problems linked to water selling and the manner in which agriculture is affected in their villages. Women participants who have lost their agricultural work explained their suffering and problems, even to find drinking water. They also explained that there is an institutional vacuum in the villages in which the local *Panchayat* (local village governing body that is democratically elected) is virtually helpless and powerless and finds itself in an awkward situation, unable to fight or compete with the city corporation or the Metro Water Board.

The workshop was widely reported in the local press (Annex 3) and will now form the basis for a continuing dialogue process with a broad group of stakeholders.

2.4. Knowledge review

The knowledge review centres on the key issue of stakeholder-led IWRM, the use of appropriate decision-support tools, successes and failures of stakeholder-led approaches in natural resource management, and key issues and approaches to peri-urban problems. The knowledge review (led by MIDS) is still being completed, and is a key project output. However, early papers that discuss many of issues to be covered were presented at the inception workshop (one of the key papers from the inception workshop is included at Annex 4 and this paper will be revised as the first paper in a NEGOWAT working paper series in addition to forming a basis for the wider knowledge review). The knowledge review itself will be completed by October 2004.

The approach to the knowledge review is to set the above issues in the overall context of key water management challenges faced in South Asia and elsewhere,

and the attempts made to overcome these challenges by the State, users and civil society. The outline structure of the review is as follows:

- *Title:* Literature review on multi-stakeholder dialogues and the combined use of decision-support tools: with particular reference to natural (especially water) resource management at the peri-urban interface, and empowering marginalised groups
- *Section 1:* The application of multi-stakeholder dialogues to empower marginalised groups in society (especially where state is weak or corrupt)
- *Section 2:* The use of decision-support tools (Bayesian networks, role game playing, multi-agent systems etc) to improve functioning of multi-stakeholder dialogues
- *Section 3:* The application of multi-stakeholder dialogues to issues of conflict at the peri-urban interface (other issues not just water)
- *Section 4:* The application of multi-stakeholder dialogues in local water management (from any areas i.e. not just peri-urban)

2.5. Stakeholder and poverty analysis

Stakeholder analysis and poverty analysis are also still in progress. A stakeholder analysis in the upper Palar basin is complete but needs to be replicated to the lower Palar basin and other study areas. Analysis will be completed only after finishing the ongoing first phase fieldwork. We are also in the process of analyzing secondary data and available literature.

Poverty is acute in the peri-urban areas of Chennai. The secondary data from published official sources indicate that over 30% of the population lives below the poverty line: primary indicators of poverty are malnutrition, lack of infrastructure such as safe drinking water and sanitation, lack of adequate health care, high infant mortality rates, high unemployment and low literacy levels. All these are prevalent in the peri-urban areas of Chennai. Many people have migrated to the city either permanently or temporarily seeking work.

A stakeholder analysis has already been completed in the upper Palar basin where intensive research was carried prior to this study. A similar exercise is being carried out in the lower Palar basin where actual stakeholders have been identified, many of whom were involved in the inception workshop. The initial stakeholder analysis in the peri-urban areas reveals that water-related conflicts are quite severe and conflicting tendencies are gathering momentum. The ongoing first phase field research in about 50 villages in the peri-urban areas of Chennai will be used to complete the stakeholder and poverty analysis (including variations in poverty along corridors into the city across the rural/peri-urban/urban continuum). However, the initial analysis indicates that key stakeholders are farmers (especially farmers utlising groundwater including both those who do and do not sell water), landless agricultural labourers, peri-urban domestic water consumers, democratically-elected local governing bodies, urban water consumers (and industry) and the Metro Water Board. We have also identified a good number NGOs and civil society organisations, who are actively involved in work on these issues.

2.6. Other activities

The key additional activity has been establishing linkages with other relevant research projects and development activities. Contacts have been developed with:

- Peri-urban projects funded by the European Commission and DFID Natural Resources Systems Programme in Hubli-Dharwad and involving the Institute of Rural Management, Anand,
- 'Resolving Problems in the Water supply and Sanitation Sector in the Peri-urban areas of Chennai: a Policy approach'. This effort is part of a study of peri-urban areas being carried out by SUSTAIN with the support from DFID.
- A Ph.D student from Stanford University who is doing her doctoral thesis on 'Assessing the efficiency and equity impacts of informal rural-urban water transfers in Chennai and its peri-urban areas'.

2.7. Publications

A project website is being developed using IRC's 'portal' system where working papers and other key documents focused on Chennai, India will be published. A project website for the EC supported project in Bolivia (and Brasil) can also be accessed at www.negowat.org and appropriate links will be developed.

Papers completed or in stage of making final revisions include:

S.Janakarajan. *A snake in the grass!! Unequal power, unequal contracts and unexplained conflicts: Facilitating negotiations over water conflicts in peri-urban catchments*. Negowat working paper 1. Forthcoming (see Annex 4)

Gilbert Rodrigo, Sundar Raman, Prabahar Gnanakkan and G. Jothi. Chasing a mirage: *Peri-urban water issues in Chennai, India*. Negowat working paper 2. Forthcoming (A working paper based upon the preliminary fieldwork)

3. INITIAL ACTIVITIES AND FINDINGS: COCHABAMBA, BOLIVIA

3.1. Activities to date

In Cochabamba, activities partially supported by DFID as part of the otherwise EC-funded research have focused on work packages EC1-4 (see section 1.3.1). Work packages EC1-3 (EC1. Preparation for modelling; EC2. Model design and development; and EC3. Collecting complementary data) have been completed, and work package EC4 (Development and testing of a 'negotiation' methodology) is underway. This section briefly discusses DFID-supported inputs to these activities by the Natural Resources Institute.

3.1.1. Work-package EC1: Preparation for modelling

Participation in the kick-off meeting held in Sao Paolo in January 2003, and the associated multi-agent systems (MAS) training, provided an appreciation of MAS modelling (Box 4), and an opportunity to understand the scope of the research, team members skills and develop more detailed for follow-up work.

3.1.2. Work-package EC3: Collecting complementary data

Visits to Cochabamba, Bolivia in May, August, and November 2003, and February and June 2004 focused on supporting collection of baseline data and the engagement in

Box 4 Agent-based modelling

Multi-agent systems (MAS) are advanced social science simulation tools that can be used to simulate complex behaviourial and management situations like the use and management of water resources in a catchment. Role-playing games have been successfully combined with the use of MAS models in order to open the 'black-box' of these systems, and to involve stakeholders in the development and interpretation of scenarios

negotiation processes (see next section). Specific areas of work focused on backstopping support to the team in Bolivia included:

- Supporting documentation of research on locally-managed domestic water supply systems
- Supporting development of survey methodology and documentation of research on multiple uses of water supply systems at the household level
- Supporting other areas of research and team members as requested (on hydrological issues, water quality, linking modeling to negotiation processes, planning for project workshops, website development, supporting various research students etc).

Participation in the second workshop and steering committee meeting in Sao Paolo, May 2003, and in the third team workshop and steering committee meeting held in Cochabamba in November 2003 focused on this work package.

3.1.3. Work-package EC4: Development and testing of 'negotiation' methodology

Current supporting work is focused on NEGOWAT engagement in negotiation processes in Cochabamba, including assisting the development of methodologies. This is discussed further in section 4.2.2.

3.1.4. Stakeholder and poverty analysis

As in India, completion of a strong stakeholder and poverty analysis has been problematic and taken longer than expected to document. A key staff member (Gonzalo Vargas) tasked with documenting the stakeholder analysis left Ceres, leading to further delays. There is also relatively little reliable secondary information available. In early 2004 a large sample questionnaire survey (by a research centre within the University of San Simon focused on urban and planning issues) incorporated poverty and livelihood related questions. This survey is still being analysed.

3.2. Review of findings

The city of Cochabamba (520,000 people in 2001) in central Bolivia lies at the edge of the Andes and within the upper part of the Amazon basin. The climate is mild but relatively dry, and scarce water supplies are often contested between the rapidly growing city and the surrounding agricultural communities. In 2001, concerns about irrigation water rights in peri-urban areas were one of the issues that led to the so-called 'water war' and eventually the cancellation of a concession granted to a private company to provide water and sanitation services in the city. The city is surrounded by productive valleys that even in modern times remain bread-baskets for the country as a whole. One of these agriculturally productive areas, where this study focused, is the municipalities of Tiquipaya and Colcapirhua on the western peri-urban fringes of the city.

The centre of Tiquipaya is 11 km to the north-west of the city of Cochabamba. Due to its varied topography the municipality has important contrasts in its geography over relatively short distances. To the north are rural tropical areas, in the centre are high mountains, and to the south and close to the city, the valley area. The municipality had a population of 37,800 in 2001 according to census data, and population growth averaged over 11% per year, concentrated mainly on the valley area. Despite such

population growth, this 'peri-urban' part of the municipality still retains a relatively strong agricultural character based upon the traditional irrigation systems.

Colcapirhua, in contrast, is a smaller and more 'urban' municipality located to the south of neighbouring Tiquipaya (but with an almost identical population size). Located approximately 8.5 km to the west of Cochabamba it straddles one of the main highways leaving the city, along which the pace of development has been rapid. Colcapirhua has an area of only 28 km^2 from which 61% is urban and only 39% can be considered as rural. Colcapirhua has a population of 37,800 inhabitants that largely live in the urban areas. According to census data, population growth is 6.9 % per year.

Urbanisation is strong throughout the Cochabamba valley: the urban land area in Tiquipaya (excluding mountain and lowland areas) increased from 3 to 40% between 1983 and 2003 due to in-migration and local population growth. Both Tiquipaya and Colcapirhua are facing profound changes due to these urbanisation processes in formerly agricultural areas, with obvious impacts on patterns of land use and related impacts upon water use and the delicate balance between water demand and supply in this water-scarce region.

A series of small reservoirs in the mountain catchment harvest water for dry season irrigation in the valley, as well as being important for fishing. The rights to water in these reservoirs (there are also rights to dry season and rainy season river flows) belong to the members of six main irrigation systems in the valley (around 2500 farmers), although water is conveyed using the same main river channel. Irrigation supports generally intensive agriculture including production of flowers, horticultural products and dairy farming (based upon cultivation of alfalfa). Additional irrigation water is provided by a canal from the Angostura reservoir to the south-east of Cochabamba, and wastewater is also utilised. The catchment area also includes storage reservoirs for domestic water supplied to the city of Cochabamba and a small hydropower scheme.

Pressures on available water resources in the valley have gradually built up between water users. Since the 1970s groundwater has been progressively developed, and there are now concerns that groundwater levels are declining and the flow of springs is reducing. Pollution of groundwater is a further concern. As domestic water demands have increased in the valley and in Cochabamba, competition for scarce water resources has been exacerbated and there is increasing potential for conflict between different stakeholders including irrigators, municipalities, locally-managed domestic water systems, and urban domestic water utilities. Development policies and projects have considerable potential to clash with the existing domestic and irrigation systems that are based upon local norms and rules. Currently, the development of water and sanitation infrastructure is a major political and social issue.

In peri-urban Tiquipaya and Colcapirhua, domestic water supplies are managed by a large number of relatively small community-based associations, and a larger association for the urban centre (supplying partially treated surface water and also sewerage infrastructure). The smaller water committees typically manage piped water systems serving 50-200 families from a groundwater source (approximately 85% systems utilise wells or springs according to van der Meer, (2004) based upon a survey of 28 out of 90 systems in Tiquipaya and neighbouring Colcapirhua), although

some systems also share surface water sources with the holders of irrigation water rights. These locally-managed systems are considered to function reasonably well: there is a high level of community participation and ownership in their operation, water is often available 24 hours a day, water quality of groundwater sources in Tiquipaya is relatively good (but not in Colcapirhua where there are problems with iron, manganese and microbial contamination) and monthly water charges are low (averaging 1 Bs/m^3 or 0.13 US$/$m^3$ compared to normal charges of 0.4-0.5 US$/$m^3$ in urban areas (Ministerio de Servicios y Otras Públicas, undated)). However, joining fees for new connections are high (generally US$300-400). Except in the 'urban' centre, households rely upon cess pits and septic tanks for wastewater disposal.

However, a comprehensive water and sanitation project, *Empresa Proveedora de Servicios de Agua Potable y Alcantarillado* from the *Mancomunidad Municipal Tiquipaya-Colcapirhua* (EPSA-Macoti) currently being planned will result in major changes. Development of new water sources and water treatment works are planned to supply bulk water (initially from new deep wells and potentially later from a major regional project to develop new surface water resources for domestic use, irrigation and hydropower) to the existing systems and to meet the needs of new users, and a sewerage network and treatment plant will be constructed. The EPSA-Macoti project has been hugely controversial, with many concerns raised and demonstrations held, including local objections to: a lack of information and consultation, a perceived loss of control and community involvement, the high cost of the project and associated loans, concerns about proposals that involved privatisation, and the high water and sewerage charges that could be levied as a result.

The average annual income per person in Quillacollo (the Province in which Tiquipaya and Colcapirhua are located) is US$1448 (Source: UDAPE) but incomes are almost certainly lower in parts of Tiquipaya and Colcapirhua when the urban area of Quillacollo is excluded. According to EPSA Macoti project documents, 55% of the population fall below a poverty line of Bs 3330 annual income per person (US$426) with an average income of only Bs 2160 (US$276). Government guidelines propose that water and sewer services should be within 3-5% of peoples' income which is equivalent to Bs 5-9 (US$0.6-1.2) per person per month for these poorer families. Currently users of the locally-managed water systems pay an estimated Bs 3.9 (US$0.5) per person per month (Bs 15.9 or US$2.0 per household) if they use 140 lpcd or 17.5 m^3/ month per household (a relatively high level of use) i.e. less than 3% of income. Although water and sewerage tariffs for the proposed new system are uncertain (and now it is proposed the system will supply bulk water for smaller systems), Woudstra (2003) analysed proposed tariffs and reported that they were equivalent to 11.1% income for domestic water supply, and a further 11% for sewerage services.

3.3. Publications

Papers completed or in stage of making final revisions/ translation where DFID supported inputs have directly contributed include:

Bustamante, R., Butterworth, J., del Callejo, I., Duran, A., Herbas, D., Hillion, B., Reynaga, M. and Zurita, G. 2004. *Multiple sources for multiple uses: Household case studies of water use around Cochabamba, Bolivia*. [online] Available at www.irc.nl/content/view/full/8031 (accessed 22 March 2004).

Bustamante, R., Butterworth, J., Flierman, M., Herbas, D., den Hollander, M., van der Meer, S., Ravenstijn, P., Reynaga, M. and Zurita, G. 2004. *Livelihoods in*

conflict: disputes over water for household-level productive uses in Tarata, Bolivia. [online] Available at www.irc.nl/content/view/full/8031 (accessed 22 March 2004).

Duran, A., Herbas, D., Reynaga, M. & Butterworth, J. *Planning for multiple uses: Household case studies of water use and livelihood activities in peri-urban Cochabamba, Bolivia.* Forthcoming.

Bustamante, R., Butterworth, J. and Faysse, N. 2004*. Is there a future for locally-managed domestic water supply systems in peri-urban Cochabamba, Bolivia? Analysis of performance and some possible scenarios*. Forthcoming.

Abstracts of each of these papers are included at Annex 5.

4. PROJECT PLANNING

4.1. Proposed adjustments to project

A revised project logframe is included at Annex 6. This includes only minor changes: rewording of activity 3 and modification of the milestone dates. No revisions were felt to be required at either the purpose or output level. Due to delays in starting DFID-supported research in Chennai, which effectively started in December 2003 rather than September 2003 while awaiting contracts and to mobilise the research team, it is proposed that the project implementation schedule is therefore delayed by 3 months i.e. to complete in September 2006. However, there are no expected implications for the budget across DFID years. A revised workplan is included at Annex 7.

Since MIDS have sufficient capacity to undertake the knowledge review, VIKSAT (Vikram Sarabhai Centre for Development Interaction, in Gujarat, India) will not collaborate in this project as expected originally. It is also likely that IRC will provide backstopping support in undertaking resource audits in Chennai, rather than Water Resources Management Ltd.

4.2. Project methodology

The project methodology as set out in the proposal is believed to still be appropriate, however it will be reviewed continually throughout the remainder of the project, and lessons learnt from the stakeholder-led processes, and especially the use of decision support tools within the negotiation processes, will be used to continually improve the methodology.

4.2.1. Chennai, India

Fieldwork is currently being undertaken to understand poverty-livelihood relationships and to aid stakeholder analysis. A key next step in the research is the completion of resource audits based upon use of secondary data and field work in the peri-urban areas of the Chennai city. At the inception workshop it was decided to divide the resource audit between:

- *A city wide water audit*: This essentially looks at the city's demand and supply from various systems. It particularly considers what happens in the stressed summer period as well as average annual/ normal design data. Most information is already collected and analysis can be completed fairly soon. The spatial limits of this audit are illustrated in Figure 1, and analysis will include looking at patterns along the length of each of the 'corridors' supplying water to the city.

- *Detailed peri-urban zone studies*: village water audits from 1 or 2 villages will be conducted. A methodology for the water audit is yet to finalized. We will seek the help of a hydrogeologist, but a key aim is to keep the assessment simple and replicable by government, or more likely local NGOs, who where possible will be involved in methodological development. The project will then assist the testing and improvement of the methodology within the context of the work of the stakeholder platforms/ negotiation processes that will be developed.

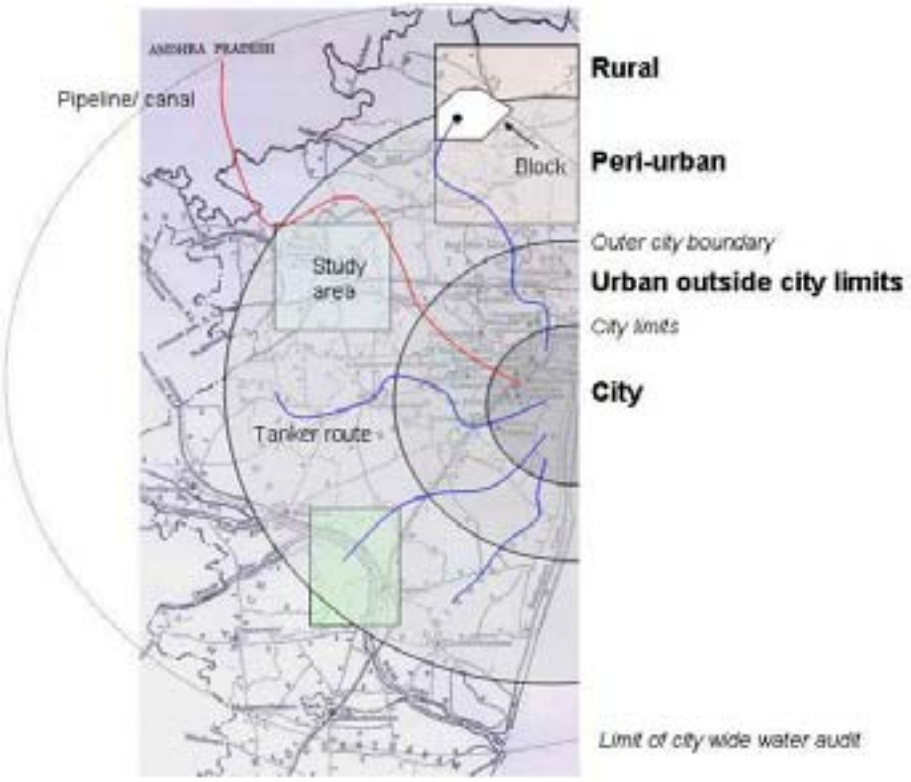

Figure 1 Spatial scales for resource audit in Chennai, India

Building upon the successful inception workshop, a series of multi-stakeholder dialogue meetings will be organized to discuss focus problems and to work to arrive at negotiated solutions for the sustainable use water resources. It is planned to begin with two large multi-stakeholder meetings in the month of July 2004 – one in the southern part and the other in the western part of the study area. These stakeholder meetings are crucial and will further contribute to our understanding and to the stakeholder analysis. Subsequently, GIS and Bayesian Network-based Decision Support Systems (Box 5) will be used to aid stakeholder-led water resource management, and currently the project staff are being trained in use of these tools.

At the local level, one aim is an adapted village-level water assessment spreadsheet (perhaps with linked Bayesian Network) that could be used by the Metro Water Board and government agencies in managing impacts of water abstraction on communities. But the tool is initially being developed for stakeholder dialogues, and more likely may only be used by

Box 5 Bayesian networks

A graphical tool for building decision support systems that is suited for use with mixed stakeholder groups and the uncertain nature of many of the factors associated with water conflicts and IWRM.
(See Cain, 2001 for more information)

local NGOs to back up their advocacy. Ultimately any such tool needs to be based upon an adaptive approach, with monitoring of impacts and quality linked to revision of abstraction targets.

4.2.2. Cochabamba, Bolivia

Current work in Cochabamba (work package EC4) is focused on participating in on-going negotiation processes and capacity building of locally-managed domestic water supply systems linked to the proposed EPSA-Macoti water and sanitation project. These now appear very promising as processes within which to test decision-support tools. The *Centro Andino para la Gestión y Uso de Agua* (Centro-AGUA), *Centro de Estudios de la realidad Economica y Social* (CERES), and other partners have a clear established role as part of the current, officially sanctioned consultation process (known as the *Mesa Tecnica*). This has been established by government with a view to resolving problems in the project design, and will hopefully lead to a revised, and more widely accepted, project.

However, several lessons have been learnt to date, and will feed into the research in Chennai:

1. Considerable time has been devoted to baseline data collection, and while this provides a rich knowledge base, it was not driven by the needs of negotiated processes and the questions posed by stakeholders (it was researcher-driven).
2. Initial attempts to developing modelling frameworks and tools have also been researcher-driven, and not clearly linked to negotiation processes on the ground.
3. Multi-agent system modelling requires a high level of expert knowledge which may not be replicable in some situations (in Chennai, simpler Bayesian network based approaches will be tested).
4. Attempts to develop ideas and establish support for a researcher-initiated multi-stakeholder platform were not successful, and were abandoned in favour of participating within existing negotiation processes that are driven by other stakeholders, with official mandates, and where there is clear willingness of key groups of stakeholders to participate (even though the project has a major role focused on the methodology for negotiations).

Participation within the current *Mesa Tecnica* process is being guided by a checklist based methodology that will be developed as a ‘conflict negotiation’ methodology, together with the water and sanitation case study, user guidelines and supporting more academically orientated papers (this is partly based upon ideas from Hemmati, 2002).

4.2.3. Links between research in India and Bolivia

Research constraints do not allow for extensive face-to-face exchanges between the Bolivian and Indian research teams. However, the team will make use of potential opportunities for meetings at other conferences and events, and electronic communication. To help develop linkages, a visit to Bolivia is however planned by Professor Janakarajan from MIDS in October or November 2004.

4.3. Research team and management

The research team at MIDS now comprises two Research Associates (Dr.J. Sacratees and S. Sundar Raman), two Research Assistants (Mr. Prabahar Gnanakkan and Mr.G.Jothi) and one part-time consultant (Mr. Gilbert Rodrigo). CVs are included at Annex 9. Dr. Sacratees is responsible for the knowledge review. Mr. Sundar Raman is responsible for developing the field-based GIS and Bayesian

Network-based decision support systems tools, which is further aided by collaboration with Dr. Patrick Moriarty of IRC. Mr. Sundar Raman is also expected to complete his Ph.D during the project period. Mr.Prabahar and Mr.G.Jothi are field assistants who will devote their time to data collection and processing. Mr. Gilbert Rodrigo will assist the fieldwork as well as in organizing stakeholders' dialogues. The project activities are managed through periodic meetings, weekly reviews, and process monitoring through individual diaries. The project team is managed by Dr. S.Janakarajan, Professor in MIDS, and backstopping support where required is provided by Dr Patrick Moriarty at IRC, and Dr. John Butterworth at NRI. A revised responsibility matrix is included at Annex 8.

5. MONITORING, EVALUATION AND UPTAKE STRATEGY

The progress of project activities, and impacts, will be monitored against the project log-frame and as set out in the project proposal, and reported in six-monthly progress reports to DFID (March and September each year) and annual progress reports to the EC (June each year).

5.1. Process monitoring arrangements

Multiple methods have been adopted for process documentation. These include:

- weekly minuted review meetings of the project team at MIDS
- monthly self evaluation reports that are discussed in the project meetings
- individual diaries as a process monitoring mechanism

The project team leader at MIDS is responsible for evaluating, streamlining and strategizing project activities.

5.2. Uptake strategy

5.2.1. General

The main users of the research in the two study areas will be local resource centres and multi-stakeholder forums representing water users. The project aims to build the capacity of two resource centres through the research (Centro AGUA in Cochabamba and MIDS in Chennai), and to make available the tools developed and associated training materials for use by other resource centres and groups working with multi-stakeholder forums elsewhere. In both countries, government at different levels play a central role in water management at the catchment scale and through involvement in management of municipal water supplies in urban areas. These government and quasi-government bodies have been specifically targeted and involved in the inception phase. A wider target audience includes researchers, resource centres (including the Streams of Knowledge coalition of resource centres) and catchment managers elsewhere and these are represented in key fora such as the Global Water Partnership and country water partnerships in both India and Bolivia. Contacts are continually being developed and the research team will seek early feedback on the research findings and possible opportunities for collaborative in dissemination.

5.2.2. Specific activities in India

The project team will:

- produce a Negowat working paper series for publication on the project website. The first two working papers are currently being edited for publication.

- manage an Indian-focused project website with appropriate links to the project website for the EC supported project in Bolivia (and Brasil) at www.negowat.org
- conduct at least two major dissemination workshops in Chennai during the course of the project – one at mid-term and the other at the end of the project with fully documented papers and discussions.
- wherever possible attempt publication of our outputs both in English and Tamil (local language). Tamil publications have potentially much larger impact in Chennai, especially within government.

5.2.3. Specific activities in Bolivia

NRI lead as part of the EC-supported project on the development of training materials (part of work-package 5). It is intended that training materials will be developed in multiple languages (English, Spanish and potentially French and Portuguese) and will use a modular or appropriate format that includes research findings from India. Where possible training outputs will be developed in partnership with appropriate initiatives and existing programmes. The NEGOWAT team have already agreed to help organise a one-week workshop on conflict resolution supported by the network LA-Wetnet (the part of the Cap-Net IWRM capacity building alliance that is focused on Latin America) in March 2005.

A further specific opportunity to disseminate findings and to utilise NEGOWAT training materials in Latin America is a new EC supported higher education linking project (GovAgua network) that focuses on water management and governance in peri-urban areas. The project includes participants from the Brasil, Bolivia, Chile, UK (NRI), France and the Netherlands.

5.2.4. Specific activities linking research in India and Bolivia

The research team propose to produce a book on stakeholder-led water resource management based upon work in India, Bolivia, and the Middle-East (the IRC-led Empowers project www.empowers.info), perhaps combined with an international conference in 2006. The IRC International Water and Sanitation Centre have offered to help organise and fund a related conference/ book.

6. REFERENCES

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van der Meer, S. 2004. *La gestion de agua potable en Colcapirhua y Tiquipaya*. Unpublished research report. Centro-AGUA, Cochabamba.

Woudstra, R. 2003. *Desempeño de los Comites de Agua Potable en Tiquipaya y análisis del Proyecto EPSA Macoti*. Unpublished research report. University of Twente, Netherlands and Centro-AGUA, Cochabamba, Bolivia

Annex 1 Original log-frame

	Narrative summary	Measurable indicators	Means of verification (MoVs)	Important assumptions
Goal	Improved assessment, development and management of water resources	Improved access to safe and sustainable water supplies for the peri-urban poor for multiple uses	National data and sector studies	No input required.
Purpose	More inclusive and pro-poor management arrangements to facilitate the avoidance and resolution of conflicts over access to water resources in peri-urban areas.	Improved levels of consultation and management, especially representing poor people from peri-urban areas, in two selected cities and their catchments (Chennai and Cochabamba) with severe water resource issues by Jun 2006 Utilisation of methods developed by the project to better manage peri-urban water issues in at least 5 other catchments by Dec 2006	Reports of government and municipal authorities; Reports of multi-stakeholder water users fora Local press and other media. External evaluation Project reports Consultation	
Outputs	1) Appropriate management tools and institutional structures for improved, stakeholder led Integrated Water Resource Management (IWRM encompassing peri-urban zones and the adjoining urban and rural catchment areas.	Tools developed and institutional development supported in the catchments of Chennai and Cochabamba, with better representation of peri-urban zone residents and issues by Dec 2005	Project reports including evaluation by stakeholder groups; Conference proceedings, journal papers	Given the willingness and enthusiasm to develop and adopt water resource management scenarios and assess implications, the user groups will be able to influence policies and implement plans based on these scenarios in the face of political, climatic and other pressures
	2) Improved capacity of resource centres to support and facilitate stakeholder led IWRM in peri-urban contexts	Local capacity enhanced to provide training and facilitation in stakeholder-led management of water resources and implementation of IWRM by catchment managers, support organisations and other stakeholders by Jun 2006	Resource centre reports including requests for support; Project reports including evaluation by stakeholder groups	
	3) Widely disseminated approaches that are and accepted as a basis for good practice	Guidelines and training materials in use within two selected city catchments by Jun 2006	Final training materials and guidelines; Project reports; Continuous dissemination through project website; Conference/journal papers focused on replication and policy-level	

	1) Inception phase 1.1 Research team inception workshops for development of methodology and general training with partners (note that each work package also starts with specific training with partners) 1.2 Poverty analysis based mainly upon existing data of patterns of poverty within the study area, livelihoods and relationships to water security 1.3 Initial identification of focus areas within catchments and key stakeholders including assessment of areas with most severe water resource problems; participatory stakeholder analysis at different levels; explanation of process to key stakeholders	<u>Milestones and Budget</u> • Inception report by Mar 2004 including details of improvements in methodology, results of stakeholder analysis and poverty analysis and implications for subsequent work packages. Also to include details of PhD researcher recruited, inception workshops held in Bolivia and India, water-livelihoods-poverty relationships understood and focus areas within catchments identified.	(Activity to Output)
	2) Literature review: review of problems and potential solutions to water resource competition between urban and rural areas, both worldwide and in the two study countries.	• Methodology and format agreed at inception workshops by Dec 2003 • Thorough literature review published and disseminated by Mar 2004	
	3) Resource audits in pilot catchments: water resource audit for study catchments based mainly upon synthesis and quality control of existing secondary data sources covering rainfall, runoff, groundwater levels, groundwater abstraction, surface water use, cropping patterns, crop water use efficiency, crop value, water use in per-urban zones, value of different water uses etc.	• Key personnel trained in water resource audit methodology by May 2004 • Initial data gathered and quality controlled by Aug 2004 • Data ground truthed, gaps identified and filled by Sep 2004 • Participatory assessments of water use carried out with target groups (urban users, peri-urban users, rural users) by Sep 2004 • GIS developed with all necessary baseline information to form foundation for better decision making by Dec 2005 • Analysis and discussion of results with stakeholders by Jan 2005 • Two summary water resource audits published and disseminated by Mar 2005	Availability of adequate baseline data.
	4) Development of stakeholder platforms, and Agent-based models and/or Bayesian networks	• Strengthened water resource user groups in place with agreed constitutions and decision making frameworks by Dec 2004 • Core people trained in Agent-based modelling and/or Bayesian Network methodologies by Jan 2005 • Agent-based models and/ or Bayesian networks of resource use and competition developed by Mar 2005	Failure to develop a common model of water resource use and availability by consensus
	5) Development of decision support support systems integrating the water resource audit compiled in GIS and agent-based model or BN	• Basic systems developed by June 2005 • Full systems developed and institutionalised by Sep 2005	
ities			

Activities

6) Identification of favoured scenarios and support in development of management plans in stakeholder forums

- Participants trained in use of DSS for participatory exploration of management options by Sep 2005
- User groups understand functioning of DSS and strengths and weaknesses by Oct 2005
- User groups agree a limited number of options for further 'political' discussion/settlements by Nov 2005
- Possible implications for management plans developed and agreed by Dec 2005

7) Development of guidelines and training materials based upon findings

- Agreement on format, content, and target audience in conjunction with resource centres and potential users by Mar 2004
- Development of first draft by Sep 2005
- Publication and dissemination of final product by Mar 2006

8) Dissemination of results and of guidelines

- Punctual reporting and publication of a range of information products – conference papers, journal articles, web-pages etc. - as opportunities are identified

9) Management, process monitoring and evaluation: continuous monitoring, assessment, feedback and re-formulation including stakeholder assessment of process and integration of feedback into plan.

- Monitoring plans developed and key indicators identified by Mar 2004
- Regular meetings and progress reports

Budget

Personnel Costs	64738.71
Capital Equipment	1400.00
Institutional Overheads	50788.10
Other Charges	33284.00
TOTAL COSTS excl. VAT	150210.81
VAT	26286.89
Total cost incl. VAT	176497.70

Pre-conditions

Widespread support in selected catchments for development of multi-stakeholder institutions to address water resource issues.

Annex 2 Summary notes from inception workshop discussions, Chennai, 20-21 April 2004

Inception workshop on

Facilitating negotiations over water conflicts in peri-urban catchments (negowat)

20-21 April 2004

Workshop Report: Facilitating negotiations over water conflicts in peri-urban catchments

Organised by- **Madras Institute of Development Studies, Chennai, India**
IRC International Water and Sanitation Centre, Netherlands
Natural Resources Institute, UK

Funded by - **DFID, UK**

Synthesis of the multi-stakeholder dialogue meeting held in Chennai during 20-21st April 2004

A two-day inception workshop of the project was organized in MIDS, Chennai, not only to formally launch the project, but also to discuss the critical issues and problems faced in the peri-urban areas of Chennai city, and to examine conflicts in the use of natural resources, particularly water. The idea of the inception workshop was also to begin a multi-stakeholders' dialogue process to examine the nature and intensity of conflicts and to find ways forward for sustainable development through stakeholders' participation.

Therefore, the inception workshop had the following objectives:

- To bring together all the stakeholders (in relation to Chennai city water supply) in a common platform for a fruitful dialogue
- To gain the support and feedback from bureaucrats, water managers, farmers, NGOs, researchers etc.
- To brainstorm on drinking water problems faced by Chennai city and livelihood and environmental problems faced by peri-urban communities
- To understand and examine the problems of Chennai city's drinking water needs and the consequent problems faced by peri-urban areas from various perspectives – from the perspective of the bureaucracy, water engineers, activists, researchers, farmers in peri-urban areas, city water users etc

The workshop was attended by nearly 100 participants drawn mostly from the farming community of peri-urban areas, researchers, NGOs, government officials, scientists, Panchayat Presidents (local government), village self-help groups and media. Ten papers were presented by on various aspects of water issues with particular reference to Chennai city and peri-urban areas.

Papers and presentations on the first day:

1. *A snake in the grass! Unequal power, unequal contracts and unexplained conflicts: Facilitating negotiations over water conflicts in peri-urban catchments* by S.Janakarajan
2. *Chasing a mirage: Peri Urban water issues- an experience* by Mr.Gilbert Rodrigo, Sundar Raman.S , V.Prabahar Gnanakkan and G.Jothi
3. *Bayesian Networks – Decision making support system* - by Patrick Moriarty
4. *Livelihoods in Conflict: Disputes Over Water for Household Level Productive uses in Tarata, Bolivia*- by Rocio Bustamante, John Butter worth, Mariska Flierman, Daniel Herbas, Marieke den Hollander, Sjoerd van der Meer, Paul Ravenstijn, Magaly Reynaga and German Zurita
5. *Urban Water Supply – Chennai City- An Over view* **–**by Mr. N. Pasumalaithevan, Hydrologist, Technical Secretariat, Institute for Water Studies, Tharamani, Chennai-113
6. *Ground Water Quality in Chennai City***-** by Mr. K. Santhanam, GIS, Specialist, IWS, and Mr. M. Natarajan, Technical Expert Geo-chemistry, PWD, Ground Water
7. *Conditions and Characteristics of Groundwater in and around Chennai City*– by Mr.S.Suresh, Scientist-C, CGWB, SECR, Chennai.
8. Institutional Arrangements in the Peri-Urban Interface of Medium and Small Towns: A Look into the Future –by Mrs. Smita Mishra Panda and Sangeetha Purushothaman
9. *Drinking water and gender in the peri-urban areas- experience from Gujarat*-by Sara Ahmed
10. *Resolving Problems in the Water supply and Sanitation Sector in the Peri-urban areas of Chennai a Policy approach*-by Mr.G. Dattatri, Trustee, SUSTAIN, and Mr.Anand R. Doss, Director, SUSTAIN

2nd Day: Multi-stakeholders' Dialogue

Prof. S. Janakarajan, emphasized the need for a sustained dialogue among stakeholders and drew the attention of the participants to the motivation of the workshop and the project. He argued a clear case for decentralized management, new partnerships, co-operative management and stakeholder-led participatory processes.

The poor are particularly vulnerable to the lack of access to water services, and to pollution and flooding. Improving water security for the poor is immensely important. Water is a priority sector. We know that investments to improve the management of water resources and the delivery of water services are essential for livelihoods. For that we need more investments and to make these more effective through better water policies, institutional development, and public-private partnerships. The first is about water sector governance, and the second is about financing water services. Hence, we need good water governance. Good governance means sound development management. Stakeholder participation, transparency and

accountability are pillars of good governance. Good governance and capacity building are like two sides of the same coin. Water governance is a challenge in each country, and there is no standard approach, which can be prescribed.

The subject of Multi-Stakeholder Dialogue is an integral part of the workshop. We expect that the results of this dialogue will feed into a large level consultation with various stakeholders. The dialogue could center around the main issues of water quality – due to industrial effluent and discharge of domestic sewage and the second major concern is the pumping of groundwater at an alarming rate and seawater intrusion. Other related issues are issues of sand mining, degrading ecosystems and deprivation of basic needs, the institutional vacuum in the peri-urban areas and short-term and long-term water selling and its impact on the peri-urban population in particular women and landless agricultural labourers. Water management is key to fighting poverty, and calls for good governance and stakeholder participation.

After this introduction, representatives of key groups were invited to speak.

Mr. Durai, Ex-president, Ullavoor Panchayat Unit, Kanchipuram District.

- Paddy used to be the traditional crop. However, due to changes in the local water supply conditions, crop pattern in this basin has undergone a radical transformation.
- Sand mining goes beyond 25 to 27 feet of the riverbed, which leads to deterioration of the riverbed aquifer.
- Major crops such as ragi, groundnut and paddy have been affected due to extensive water sale.
- The frequent movement of tankers causes accidents and roads get damaged
- Nearly 30 percent of people are holding 70 percent of the lands, the remaining 70 percent of the people holding 30 percent of the lands. Hence, due to sale of water by the landlords, landless labourers and small farmers have been severely affected.
- Therefore, he emphasized that government should come forward to construct a dam to restore water at Thirumukoodal, a place where Palar, Cheyyar and Vegavathi rivers meet.
- The villagers are not opposing extraction of water for urban use but it should be controlled.

Mr. Arivanandan, Social Worker, Minjur

- Majority of the peoples were depending on agriculture. But sale of water is more lucrative to the farmers than ploughing the fields he said. As a result, casual labourers who depend on agriculture traditionally end up without work and migrate to the urban areas like Chennai.
- There were nearly 120 bore wells in Minjur areas from which nearly 1500 tanker loads of water is supplied to Chennai city every day. The farmer is paid about Rs.40 for every load of 12,000 liters and Rs.70 for 20,000 liters.
- Some times, the sale of water leads to conflicts between landowners and landless laborers (especially dalit people).
- In some cases, landowners do not want to sell water but when their neighbors do, they also decide to join with them because the net result is same: they would lose their groundwater anyway.
- Women are most affected by the water shortage due to lose of agriculture employment.

- In Karanodai and Sothuperumbedu, women's groups launched agitations against extraction of ground water from their bore wells and have got victory along with Self Help Groups (SHGs).

Mrs. Paranjothi, Magaral,, Kanchipuram District

- She has stated that her village was green and fertile for many years. But now, looks deserted due to too much of land grabbing, sand mining and extraction of ground water.
- Nearly 40 bore wells have become defunct. Sand miners are removing sand up to 20 feet but the government allows only up to 3 feet.
- Many of the villages have formed self-help groups and water users groups to rally against the exploitation of their resources.
- Over exploitation of groundwater, has led to only one crop in a year instead of 3 crops.

Mr. Srinivasan, Convener, Tank and Ground water Forum, Tambaram

- Local politicians have encroached a big tank in Tambaram. But the District Collector of Kanchipuram intervened and removed the encroachments. Tanks and ponds were brought back under the control of the community in Tambaram Taluk.
- Rich farmers who are selling water make more money than the small farmers in these areas.
- The city business people have occupied various parts of the village agricultural land.
- He emphasized that all 39 Temple tanks needs to be restored.
- He has recommended smaller level of recycling process have to be started at various parts of Chennai City.
- He accused that while people of Chennai use more water compared to rural areas, they never come forward to restore temple tanks.

Mrs. Padma, Ward Member, Villiyambakkam,

- Large quantum of illegal sand mining have negative impact on environment
- Palur and Thimavaram are severely affected due to over extraction of ground water. Many wells have already gone dry; many villagers did not have water for their consumption
- Illegal sand mining have also resulted in drying up of spring channels and tanks
- The agricultural production is reduced drastically due to groundwater decline
- The availability of drinking water is very less; people get drinking only once in three days.

Mr. S. Ramesh, Vengaivasal

- His village is located about 15 km away from Chennai. His village people have conducted a meeting to discuss water scarcity before the problem arose. The village people have formed an
- The association has passed a resolution against water sale to urban areas
- They launched agitations against tankers and water buyers
- Complaints made to government officials have had no effect
- But the association continued to fight joining hands with women self-help groups. But on the day of the agitation, the problem ceased, only to begin the next day.
- They tried to find a solution through the media. They even spoke of their problems to political leaders, but nothing has been done in reality.

- In many places, the political leaders themselves own tankers and are involved in the water selling and tied up with water business.

Ms. Mary, Guide, Chengalpattu

- She is a part of the organization called GUIDE which has gathered 400 women agitated and demonstrated through cycle rally.
- Finally, they made complaint to the Taluk Office and police about illegal sand mining and sale of water
- But the police never entertained the complaint lodged
- Finally, people joined together and raised slogans through a big procession which attracted the attention of the media; this forced to the police and the revenue authorities to take action but only temporarily
- Those who involved in the sand mining activities, never follow the government norms. They have dumped pipelines under the road without the knowledge of the people and extracting water from the riverbed.
- She emphasized the need for a continuous dialogue among stakeholders

Mr. Durairaj, Sithammur, Chyyur Taluk

- There were four companies located in all directions ion his village which includes a thermal plant. All these companies compelled the people and occupied their lands, stating that it would provide employment
- All these companies discharge untreated effluent back to the village; this has affected entire agricultural land and people's livelihoods. Therefore, majority of the people migrated to urban areas.

Mr. Gajendran, Mathuranthagam

- He has stated that his village is located 2KM away from Mathuranthagam Lake. The Tamil Nadu State Chief Minister has given the statement for the last 2 years back that we would take water from Mathuranthagam Lake to Chennai City for their water scarcity. People have protested this move of the government

Mr. Vedagiri, Thiruporur, Kanchipuram District

- Orchid Chemical Company was started nearly about 10 year back in the village. Usually they release foul and waste gases at night time without the knowledge of the people. It results in breathlessness and irritation of eyes to people
- Wells have failed and agricultural production has been affected due to too much of water extraction and discharging of untreated effluent.

Mrs. Shanthi, North Chennai

- Due to over extraction of groundwater her village faces a acute drinking water scarcity
- Agriculture is on the decay and people have migrated on a large scale

Mrs. Ellamma, Guide, Chengalpattu

- Water is a vital natural resources and ther basic need of the peole
- But access to Potable water is becoming increasingly difficult.
- When water is scarce, polluted or unaffordable worst sufferers are women
- As economic providers, caregivers, and household managers, women are responsible for ensuring their families water for daily living.
- Every day many women and girls walk long distances to bring water to their families.

- Often, they loose income due to this
- She walks for about 2 KM every day to fetch water for her household
- The people's forum have made complaints to the District Collector about their water crisis; soon a overhead water tank was built; but there was no trace of water.
- One day, they demonstrated their anger and grief by organizing a procession; but it had no effect
- The quality of water is getting saline due to too much of pumping and seawater intrusion

Mr. Srinivasan, Puduvellam, Thiruvanmiyur

- 20 years back the Temple tank at Thiruvanmiyur was with full of water. He has used to swim everyday in the tank. Now all sewage water gets into the temple tank
- Now, rainwater is collected into the tank which has not only improved the water storage condition in the tank but has also improved groundwater recharge in its neighbourhood

Mrs. Boologam, Kaliyanur, Kanchipuram

- She has stated that everybody is fighting for water but we the people fighting for the existing water resources. All the discharged water from various industries will continue to be dumped have impact on the existing water resources. The water is being contaminated due the discharges done by the industries. The color of the water becomes green, the water turns foul and cattle used to die when they drink it. Both rainwater and waste water discharged by the industries were get together at one place where the supply of drinking water is being pumped.

Mr. Ramakrishanan, Nallathur

- Sand mining takes place to a depth of 30 feet while the legal limit is only 3 feet
- Millions of gallons of water is pumped everyday from this village to feed the nearby atomic power station
- Besides, the Ford Motor Company have made their own bore wells and keep extracting millions of gallons of water everyday
- This has posed a serious problem of seawater intrusion as the seacoast is only 15 KM away from this village
- Nearly 150 bore wells have been closed due to salinity caused due to seawater intrusion in this village
- Illegal sand mining on the other hand has practically exhausted the riverbed aquifer which used to be the best source of drinking for many villages situated along the rivebed

Panel Discussions

Dr.Smita Misra, Panda,

- The severity of the peri-urban problem is such that there is a need to
- Mobilize people
- Build partnership with stakeholders
- Work with bureaucracy
- Strong institutional forces needed to curb water pumping and illegal sand mining
- There exists an institutional vacuum in the peri-urban areas and proper institutional mechanism should be formed.

- More NGOs and even the private sector should be involved in preserving environment
- Need to move towards integrated holistic planning where urban and rural agencies can plan and begin to work together to address peri-urban area issues

Mrs. Sara Ahmed

- She emphasized the need for working towards reconciliation process to protect our ecosystem
- Strengthen institutions and speed up social learning process
- Facilitate a basin level water forum
- Articulation of equitable water rights, clear rules and transparent conflict resolution mechanisms need to be evolved
- Need for information flow among stakeholders
- Need for disseminating research results through a variety of ways

Mr. Patrick Moriarty

- Lack of equality breaks the whole system
- Unequal differences between the community
- Strong institutional setup needed
- Bring all the Stakeholders to one platform
- Any issue can be shared and executed with local level support e.g. Panchayat
- All stakeholders should be involved in decision making
- Strengthen local government
- Create Capacity building at all levels – in particular stakeholders
- Effective multi-stakeholder participation in decision making on watershed management
- Specific encouragement and support for some groups in order to ensure their meaningful participation

Annex 3 Press reports from inception workshop, Chennai, 20-21 April 2004

City Express
We Bring The City To Your Home
Chennai, Wednesday, April 21, 2004 With The New Indian Express

Groundwater extraction affects farmers on Palar basin

Express News Service

Chennai, April 20

THE livelihood of villagers living along the lower Palar basin has been deeply affected by the excessive extraction of groundwater for the city, according to the preliminary findings of a new study by the Madras Institute for Development Studies (MIDS).

An estimated 40 mld (million litres per day) is transported to the city from the river bed aquifer, thus draining out a precious natural resource vital to the livelihood for farmers there. The over-exploitation has a severe ecological impact too, as sea water has intruded into the aquifer.

"Since urbanisation is an inevitable process, should we let the peri-urban population suffer or is there a way in which urbanisation could be used for the best use and advantage of both populations," is the question that the MIDS study, in collaboration with the Natural Resources Institute of UK, seeks to answer. To this end, they have formed a team to study the impact of urban demand for water on the peri-urban areas located within a circumference of 20 km of Chennai city.

Says S Janakarajan, Professor, MIDS, "There is a need for peri-urban areas and urban areas to be viewed as a single ecosystem and an integrated economic system." He points out that the degradation of peri-urban systems is because they are viewed in isolation, when in fact they provide natural resources for the city.

Based on the preliminary findings, a full-fledged study would be done to define policies to save these dying villages. The study was formally launched on Tuesday.

The story behind the ailing livelihoods of the farmers is simple: A farmer enters into a contract to sell his water from an irrigation well. In return, he is paid a sum, which is sometimes more than what he would have earned through agriculture.

But the consequences can be disastrous. The MIDS study says that majority of the population still depend on agriculture. The water sellers are the minority. "The irony is that an individual seller enters into a contract knowing fully well that his bore-well would become dry due to non-stop pumping... mainly because if he does not enter into a contract for selling water, his neighbour would do so, in which case, the net result is the same," writes Janakarajan in the study proposal.

From field visits made by the researchers, it was learnt that many of these wells in peri-urban areas have become dry. Sea water has reduced the quality of the groundwater. The researchers were also told that officials often invoked an emotional argument for water sellers: If you cannot supply water to your own people at Chennai, how can we ask water for our farmers from Karnataka?

"Local governments of these areas find it difficult to take action against illegal encroachments on pumping from the river bed or water transport. City demands for water will be met if there is a crisis, but no institution is going to supply water for the villages if their resources dry up," says Janakarajan.

This is mainly because urban local bodies are stronger, with more political power. The MIDS study seeks to engage both strong and weak stakeholders of water from the Palar basin in a dialogue. A committee with 24 members represented by different stakeholders has been formed. The biggest challenge before the committee is to weave in the government. K Nagaraj, Professor, MIDS says, "This is not an exercise for papering over the conflict, but for the losers and winners in the issue to stick to the dialogue."

CityExpress
Chennai, Thursday, April 22, 2004

NEWS

Palar basin farmers bring their fight to the city

by Kannal Achuthan

Chennai, April 21

FARMERS' groups from villages in the periphery of the city gathered here to voice their concerns about the falling water levels in their areas because of excessive extraction for the city.

The farmers belonged to villages in the Palar basin, Kosathalaiyar, Minjur and Panchetty – from where thousands of tanker-loads of water are extracted daily. In a workshop at the Madras Institute of Development Studies (MIDS) on Wednesday, they said that water was being taken for the city at the expense of their own needs.

"Our village was green and fertile for many years. But now, 40 of our borewells have failed after over-extraction of water by pumping," said Paramjothi from Mangal, a village in Kancheepuram district. Sand mining is also a problem here.

Many of the villages have formed self-help groups and water users groups to rally against the exploitation of their resources. Some farmers said that they were willing to give water for the city, provided they were not left without any water in their wells.

The farmers' viewpoints are only one side of the story, said MIDS researchers. "Other stakeholders such as Metrowater, private tanker suppliers and sand miners would have to engage in a dialogue to work out a solution," said S Janakarajan, Professor, MIDS. This is the need of the hour.

Almost 18,000 tanker-loads of water are brought to the city from peripheral areas. Both Metrowater and private water suppliers are engaged in this process. Thimavaram, Pavalur, Reddypalayam, Urithiramerur, Nallathur and Thiruporur areas have been affected by the extraction of ground water.

Ellamma, a vociferous woman in her 60s, said, "We have to walk long distances to get drinking water. Our own wells have become saline." She lives in a village on the outskirts of Chengalpet district. Now the villages have formed a group to represent their woes, as they feel their collected voice would be stronger.

Yu Dorai, a former panchayat leader, is the head of one such association in Ullavur. The Palar river is as close as three kilometres to where he lives. "Yet, our crops such as ragi, groundnut and paddy have been affected due to continuous withdrawal of water and sand from the Palar basin," said Dorai. He urges that a dam be constructed at Thirumaakoodal – where Palar, Cheyyar and Vedavathi meet.

The farmers say that Metrowater pays them Rs 40 to fill per tankerload from their borewells. Arivanandan of Minjur said that land owners who have borewells have sunk them so deep that common borewells from where villagers obtain drinking water were drying up. He also said that as farming had stopped in some lands, traditional water harvesting sources such as tanks and ponds were neglected.

The selling of water has also led to conflicts between land owners and landless labourers, as the latter are left with no jobs because of lack of farming activity. "Some land owners do not want to sell water but when their neighbour does it, they also join in because the net result is that they anyway lose groundwater," said J Socrates, a research associate of MIDS working on the issue.

Women have been on the forefront in protesting over-exploitation of groundwater because they are most affected by the water shortage. In Karanodai and Sethupakkam, women's groups launched agitations against extraction from their bore wells and have emerged successful.

But the problem has not been addressed as a whole. "Only a prolonged and sustained multi-stakeholders' dialogue would help. Every stakeholder must come forth to participate," Janakarajan said.

NNAI THE HINDU, Thursday, April 22, 2004 3

Water extraction for city hits farmers

By Our Staff Reporter

CHENNAI, APRIL 21. Save us from losing our livelihood. We will save you from the water crisis.

This was the plea of farmers from villages near Chennai whose lives have been affected by 'indiscriminate' groundwater extraction for the city.

To meet the insatiable demand of the city, a few farmers indiscriminately pump water from their wells either lured by money or 'pressured' by the government, the agriculturists say. Selling water is more lucrative to the farmers than ploughing the fields. As a result, casual labourers who depend on agriculture end up without work and migrate to the city.

At a two-day workshop organised by the Madras Institute of Development Studies (MIDS) that concluded today, the villagers highlighted the spill-over effects of the present water management system, especially in the villages along the lower Palar basin.

"We also need to survive," said U. Durai, former panchayat president of Ullavur, Kancheepuram district. The villagers are not objecting to the extraction of water as long as it is limited. "Only if we survive, can we supply agricultural commodities and water to the city."

Pumping water from the Palar aquifer and illegal sand mining had exhausted the renewable resource that was vital for agriculture, he said.

The workshop on "Facilitating negotiations over water conflicts in peri-urban areas" was based on preliminary observations of a study carried out by MIDS and the Natural Resources Institute, United Kingdom. The three-month study, which concluded a few weeks ago, surveyed 20 villages in a radius of 30 kilometres of the city that suffer from the consequences of the urban demand for water.

Participants at a workshop on "Facilitating negotiations over water conflicts in peri-urban areas" held in the city. —Photo: N. Balaji

It documented the impact of the urban expansion on natural resources and aims to find out whether urbanisation can be used for the advantage of both the rural and urban population.

Every day, about 20,000 tankerloads of water is drawn from wells in these areas. The farmer is paid about Rs. 40 for every load of 12,000 litres and Rs.70 for 20,000 litres, the study noted.

An estimated 40 million litres of water is pumped round the clock from the Palar bed.

S. Janakarajan, professor at MIDS, said there were many dimensions to the water extraction. Some rich agriculturists enter into a contract to sell water from their irrigation wells as it was more lucrative than farming.

Some of them enter into contract knowing fully well that their borewells would become dry soon due to non-stop pumping. If they did not sell water, their neighbours would do so. Farmers felt that in any case, water would be depleted. So, they might as well sell it and make some money, he said.

Gilbert Rodrigo, one of the field researchers, said at least 4,000 tankers bring water from villages south of the city. Many wells had already gone dry; many villagers did not have water for their consumption though water was still extracted for the city.

Illegal sand mining had also resulted in drying up of spring channels and tanks. Though the villagers formed committees to prevent such activities, only a few have succeeded, he said.

City demand for water would be met by extraction of water from villages in surrounding areas. But no institution would supply to the villages if their resources dry up, the experts said.

The long-term solutions included maintenance of peri-urban resources by an agency involving academicians and locals and water supply in a decentralised manner. For now, the government could provide alternative livelihood to the villagers and allow limited extraction of water, the experts suggested.

The MIDS plans to conduct meetings involving the villagers, government officials and private water suppliers to find a mutually beneficial solution.

Annex 4 Key note background paper from Chennai inception workshop by Professor Janakarajan

A snake in the grass!! Unequal power, unequal contracts and unexplained conflicts: Facilitating negotiations over water conflicts in peri-urban catchments

S.Janakarajan
Professor, MIDS
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1 Genesis

Implications of rapid industrial growth and fast urban expansion pose serious problems in many cities across the world today, more so in the developing countries. These problems would become more pronounced if industrial development and urban expansion are unplanned and unregulated. The biggest casualty of such scruffy developmental activities is peri-urban areas[1]. Peri-urban areas spread around cities get exploited of their natural resources such as land, water and forests. Further, key factors such as unstable employment pattern, insecure agriculture, increasing rural – urban migration, raising number of foot-loose population and emergence of conflicting cultural practices and alterations in characteristics of traditional institutions contribute to marginalization process of peri-urban areas. Thus the status of peri-urban areas is eventually reduced to the one of `*neither here nor there'* situation, in which they lose their traditional characteristics of being predominantly agrarian economies and at the same time have no identity of being a part of an urban economy. In other words, the peri-urban areas are forced into a situation to lose their traditional identity and livelihood options and at the same time get no *assured benefits* of an average city dweller like urban employment, urban infrastructure etc.

Spreading of cities and subsuming of peri-urban areas into mega cities is like snake catching a frog! A snake catches a frog; the latter screams initially but the sound gets reduced gradually and finally we will not hear anything at all. And, this snake is a hidden friend!! This particular process does not have any specific time frame – it is a process which is determined by many socio-economic, political and environmental factors. In this process, few people benefit but a majority suffers in the peri-urban

[1] The expression peri-urban is used quite frequently in recent literature; however, there is little conceptual clarity in the usage and definitions are more restrictive and location specific. The Organization for Economic Co-operation and Development (OECD) in its report on peri-urban agriculture (OECD, 1979: 10) states: *The term "peri-urban area", cannot be easily defined or delimited through unambiguous criteria. It is a name given to the grey area which is neither entirely urban nor purely rural in the traditional sense; it is at most the partly urbanized rural area. Whatever definition may be given to it, it cannot eliminate some degree of arbitrariness.*" Multiple meanings of the term peri-urban include: fringe; edge city; urban spread; less important part; incidental to main activities; outer edge; fringe to the main; spillover, peripheral to or adjoining main area etc.

areas. As long as the level of urban development and the available institutional mechanisms absorb the displaced peri-urban population, there is little to worry; but if the displaced or the affected population is left uncared, then it is going to become sticky and challenging. Therefore, the key issue is that one is not against the horizontal spread of cities or per se but against an irresponsible, unplanned and unjust spreading of and encroachment into peri-urban areas. Therefore, it is recognized that in the process of city development and vast urban expansion, its `spill-over effects' are inevitable; but if such `spill over effects' are minimal and mutually beneficial it may be sustainable; otherwise, if `spill over effects' are *forced upon, negative and exploitative* it would not only become unsustainable but would also turn out to be a *contested terrain*, resulting in the surfacing of conflicts. Indeed, the clear case in point is water. The conflicts emerge mainly because of the following reasons:

- The urban stress is transferred to adjoining areas when urban population migrate and settle down in peri-urban areas
- Industries are relocated or many industries prefer outer locations due to better land and water availability
- Dramatic change in land use pattern: The land in the peri-urban areas is bought over for urban use
- Pollution and degradation of natural resources such as land and water due to increasing urban activities
- Water, hitherto claimed only by the agricultural sector is used more and more for non-agricultural urban uses – there emerges competing demand for water – water transport from rural to urban areas
- Agricultural employment declines and agricultural as an occupation weakens causing serious livelihood problems for the people living in peri-urban areas
- The village commons –land and water bodies – are either encroached or left in disuse
- In the transition stage, peri-urban areas stressed due to institutional vacuum which leads to inadequate or lack of provisions for infrastructure development; what one would encounter is a `neither here nor there situation'.
- Women, who have lost agricultural employment, are the worst hit among the peri-urban population

But in each one of these developments, there is certain section of the village population, which gets distinct benefit. For instance, due to hike in land values (in those plots which are favourably located) a few land owners get a huge jump in their asset value; but a majority lose even the existing value of their lands due to lack of agricultural activities and water; Similarly water sellers – a few benefit a great deal by selling water to urban use by abandoning their agriculture but this affects groundwater availability in the adjoining wells; depletion of groundwater or fast declining groundwater table would affect the livelihoods of a majority of village population. Very often riverbed aquifer is exhausted by installing bores along riverbed which reduces water availability (both surface and GW) for agricultural uses in the adjoining villages; the village commons are encroached which reduces access to poor people in the villages. Therefore in each one of these developments a majority loses and a few gain significantly. Most importantly, urban users exploit the natural resources to their best advantage and transfer the pollution to the peri-urban areas from where the natural resources were exploited. E.g., Urban demand for fresh water is met from rural areas but urban wastes (by way sewerage, industrial effluent, urban solid wastes, hospital wastes, industrial sludge etc) are dumped back into the peri-

urban areas (e.g., sand mining and water transport from around Chennai; Tiruppur industries and water company).

2.1 Core Arguments

- In a context of rapid industrial growth and vast urban expansion, cities experience a severe stress due to factors such as scarcity of land for urban use, pollution, lack of adequate drinking water and sanitation and degradation of coastal ecology and seawater intrusion. In most of the situations, with a view to reducing stress, metropolitan cities eat into peri-urban areas. This builds up pressure and often results in conflicting interests in the use of natural resources in peri-urban areas.

2.2 Main Objectives

- The present project aims to document and analyze impacts of unregulated and unchecked horizontal urban expansion on natural resources, in particular water; its impact on poverty and livelihoods, ecology, environment, and on health conditions of people living in peri-urban areas.
- This project will also develop and test tools and institutional structures that support and enable effective stakeholder led water resources management for negotiating emerging conflicts and water rights. It aims to draw upon developments in Integrated Water Resources Management (IWRM), and decision support methodologies that can be readily understood and adapted to meet the needs of multi-stakeholder groups.

3 Proposed methodology and tools of analysis

The methodology of the study has got different components:

- The first and foremost is to accomplish a comprehensive literature survey on issues relating to per-urban areas, competition between rural-urban and urban-peri-urban areas in the use of natural resources - in particular water and on stakeholder participation and stakeholder platforms as a policy option for achieving sustainable use of natural resources
- A meso-level survey in various parts of the peri-urban area of Chennai (covering as many villages as possible) and a detailed a survey in a small sub-set from among these villages (exact number is yet to be decided) with a view to collecting information on various aspects such as poverty and livelihoods, current and past water use pattern, nature, extent and history of rural-urban water market, impact of water sales on agriculture, employment, income, ecology and environment and so on
- To carry out water resource audit for study area based upon secondary and primary data
- GIS will be used for carrying out water resource audit
- To develop agent-based Bayesian models or Bayesian networks[2]
- Development of stakeholder platforms and user groups for a sustained dialogue to promote stakeholder led IWRM[3]

[2] A Bayesian network is basically a graphical tool that can be used to build a decision support system, i.e., to help decisions under certain conditions. It helps to conceptualizing a basin or an environmental system to be managed. “In an uncertain world, Bayesian networks allow users to estimate the chance that a management intervention will have a particular effect and then investigate the consequence of their uncertainty” (P.7 for details, Cain, Jeremy, 2001).

4.1 The proposed study region: The Palar river basin - Issues and concerns

The Palar river basin covers an area of about 18,300 sq.km. Of which, approximately 11,000 sq.km lie within the (Tamilnadu) State's borders. Average annual rainfall ranges from 800 mm to 1200 mm; most of it is contributed by the southwest and northeast monsoons. The climate is tropical and highly humid. Evapo-transpiration rate is as high as 2000 mm per year, which is much higher than the annual rainfall. Flash floods are common only during the northeast monsoon months. Water balance study undertaken in the Institute of Water studies, Government of Tamilnadu, indicates that the Palar basin is a water deficit area (Institute of Water Studies, 1992). Major irrigated crops in this basin are paddy, sugarcane, groundnut and to some extent banana. Major unirrigated crops are coarse cereals besides groundnut in water scarce areas.

Tanks have historically been the most important surface irrigation source in the basin (Janakarajan, 1993). There are no storage reservoirs in this basin but one finds a series of seven anicuts (diversion weirs), which fill a large number of irrigation tanks. The total number of tanks filled by these anicuts is little less than 700 and the total area irrigated by these tanks is about 61,000 hectares. These are called system tanks. Besides system tanks, a large number of non-system tanks also exist in this basin, exact number of which is not known. Groundwater is the primary source of irrigation in the upper reaches of the basin compared to the lower reaches.

Besides tanks, there were numerous spring channels, which had their origin in the Palar river, or its tributaries, which irrigated thousands of hectares along the villages located on both sides of the river. According to the Institute of Water studies, there are about 606 spring channels in the basin area (Institute for Water Studies, 2000). In many villages, even now, the spring channels remain but in a dissipated condition. In some villages spring channels are used to let out tannery effluent.

However, as tanks and springs (as the major surface irrigation sources) are becoming more and more undependable due to their neglected condition, wells have emerged as the major source of irrigation in the basin area. Indeed, the introduction of high yielding – new bio-chemical technology – in this region in the mid 1960s has prompted farmers to invest in groundwater irrigation quite extensively. This trend touched its momentum in the 1970s (Farmer,B.H 1977 Janakarajan 1986). Thus, at present net irrigated area by wells in the basin works out to about 75% (Rajagopal and Vaidyanathan, 1998). The study carried out by the Institute of Water Studies indicates that in the late 1980s there were around 132,000 irrigation wells in the basin area and the density of wells varies from 0.74 to 2.82 per hectare. Groundwater utilization is as high as 92 percent in this basin. Groundwater has also been a major source for drinking and industrial water needs. Quality, however, varies a great deal across the basin. This issue of water quality has not been addressed while assessing the groundwater potential in the river basin. This is in particular

[3] Although the IWRM tool has been widely accepted as an effective way to manage water resources, there is however less agreement about its implementability in particular a developing country because of lack of enabling environment. It is possible however to make use of the merit of the IWRM tool with the appropriate participation of all stakeholders in a river basin. But in this case, the application of the IWRM will be through bottom-up approach rather than through the conventional top - down method. Nonetheless, it would be a big challenge to bring together various stakeholders, who have diverse and competing interests into a common negotiating platform. One of the motivations of the present project is to create space for such stakeholder-led IWRM in the context of peri-urban areas of Chennai, in particular Palar basin.

important because of the long history of tanning industry in this river basin, which has contributed quite significantly to the groundwater contamination.

4.2 High degree of urbanization and rural-urban water market in the Palar basin

Though agricultural sector is still the single largest user of groundwater, there have been growing demands for this resource from other sectors or users. The urbanization process, the increasing demographic pressure and expansion of industrial activity have all generated competing demands for groundwater[4]. This is more acute in a State such as Tamilnadu, where, almost all the available surface water sources have been utilized. As competing claims on limited groundwater stock has increased over time, conflicts or conflicting interests have also emerged among various user groups. The word `conflict' in our present context need not be understood as the one, which refers to physical violence. It should be rather seen as a potential force for competition and change. This competition could lead to stagnation or advancement of an economy depending upon degree of cooperation among stakeholders.

In the particular context of groundwater resource, conflicts take place due to one critical factor, namely, scarcity. The scarcity in turn is caused due to imbalance between supply and demand. One can attribute two reasons for this: One, due to excessive unregulated pumping, resulting in secular lowering of water table (in some cases, the damage due to depletion is irreversible) and two, due to groundwater pollution caused as a result of discharge of industrial effluent, the use of chemical inputs in agriculture and due to domestic and municipal sewage. In both these cases, scarcity occurs: While in the case of the former scarcity occurs due to over-extraction, in the latter, it is due to contamination. Yet, aquifers are damaged in both cases and in some areas, the damages are permanent.

The primary non-agricultural users are urban industrial owners and Municipalities. Whatever quantity of water, that is consumed for domestic needs and industrial processing is discharged as sewage and effluent in the open surface, streams, lakes/tanks and rivers, contributing thereby, significantly to pollution load of surface and groundwater bodies. Therefore, the transportation of potable groundwater from villages to urban uses not only aggravates the already depleting groundwater table, but also contributes to permanent damage to groundwater. All these in turn be part of the cause to influence drinking water scarcity, health hazards, decline in soil quality, reduction in agricultural yields, rise in the cost of living and in an overall sense contributes to persisting poverty conditions[5].

4.3 Rural-urban water transport and competing demand for water: A quick run through of the case of the upper Palar basin

The leather industry has been the most important industrial activity in this part of the basin. Let us have a look at some facts about the leather industry. Export earnings of leather industry shot up from a mere Rs.0.32 billion in 1965 to Rs.100 billion in 2001. This industry provides direct employment to over 2 million people in the country. 51% of leather exports originate from the southern states and 70% tanning industries are concentrated in this region. Of the total exports from the South, Tamilnadu State alone contributes to about to 90%, the value of which is Rs.50 billion. And, 75% of

[4] The transformation processes in Latin American countries have contributed to a similar competing demand for water resulting in growing contamination and vulnerability of human settlements in marginalized areas. See Moreyra, Alejandra, 2001,

[5] Similar cases have been observed in the Latin American Countries (Moreyra, Alejandra, 2001). See also Harriss-White and Janakarajan (forthcoming).

the tanning industries of the Tamilnadu state are concentrated in the Palar basin, contributing to over 30% of country's total exports.

While these facts about the leather industry may appear quite heartening, the other side of it is totally discouraging, demoralizing and frightening. Let me give some details about the impact of tannery pollution on the local economy, agriculture and people[6].

- On an average, 35 to 45 liters of wastewater is discharged per kilogram of raw skin / hide processed. Total quantity of water used by the tanneries in the basin works out to a minimum of 45 to 50 million liters per day; The quantity of effluent discharged from the tanneries (numbering 847), which are supposed to be connected to one of the 8 Common Effluent Treatment Plants (CETPs) installed in the Palar basin, works out to 37,458 kld or 13.5 mcm per year
- The extent of effluent generated by processing one kilogram of raw hides and skins to finished leather is around 34 liters. Therefore, the total weight of the raw hides and skins processed works out to 1.1 million kilograms per day
- Further, for each 100 kgs of raw hides and skins processed, solid waste generation works out to 38.5 to 62 kgs; And, the 100 kgs of raw hides and skins is reduced to 20 to 32 kgs of finished leather after processing
- According to a study carried out by Stanley Associates sponsored by the Asian Development Bank and executed by the Tamilnadu Pollution Control Board, pollution loads in the Palar river is extremely threatening: (all parameters are in kilograms per day) TSS: 29,938, TDS:400,302; Chloride: 101,434, Sulphide: 3818; BOD: 23,496; COD: 70,990: Total Chromium: 474; Cyanide: 22
- According to the study carried out Stanley Associates the Palar basin is one of the worst affected due to industrial pollution, where groundwater is quite heavily contaminated. To quote, "Judging by the amount and strength of the effluents, it is likely that the aggregate tannery effluent will have an adverse effect on the groundwater quality in the entire area and also on the Palar river, where the effluents are finally getting mixed" (ADB, 1994, P.1.30 Volume III).
- The Tamilnadu Water Supply and Drainage Board (TWAD Board) has conducted a study in 1997 collecting random samples of water along the Palar river to a distance of about 60 KM. These results were compared with a study conducted by the Kings Institute in 1968. The latest study by the TWAD Board indicates that TDS has increased by 79% in the upstream tannery cluster. The study also found that in the downstream the value of TDS stood at 142%. This establishes the travel of pollutant, which is significant. The report also indicates that even if all the tannery effluent is stopped immediately, the extent of inorganic chemical constituents already dumped in the river could not be recovered even in the long run (TWAD Board, Government of Tamilnadu, 1997).
- The drinking water is sold at Rs.2 per pot in Ambur (one of the worst affected towns in the basin). An epidemic has spread in the town recently in which 8 people were killed. Consumption of Polluted drinking water alleged to be the reason for the outbreak of epidemic (The Indian Express, 8-4-1997).

[6] Most of the information provided in this section has been collected through a survey carried out during the years 1997-99 in 51 villages of the Palar basin. This was a part of the research funded by International Development Research Center, Canada.

- A detailed survey of 8 villages conducted in this basin as a part of the IDRC research programme indicates that the value of land has come down drastically due to degradation of groundwater and soil salinity
- There has been a steep reduction in the area under paddy in the affected villages; since 1980, area under paddy has come down by more than 50%
- Poor germination, stunted vegetative growth, poor grain formation, reduced grain weight and low quality output; coconut water has turned saline, size of the nuts is reduced and falling buttons are quite large in number (findings of Tamilnadu Agricultural University research station); Incidence of crop failure is very high;
- Net area irrigated by wells in the affected villages is extremely low compared to those of unaffected villages
- More than 60% of the wells in the affected villages are defunct due to water contamination; the investments that have gone into those contaminated wells are also lost permanently
- Soil salinity is quite common in the affected villages
- Yield of paddy per wells in the affected villages is 628 kgs, whereas, in the unaffected villages, the yield of paddy per well works out to 7118 kgs
- Of the 51 sample villages (located along the river) that were selected for the survey, 42 were very badly affected, 3 were moderately affected, 3 were marginally affected and 2 were unaffected
- Groundwater quality data collected by various government and private agencies indicate very high level of contamination
- Of the 110 sample wells in the affected villages, 104 have reported water contamination and 38 of them have completely abandoned their wells
- Forced migration of people from villages is taking place which is permanent and semi-permanent in nature
- Consumption of contaminated water is commonly seen; the common health problems reported are skin allergies, asthma and gastritis

To sum up, the extreme stress in the upper Palar catchments is caused due to,

- The traditional irrigation sources such as tanks and spring channels are on the decay
- There has been competing demand for groundwater among agricultural, industrial and domestic sectors;
- Groundwater table has been progressively falling
- Declining agricultural activity, yield, farm income and employment
- Flourishing rural-urban water trade
- Contamination and drying up of the river bed aquifer which was the most important source of drinking and irrigation for 100s of villages and towns in this basin
- Drinking water crisis – and the emergence of market for drinking water in the urban, semi-urban and rural areas
- Declining groundwater quality and increasing number of abandoned wells; increasing indebtedness among farmers due to lost investment on wells
- Declining life expectancy of tannery workers as well as people in the basin area; Fear of impotency due to the consumption of contaminated water

This is an extremely stressed regime, which may explode anytime. Such an explosive situation could have been contained had there been some thoughtful policy measures. But unfortunately, all hitherto policy measures have failed to address

these important issues of conflicts in the use of water, competing demand for water, relationship between over-use of groundwater and pollution on the one hand and rural-urban migration, deteriorating health due to water contamination and poverty on the other.

The Vellore Citizens Welfare Forum filed Public Interest Litigation against the tanners in 1991 before the Supreme Court of India under Article 32 of the Constitution. The Supreme Court Bench in their judgment clearly upheld the Precautionary Principle and the Polluter pays Principle as the most fundamental and essential features of sustainable development. Excerpt from what is regarded as a far reaching judgment delivered by the Supreme Court Bench, constituting, Justices Kuldip Singh, Faizan Uddin and K.Venkataswami:

> "It is no doubt correct that the leather industry in India has become a major foreign exchange earner and at present Tamilnadu is the leading exporter of finished leather accounting for approximately 80% of the country's export. Though the leather industry is of vital importance to the country as it generates foreign exchange and provides employment avenues, has no right to destroy the ecology, degrade environment and pose as a health-hazard. It cannot be permitted to expand or even to continue with the present production unless it tackles by itself the problem of pollution created by the said industry".

On Supreme Court's direction that polluters should pay for the restoration of the ecology and compensation for the victims, `about four-fifths of the tanners said that the Government and society should bear most of the burden. Many of them asked why the tanners alone be penalized for the past environmental degradation' (Madras School of Economics 1998). They have even gone to the extent of asserting that the notification of the Government of India conferring power to Loss of Ecology Authority is ultra vires of the Environment (Protection) Act 1996 and the provision of the Constitution. They also added that the Authority has no jurisdiction to assess or demand compensation in law and that the Authority claiming compensation is violative of principles of natural justice.

The most popular view is that the polluters should pay for the damages. But what is the practical mechanism with which one can ensure that the industries do internalize environmental costs? This is difficult, in particular in a situation where there exists a nexus between bureaucrats and polluters. The Tamilnadu Pollution Control Board (TNPCB) prescribes the norms; The Supreme Court orders for the closure of the units, which do not comply with the norms prescribed by the TNPCB. This is at best what has happened in the past. But beyond that so far, even the judiciary could not go. Under these circumstances, how to make sure that the polluters follow the TNPCB's regulations in following the standards prescribed by them.

4.4 Rural-Urban and peri-urban –urban water markets

Why is it important to take a serious view of the rural-urban and peri-urban –urban water market or water transfer? *First*, India is projected to be more than 50% urban by 2020. While the absolute number of people living in rural areas will continue to grow, urban areas will grow far faster and will create huge demands on water resources. *Second*, as a result of the above shift, there will be increasing pressure to transfer water out of agriculture to urban dwellers. Urban dwellers are likely to be more educated and politically active and influential than their rural counterparts. As a result, political power in India is likely to shift even more heavily toward urban areas.

This will make their demands for adequate water supplies even more potent. While agricultural interests may resist pressure to transfer water, it may be very difficult to sustain such resistance since the `power' is more centralized in urban areas (Moench and Janakarajan, 2003).

This type of market is increasingly emerging adjacent to both large urban areas and intermediate sized towns. The transfers here typically involve sale of water by well owners (generally farmers) either directly to industries or to tanker companies who then deliver supplies to end-users (smaller industries, commercial establishments and households) or to the Metro Water Board. This type of market has, in comparison to the rural water markets, been less studied. The impact of transfers on agricultural users is probably the most controversial point of debate in respect to these water markets (Janakarajan 1999).

The lower Palar basin: The case of peri-urban area problems

The case of the lower Palar is more relevant to our present research because of its proximity to the Chennai city. Like the upper Palar, the lower segment of the basin is also equally vulnerable due to several factors:

- Quite a good deal of water – an estimated 40 mld – is transported to the city for industrial and domestic uses – which is pumped round the clock from the riverbed aquifer. Due to water transport from peri-urban areas, local people are compelled to enter into a contract with agents for unequal exchange. For instance, from the point of view of an individual seller, he may stand to gain in the short run from water sales; but in the long run he may lose due to unsustainable use of groundwater; more so, from the point of view of the whole village ecology and future generation;
- The irony of the fact is that an individual seller enters into a contract with a buyer for selling water from his bore knowing fully well that his bore-well would become dry sooner or later due to non-stop pumping; but still he prefers to sell water, even at the cost of his agriculture, not just because his income from water sales is more than what he might get from agriculture but mainly because, if he does not enter into a contract for selling his water, his neighbour would do; in which case, the net result is the same
- Illegal sand mining from the riverbed is a major issue in this part of the basin, which destroys the withholding capacity of the riverbed aquifer
- Both, pumping from the riverbed and sand mining, have contributed significantly to the seawater intrusion in the coastal areas of the basin; the seawater has intruded into the inland to a distance of over 10 KM
- Both sand mining and continuous pumping from the riverbed aquifer have resulted in the drying up of spring channels, tanks and even groundwater, which hitherto have contributed quite significantly to the overall prosperity of the region and agricultural stability in particular
- The past one decade has been quite dreadful for the people of this region because of total drying up of water resources
- The problem is particularly more severe in the lower Palar due to nearness of this region to the city; this area is actually peri-urban, which attracts the attention of neither the local Panchayat nor the city administration. There is in fact an *institutional vacuum*
- Capacity of local institutions to exercise control over changes in the peri-urban area of this basin is weak or find it difficult to take actions against illegal

encroachments on wetland, pumping from the riverbed, illegal sand mining and water transport.

- Agriculture as an occupation has been on the decline; there is increase in the agricultural unemployment, particularly among women and simultaneous rise in rural-urban migration
- Livelihoods of the majority of population in this region is badly affected – bad for those who still depend upon agriculture for their livelihoods; this section is a majority; On the other hand, it is a prosperity for those who benefit due to `spillover effects of urban development' (e.g., water sellers, enhanced land value due to locational advantage etc.)
- Traditional water bodies such as irrigation tanks, spring channels, ponds etc are either in a state of total neglect or are encroached for urban use.

5 Water transport from other peri-urban areas close to Chennai

A good deal of groundwater is pumped from agricultural wells and transported into the city everyday from other peri-urban areas (other than the lower Palar basin) close to the Chennai city. Most prominent such well fields exist in the Araniar and Kosathaliar river basins. United Nations Development Programme (UNDP) and Water Resource Organisation (Government of Tamilnadu) have estimated that the total water potential available in Araniar and Kosathaliar river basins is about 350 million cum meter/year and 594 million cum meter/year respectively. Currently over 100 mld of groundwater is drawn from these basins to supplement the drinking water needs of the city population. Notable well fields in these river basins are Minjur (about 120 agricultural wells have been converted into water selling wells), Thamaraippakkam (over 50 agricultural wells) Panjetty (over 100 agricultural wells), Kanigapper (60 agricultural wells) and Poondi-Kadambathur (80 agricultural wells). However, sustainability of these basins is a big question mark due to round the clock pumping in these areas. It was apparent from our preliminary field visits in these areas that many agricultural wells and many wells, which were supplying water to the Chennai city, have become dry. Moreover, due to nearness to the sea, seawater intrusion has already reduced the quality of groundwater in these areas. In several places, farmers and local people are agitated over round the clock pumping of groundwater from agricultural wells to the city needs. In fact, women's organization in two villages in the Panjatty – Minjur area have successfully stopped sale of water to the Metro water Board. We were informed that the officials invoke an emotional argument while searching for water sellers: *that if you cannot supply water to your own people at Chennai, how can we ask water for our farmers from Karnataka*?

6 Chennai drinking water: A brief discussion on the current and persisting crisis

Does Chennai face a scarcity for water? To what extent the persisting water crisis in Chennai is due to lack of integrated - long term planning?

Over a period of past two or three decades, the Government of Tamilnadu has spent over Rs.30 billion in augmenting water supply to the city. But still the problem persists. And, the per capita water supply to the Chennai city's population is still the lowest (76 lpcd) when compared to the major cities in India (Joel Ruet, Saravanan anf Marie-Helene Zerah, 2002) and that too is uncertain and unreliable. Even during the good rainfall years, water is supplied hardly for three hours per day. Therefore, it will be useful to analyze the problem a bit historically.

Let us have a quick glance over major water projects of the Chennai city:

(i) Chennai water supply augmentation project – I – New Veeranam project

The Tamil Nadu Government has been executing this project at an estimated cost of Rs.720.00 Crores. The proposal is to draw 190 MLD of raw water from the Veeranam tank in Cuddalore District situated about 230 km. south of Chennai; after the treatment, distribute 180 MLD to the Chennai city.

(ii) The second Chennai water supply project (started in 1995 and scheduled to complete by 2002):

The revised cost of the project is Rs.778 crores and carried out with the World Bank loan to the tune of US$ 86.50 million. Nature of work executed in this project includes construction of clear water pump house at Red hills, installing archemedian screw pumps at Koyambedu sewage treatment works and improvements to 16 sewage-pumping stations.

(iii) Krishna water project (Telugu Ganga)

The project envisaged bringing water from the Krishna river in Andhra Pradesh to the extent of 15 TMC ft of water every year at the cost of Rs.600 crores. The Government of Tamilnadu has already spent and executed this project.

(iv) Chennai city river conservation project

Government of Tamilnadu, jointly with Ministry of Environment and Forest, Government of India, undertook a comprehensive study of examining the cause of pollution of the waterways in Chennai and its impact on the environment. The Chennai city has six waterways viz. Adyar, Cooum, Buckingham canal, Otteri Nullah, Captain Cotton Canal and Mambalam Drain.

Essentially, these waterways perform the role as flood and sewage carriers. Flash floods occur in these waterways during heavy monsoon months. However, for most part of the year the flow is maintained in these water ways entirely due to discharge of treated, partially treated and untreated industrial effluent and domestic sewage through about 311 out falls meant for storm water discharge, resulting in accumulation of large volume of sludge and formation of sand bar in the mouth of rivers. Hence, longterm objective of the project is to improve the wastewater or sewage disposal network so as to prevent toxic substances from reaching the waterways. The entire project, estimated cost of which is Rs.720 crores, would be implemented by Chennai Metro Water.

Major components of the project include,

- To achieve 100% effluent Standards of Sewage Treatment Plants as per the Tamil Nadu Pollution Control Board's norms
- This comprises of "Interception, Diversion and Treatment of Sewage" in all the five zones and providing additional 264 mld capacity of sewage treatment plants in four locations

The entire project is to be completed by July 2004.

(v) Amount spent on transporting groundwater from rural and peri-urban areas

Besides all major projects mentioned above, the state government has been spending quite a good deal of money in tapping and transporting groundwater from distant rural and peri-urban areas or from *wherever* possible within the State. Although these projects are planned with a view to getting over crisis situation, it involves a substantial amount both ways of recurring and capital costs. It is estimated that on an average, the Metro Water Board is spending about Rs.10 million on purchase of water from farmers and in transportation and distribution network[7]. Furthermore, the crisis management is seemingly continuing for several years (see Table –1 given in the foot note)[8].

- From around the peri-urban areas of the Chennai city, groundwater is tapped from many irrigation wells – from the places such as Tiruvallur, Kadambathur, Chengalpattu, Panjatty, Thamaraipakkam, Minjur, Poonamallee etc.
- Another attempt is to tap water from Neyveli aquifer by extending the pipe connections being laid for bringing water from Veeranam tank
- The latest move is to tap water from Gedilam riverbed aquifer near Cuddalore. The idea is get water from 45 deep bore wells being sunk near the Gedilam – Paravanaru riverbeds at an estimated expenditure of Rs.49 crores and convey the water through 200 KM newly laid pipe line. This scheme warrants for the infrastructure of high power motor, transformer installations and other electrical appliances. This would hike the original estimated cost quite steeply. The authorities are expecting the total capital cost to cross Rs.100 crores mark. According to the TNEB (as quoted in The Hindu), each bore well is going to be connected with a 85 HP motor which requires a 100 kVa capacity transformer. It was stated that once the system becomes operational water will be pumped non-stop from 45 bore wells with a view to ensuring uninterrupted water supply of 90 mld. The proposed depth of each bore well is about 200 meters. In order to ensure continuous running of the motors, a separate electrical line will be provided. The recurring cost of running these motors – by way of electrical consumption will alone be a huge amount of nearly Rs.70 lakhs per month. There is another dimension to this project: The Gedilam aquifer is the lifeline for the

[7] The Hindu, dated 13th March 2004

[8]

	Nov' 2003	Jan' 2004	Mar' 2004	May 2004
No. of tanker lorries hired	595	726	1,100	1,300
No. of daily trips	6,733	7,555	9,500	12,000
No. tanks installed	10,030	10,430	11,315	13,500
No. of pumps installed	5,500	6,500	7,000	7,500
Daily expenditure (in million Rs)	5.5	7	8.5	10

Source: The Hindu, dated 13-3-2004

people of this region. Farmers for agriculture and for drinking use the aquifers stored in this basin. If this aquifer is exhausted, not only agriculture will be very badly hit, but also drinking water would become a serious problem (The Hindu April 7, 2004).

Estimated water requirement for the city population is about 900 mld at 150 lpcd for an estimated population of 6 million in 2011. For the rest of the Madras Urban Agglomeration, for an estimated 3 million population 300 mld will be required. The estimated industrial requirement in 2011 will be another 250 mld. Therefore, the total requirement for all purposes for the city and urban agglomeration will be of the order of 1190 mld (Supply and sanitation for Madras – The 2011 Context). Increasing urban population and urban needs (in particular mushrooming of hospitals and hotels, industries and residential colonies) would put more pressure in future for water. But the current supply position from the surface sources is nowhere near the need.

Is there a way out for Chennai population? The solutions to water crisis are quite closely associated with integrated view of water governance – which encompasses issues such as long-term perspective and planning and a broad based partnership and dialogue among all key stakeholders. The present project strives to work towards contributing to this goal.

7. Main framework: Applicability of IWRM tool under complex conditions in Chennai and Palar

7.1 Integrated Water Resources Management (IWRM): Required enabling environment

The IWRM tool provides a clear basis and a plan of action for a careful use of existing water resources. Thus, the Global Water Partnership gives the following definition to IWRM: *IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems* (p.1, GWP, Tool Box: Integrated Water Resources Management - Policy Guidance and Operational Tools, Version I. 2002). IWRM deals with water in its entirety: economic, social and eco-systems of a basin or region.

Its utility will be immeasurable if there is an enabling environment – such as proper institutional structure to implement and monitor, good governance and political will. “IWRM demands certain requirements (clear laws and institutional roles for example) that cannot be avoided. This may require facing-up to difficult trade-offs and choices have to be made. The local circumstances and political will for change and progress need to be taken in to account” (GWP, Tool Box – IWRM, Version-1, 2002, P.1). Thus enabling environment required for adopting IWRM tool may be summarized as follows:

7.1.1 Policies concerning water use, protection and conservation which need to be drafted at the highest level of government: In the particular context of India, there are national water policies -drafted at the highest possible government level in India (as suggested by IWRM tool) but they are no more than a statement of intentions; these policies are neither supported by any legislation and nor supported by concrete

– time bound - action plan. Therefore, the policies made at the highest level as prescribed by IWRM has very little operational impact in India due to lack of institutional mechanism to plan, coordinate and implement water development across State boundaries and among users (this is the clear case of fractured institutional structure).

7.1.2 Appropriate water laws: Are there not laws to take care of the provisions of IWRM in India? The 42nd Amendment of the Indian Constitution passed in 1974 was a landmark. This enabled series a water and environmental protection laws, the most important of which is *The Water (the prevention and control of pollution) Act*. Subsequently many state governments have passed their own Ordinances in order to arrest seawater intrusion, to regulate groundwater use by way of imposing a space constraint between wells, banning groundwater pumping from all surface water courses such as streams, rivers, canals etc., to prevent illegal sand mining from riverbeds, to prevent pollution of surface and groundwater bodies, to protect all water bodies from encroachments, to achieve equity between head and tail enders within an irrigation command, to protect water rights of farmers etc. But still one encounters problems of huge groundwater overdraft, appalling pollution, competition and conflict between various sectors, rural / peri-urban versus urban conflicts, neglected state of traditional water bodies such as tanks and springs, boundless sand mining resulting in draining of riverbed aquifers which in turn paving the way for seawater intrusion to an alarming level etc. Therefore, there are laws but unfortunately what India lacks is law enforcement and monitoring mechanisms. Dilip Biswas, the Chairman of the Central Pollution Control Board has confessed, `Enforcement of such legislation is a challenging task because of various reasons including the inherent flaws in the laws and infirmity of enforcement machinery' (Environmental Legislation Challenges of Enforcement, Eastern Window E-mail, Vision 2001, p.1). He further adds that though environmental laws and specific empowered authorities have been set up for pollution prevention and payment towards compensation, monitoring mechanism for implementation is undefined. This is indeed the reason for the disquieting levels of pollution in the Palar river basin.

7.1.3 Creating a conductive institutional framework or adapting existing institutions: This is a complicated job: Water Resources Organization (WRO) which is supposed to be the parent organization for all water related activities is standing apart from many other government agencies which are also connected to water in many ways. For instance, there is virtually no coordination between Metro water Board, WRO, Pollution Control Board, Groundwater Board, Department of Agricultural Engineering, Department of Agriculture, etc; each one of these agencies formulate their policies which eventually contradict each others interests. State Pollution Control Board, which is primarily responsible for controlling water and air pollution, does not undertake any coordinated activity with WRO. The construction of a dam across the polluted river is the best living proof (the case of Orathapalayam in Tiruppur, which basically dams the entire pollution generation of Tiruppur town); the revenue department (which involves in tax recovery) is considered a rival organization by the WRO, as it enjoys more powers compared to any other departments. For instance, WRO cannot take any punitive action against defaulters in an irrigation system; at best it can lodge a police complaint or can report to the revenue department; Similarly, the WRO can do nothing about the polluters of water bodies which are under its control; Agricultural Engineering department (which works on issues relating to installing community wells, water logging, sanitation, land reclamation, creating recharge structures, water sheds, on farm development work

etc) is detached from WRO and other agencies; Most important of all, the State agencies such as Groundwater Board, TWAD Board, and Metro Water Department, which involve in water use and management directly, have neither information flow among them nor any synchronized activity with WRO or other agencies. Ironically, each one of these agencies gathers and maintains data relating to water for their restricted purposes but never shares with other agencies.

To put the long story short, the existing institutional structure is such that it neither pays attentions to create proper organizational framework nor develops appropriate human resources for a well defined coordinated activities. Net result is the gross institutional failure in handling stiff water management challenges.

7.1.4 Appropriate management strategies: The key elements are assessment of water resources, to maintain a balance between water for livelihood and water for ecology and to make efforts to popularize demand side interventions for a more efficient use of water. The fractured institutional structure, myopic policies coupled with competitive populism and lack of political will, stand in the way to adopt any of the management instruments prescribed by IWRM. The vital strategy of moving towards sustainable use and development should therefore ensure that resources and ecosystems are given certain ethical, social and economic values and that external costs are internalized into market values ensuring at the same time social justice**.** And, the key strategy suggested by the IWRM tool has been demand side intervention for a better and efficient use of water rather than resorting to supply augmentation measures. This involves basically the use of price as a regulatory mechanism for a better water management. In a country like India where one-third of the population lives below poverty line, it will have disastrous consequences.

To sum up, complexities and variabilities that have stained marks over the institutional structure do not provide the required enabling environment to adopt strategies prescribed by IWRM tool. **Nevertheless, the emerging water crisis leaves no option but to work hard to achieve the fruits of IWRM**. But, how to adopt the IWRM tool, in a situation `where everything is misplaced? Multi-stakeholders' dialogue (MSD) approach may be attempted to try out the IWRM strategies. Let us discuss this issue in the next section.

8.1 Approaching IWRM through Multi-Stakeholders Dialogue: The experience of the Palar river basin

In an atmosphere of intense competition and bitter conflicts, how to bring together the multi-stakeholders for a dialogue and coordinated action? Who could initiate the multi-stakeholders' dialogue (MSD)? Government or NGOs or academics or any other? The real usefulness of MSD lies in the fact that it provides a platform for all stakeholders to express their views and concerns and discuss them with other stakeholders; it provides an enabling environment for a better understanding and analysis of the situation; stakeholders will be able to appreciate other stakeholders' problems keeping in mind the welfare of the society at large. The State, on the other hand, will be enabled to take a better view of the matter taking into account the grass-root level realities; this will help the authorities to make better management and investment decisions. **In other words, the IWRM cannot be super-imposed from above (in an atmosphere, in which law enforcement and monitoring mechanisms are very weak), but it has to be bottom-up and has to be induced by multi-stakeholders.** The government institutions have failed or have not been

successful in resolving critical water management challenges. Therefore, `it is in the best interest of government to try and facilitate such direct negotiations and become a welcomed arbiter instead of being considered as the incapable bully who wants to decide everything without taking into consideration the local realities' (p.20, Chert, Ivan, 2000, Letter to my Minister, Global Water Partnership, Stockholm, Sweden).

As may be seen from an earlier section, everything has failed in the Palar river basin, including the interventions from the highest judicial authority of the country. One wondered whether there was a way out or one confronted with a deadlock condition. This was precisely the state of affairs in which multi-stakeholders' dialogue was attempted in the upper Palar basin with a view to finding solutions to problems of growing water scarcity and pollution. The experience of facilitating MSD process in the upper Palar basin would be an added advantage to follow similar approach in the lower Palar basin and in the peri-urban areas of Chennai.

8.2 Multi-stakeholders' meeting – experiences in the upper Palar basin

The first step was to organize a meeting of multi-stakeholders with participants drawn mostly from the Palar river basin. The preparatory research and the initial stakeholder analysis carried out in the basin were found immensely useful to organize this meeting (for details on stakeholder analysis see, Janakarajan, 2002a). However, to involve tannery owners (the main polluters) in the meeting was found very difficult. Tanners initially were even refusing to meet with us. It took a couple months for us before winning over their confidence. Their main reservation was that `although the economy has gained by leather industry over a long period of time, every one uses every single opportunity to destroy us; and often suggested solution is the closure which will destroy not only tanners but also all those who are supported by this industry directly and indirectly' (Secretary, All India Skin and Hide Tanners Merchants' Association, at Chennai). Moreover, they articulated mixed response expressing fear, anguish, defenselessness and also a sense of pride for their positive contributions to the economy. **Only after repeated visits and after giving the assurance that the closure of the industry was not the solution, they agreed to participate in the meeting**. There were 12 participants from the tannery sector and all of them participated in the dialogue for 2 full days.

Indeed, we encountered much greater difficulty in involving the government officials, in particular The Tamilnadu Pollution Control Board (TNPCB). Many officials called it a `sensitive matter' and expressed fear in participating in the meeting. Altogether there were five officials from the Government, which included one from the TNPCB. All of them stayed for not more than half a day.

Other participants were drawn basically from the Palar river basin representing farmers, NGOs, local doctors, residents of local towns, micro-biologists, lawyers, media persons, academics and interested general public. Thus, the `*Multi-stakeholders' Meeting of Water Users of the Palar River Basin,'* was held, during 28th and 29th January 2002 at Chennai, with 120 participants[9]. Before beginning the dialogue on the first day, there were panelists' presentation on various aspects of water use and abuse with particular reference to the basin. There was quite a good deal of heated arguments and the discussion was intense and lively. The meeting gave an opportunity for all stakeholders to get the accumulated steam out of one's

[9] This was a part of the research `Local Water Supply and Conservation Responses' funded by the International Development Research Center (IDRC), Canada.

system. Further, the heat started melting down in the afternoon. Towards the end of the meeting there was a big sign of relief. At that time it was widely acknowledged that MSD is a process and not a one-off meeting. Therefore, there was a general agreement to constitute a Committee from among those who were present so that the dialogue process could be carried further. **The result was the birth of the *Social Committee* with 24 members represented by different stakeholders.** This Committee since then has met six times and has transacted a good deal of business. The stakeholders have understood their problems better and they have listed their future course of action for implementation. The stumbling block however is the lack of much needed support from the government. The Committee strives hard to weave-in the government into the Committee for a better result. This is going to be biggest challenge for the Committee and therefore, the success or failure of the Committee would depend upon the degree of involvement of the government[10].

9 Returning to the main issue: Negotiating water conflicts in the context of the peri-urban area of Chennai, including the lower Palar

- Since the urbanization is an inevitable process, should we let the peri-urban population / areas to suffer? Or

- Is there a way in which the spread of urbanization could be used for the best use and advantage of both the populations?

These questions arise mainly because of the hitherto wrong approaches to the problem of peri-urban issues. For a long time research was carried out with reference to either rural or urban areas. But peri-urban issues have become quite important in the recent times primarily due to urban pressure and rapid degree of urbanization. Urban population has more than doubled in the past 25 years. This has created severe stress in the peri-urban areas. All the hitherto approaches have viewed rural, peri-urban or urban issues in isolation. They need to be examined as a part of the single eco-system and a part of an integrated socio-economic developmental process of an economy. D.L. Iaquinta and A.W. Drescher have expressed similar views: *Rural, peri-urban and urban form a linked system (R-PU-U), which constitutes an uneven multidimensional continuum.*[11] A fragmented approach would only bring about rural-urban and peri-urban – urban divide, besides contributing to destruction of ecology, environment and livelihood options in the rural and peri-urban areas. In other words, the peri-urban issue has become a wrongly understood concept – viewed in isolation from the overall processes of `change'.

Following questions arise in this context, which the project would attempt to look into:

8.1 Horizontal urban expansion encroaches upon natural resources, in particular land and water, enjoyed hitherto by rural and peri-urban communities. As a consequence, severe competition and conflicts spur up between urban and peri-urban areas. While Municipal corporations, Housing Boards and State Metro water agencies collectively

[10] A similar stakeholder dialogue approach was attempted with a view to resolving the much vexed Cauvery water dispute between Karnataka and Tamilnadu. Farmers' representatives of both states have been meeting since April 2003 and have been quite successful in resolving the differences between them.

[11] D.L. Iaquinta and A.W. Drescher, ` Defining the peri-urban: rural-urban linkages and institutional connections' (by) (http://www.fao.org)

negotiate claims over land and water rights on behalf urban areas, the peri-urban areas are represented individually and often are subject to threats. These kinds of negotiations are often one-sided because of unequal bargaining power enjoyed by these agencies. This is precisely the context in which a collective - multi-stakeholders' dialogue approach and a participatory planning process would be useful for a better negotiated democratic settlement.

8.2 Though urban interests are deeply committed to make the most of the available land and water resources of rural and peri-urban areas hardly are these state agencies pay attention to document or analyze vulnerabilities and its long-term implications

8.3 Peri-urban population depends upon land for livelihood, commons for fuel wood and water for agriculture, animals rearing and for drinking; Therefore, entire livelihood options are affected due to transport of water to urban areas. These areas are in a state of decay, in particular for those, who depend upon agriculture for their livelihoods. This section is the majority. On the other hand, for those who benefit due to `spillover effects of urban development' (e.g., enhanced land value due to locational advantage or due to water selling) is a minority. However, what is important is to examine, how the majority, whose livelihoods are affected cope with spillover effects. How sustainable the continuing and round the clock groundwater transport from peri-urban areas of Chennai? What are the responses to water transport from different sections of village population? Are there any institutional mechanisms existing to cope with peri-urban issues relating to natural resource management? Role and functions of Panchayat bodies – Are they aware and what concrete actions have they taken so far to deal with the urban entry?

8.5 Do state institutions take coordinated actions to preserve the local natural resources or are they pull in different and opposite directions – due to `fractured institutional set up'?

8.6 What are the existing laws and measures, to protect livelihoods of people, natural resources such as water bodies, riverbed aquifer, protection from industrial pollution and so forth?

8.7 What have been responses from civil society, farmers' organizations, trade unions, NGOs and media for the emerging peri-urban issues?

8.8 How sensitive the political parties are and how are they reacting to these issues?

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`Institute for Water Studies, Government of Tamilnadu, 2000, *State Framework Water Resources Plan, Palar Bain,* Chennai.

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Moench, Marcus and Janakarajan 2003. `Are Wells a Potential Threat to Farmers' Well-being? The Case of Deteriorating Groundwater Irrigation in Tamilnadu', *Working Paper No.174*, Madras Institute of Development Studies, Chennai.

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Annex 5 Abstracts of papers from Cochabamba, Bolivia

Bustamante, R., Butterworth, J., del Callejo, I., Duran, A., Herbas, D., Hillion, B., Reynaga, M. and Zurita, G. 2004. *Multiple sources for multiple uses: Household case studies of water use around Cochabamba, Bolivia*. [online] Available at http://www.irc.nl/content/view/full/8031 (accessed 22 March 2004).

This paper reports on a series of household water-use case studies around the city of Cochabamba in Bolivia. In particular it examines the multiple use of domestic water supplies,and the use by families of multiple sources to meet their water needs for both domestic and productive activities. As the city expands, it is argued that productive water uses such as irrigation of gardens or huertas are likely to make significant demands upon new domestic water supply systems. These uses are equally likely to have an important impact, whether positive or negative depending on your viewpoint, on the overall availability of water resources as well as on the livelihoods of urban and peri-urban water users.

Bustamante, R., Butterworth, J., Flierman, M., Herbas, D., den Hollander, M., van der Meer, S., Ravenstijn, P., Reynaga, M. and Zurita, G. 2004. *Livelihoods in conflict: disputes over water for household-level productive uses in Tarata, Bolivia.* [online] Available at http://www.irc.nl/content/view/full/8031 (accessed 22 March 2004).

In Tarata (Cochabamba, Bolivia) disputes came to a head in 2002 over the rights to use water for urban agriculture from a multiple purpose water supply system (Laka Laka). The Laka Laka dam was planned to provide water for a large irrigation scheme and to meet the basic needs of domestic users in the town, but not specifically for productive water uses within the urban area. When the urban population demanded the right to also use water for cultivation around homesteads, there were violent conflicts with farmers from the irrigation scheme who were determined to protect their irrigation water rights.

Almost 5% of the estimated reservoir yield (or 10% of the storage capacity) was originally allocated for urban water supply, but this could not be used for drinking water supply due to the poor water quality and high costs of treatment. The urban community organised to utilise this water, on the basis of advice they received from local government supporting their proposals, for irrigation of ‘huertas’ (small plots close to homesteads) instead. An organisation was formed to develop the project and infrastructure to supply this water to huertas.

The paper reports the findings of a case-study to investigate the nature and causes of the conflict. It addresses the multiple uses of water and sources for domestic supply, urban agriculture and field-scale irrigation, and the potentially complex legislation, institutional arrangements, rights and expectations associated with these different water uses.

Duran, A., Herbas, D., Reynaga, M. & Butterworth, J. *Planning for multiple uses: Household case studies of water use and livelihood activities in peri-urban Cochabamba, Bolivia.* Forthcoming.

This paper presents two methodologies to assess livelihood activities and water use as part of the planning of water supply projects. A case study from peri-urban Tiquipaya, close to the city of Cochabamba in Bolivia, illustrates results from both the rapid and more detailed methodologies presented. The main findings of the case study are that the productive uses of domestic water supplies, particularly irrigating small gardens (*huertas*) and watering livestock appear to have been underestimated to date, both in their importance for the livelihoods of households in Tiquipaya and in patterns of water use. Currently, water supplies are mainly provided by small locally-managed groundwater-based systems, although there is a contested plan to move towards more centrally-planned systems. It is concluded that the future development of water supply systems in the area is more likely to be sustainable and to meet local needs if productive uses of water at the household level are considered at the planning stage: these activities being particularly dependent upon the availability and cost of domestic water supplies.

Bustamante, R., Butterworth, J. and Faysse, N. 2004*. Is there a future for locally-managed domestic water supply systems in peri-urban Cochabamba? Analysis of performance and some possible scenarios*. Forthcoming.

Locally-managed water supply systems are common in rural and peri-urban Bolivia. Although to some extent acknowledged by national policies of decentralisation and local government, these locally-managed water supply systems do not fit neatly into national policies and plans for water and sanitation, especially at the peri-urban interface. In urban and peri-urban areas the current policy is to develop large centrally-managed water and sanitation utilities with high levels of externally financed investment (and cost recovery from consumers) to improve services. This paper considers the performance of locally-managed water supply systems in part of peri-urban Cochabamba (Tiquipaya and Colcapirhua) and their possible future against this background. A major new water and sanitation project planned for the area will clearly result in some major changes for locally-managed water supply systems, if they survive at all over the long-term. Possible scenarios for the future of the locally-managed water supply systems are relevant to other peri-urban areas in Bolivia and elsewhere.

Annex 6 Revised log-frame

	Narrative summary	Measurable indicators	Means of verification (MoVs)	Important assumptions
Goal	Improved assessment, development and management of water resources	Improved access to safe and sustainable water supplies for the peri-urban poor for multiple uses	National data and sector studies	No input required.
Purpose	More inclusive and pro-poor management arrangements to facilitate the avoidance and resolution of conflicts over access to water resources in peri-urban areas.	Improved levels of consultation and management, especially representing poor people from peri-urban areas, in two selected cities and their catchments (Chennai and Cochabamba) with severe water resource issues by Sep 2006 Utilisation of methods developed by the project to better manage peri-urban water issues in at least 5 other catchments by Sep 2007	Reports of government and municipal authorities; Reports of multi-stakeholder water users fora Local press and other media. External evaluation Project reports Consultation	
Outputs	1) Appropriate management tools and institutional structures for improved, stakeholder led Integrated Water Resource Management (IWRM encompassing peri-urban zones and the adjoining urban and rural catchment areas.	Tools developed and institutional development supported in the catchments of Chennai and Cochabamba, with better representation of peri-urban zone residents and issues by Jun 2006	Project reports including evaluation by stakeholder groups; Conference proceedings, journal papers	Given the willingness and enthusiasm to develop and adopt water resource management scenarios and assess implications, the user groups will be able to influence policies and implement plans based on these scenarios in the face of political, climatic and other pressures
	2) Improved capacity of resource centres to support and facilitate stakeholder led IWRM in peri-urban contexts	Local capacity enhanced to provide training and facilitation in stakeholder-led management of water resources and implementation of IWRM by catchment managers, support organisations and other stakeholders by Sep 2006	Resource centre reports including requests for support; Project reports including evaluation by stakeholder groups	
	3) Widely disseminated approaches that are and accepted as a basis for good practice	Guidelines and training materials in use within two selected city catchments by Sep 2006	Final training materials and guidelines; Project reports; Continuous dissemination through project website; Conference/journal papers focused on replication and policy-level	

ctivities	**1) Inception phase** 1.1 Research team inception workshops for development of methodology and general training with partners (note that each work package also starts with specific training with partners) 1.2 Poverty analysis based mainly upon existing data of patterns of poverty within the study area, livelihoods and relationships to water security 1.3 Initial identification of focus areas within catchments and key stakeholders including assessment of areas with most severe water resource problems; participatory stakeholder analysis at different levels; explanation of process to key stakeholders	<u>Milestones and Budget</u> • Inception report by Jun 2004 including details of improvements in methodology, results of stakeholder analysis and poverty analysis and implications for subsequent work packages. Also to include details of PhD researcher recruited, inception workshops held in Bolivia and India, water-livelihoods-poverty relationships understood and focus areas within catchments identified.	(Activity to Output)
	2) Literature review: review of problems and potential solutions to water resource competition between urban and rural areas, both worldwide and in the two study countries.	• Methodology and format agreed at inception workshops by Apr 2004 • Thorough literature review published and disseminated by Oct 2004	
	3) Resource audits in pilot catchments: water resource audit at city and village-levels based mainly upon synthesis and quality control of existing secondary data sources covering hydrology, domestic water supply, health, poverty and development issues.	• Key personnel trained in water resource audit methodology by Aug 2004 • Initial data gathered and quality controlled by Nov 2004 • Data ground truthed, gaps identified and filled by Dec 2004 • Participatory assessments of water use carried out with target groups (urban users, peri-urban users, rural users) by Dec 2004 • GIS developed with all necessary baseline information to form foundation for better decision making by Jun 2005 • Analysis and discussion of results with stakeholders by Jun 2005 • Two summary water resource audits published and disseminated by Jun 2005	Availability of adequate baseline data.
	4) Development of stakeholder platforms, and Agent-based models and/or Bayesian networks	• Strengthened water resource user groups in place with agreed constitutions and decision making frameworks by Mar 2005 • Core people trained in Agent-based modelling and/or Bayesian Network methodologies by Mar 2005 • Agent-based models and/ or Bayesian networks of resource use and competition developed by Jun 2005	Failure to develop a common model of water resource use and availability by consensus
	5) Development of decision support support systems integrating the water resource audit compiled in GIS and agent-based model or BN	• Basic systems developed by Sep 2005 • Full systems developed and institutionalised by Dec 2005	
		Provide a budget summary	

Activities

6) Identification of favoured scenarios and support in development of management plans? in stakeholder forums

- Participants trained in use of DSS for participatory exploration of management options by Dec 2005
- User groups understand functioning of DSS and strengths and weaknesses by Jan 2006
- User groups agree a limited number of options for further 'political' discussion/settlements by Feb 2006
- Possible implications for management plans developed and agreed by Mar 2006

7) Development of guidelines and training materials based upon findings

- Agreement on format, content, and target audience in conjunction with resource centres and potential users by Jun 2005
- Development of first draft by Dec 2005
- Publication and dissemination of final product by Jun 2006

8) Dissemination of results and of guidelines

- Punctual reporting and publication of a range of information products – conference papers, journal articles, web-pages etc. - as opportunities are identified

9) Management, process monitoring and evaluation: continuous monitoring, assessment, feedback and re-formulation including stakeholder assessment of process and integration of feedback into plan.

- Monitoring plans developed and key indicators identified by Jun 2004
- Regular meetings and progress reports

Budget

Personnel Costs	64738.71
Capital Equipment	1400.00
Institutional Overheads	50788.10
Other Charges	33284.00
TOTAL COSTS excl. VAT	150210.81
VAT	26286.89
Total cost incl. VAT	176497.70

Pre-conditions

Widespread support in selected catchments for development of multi-stakeholder institutions to address water resource issues.

Annex 7 Revised workplan

3.7 Implementation Schedule (Bar Chart of Activities and Milestones)

Project title	Facilitating negotiations over water conflicts in peri-urban catchments (NEGOWAT)
Project start date & duration	1 Dec 2003/ 34 months
Version number (For DFID Office use only)	

Activities, tasks and milestones	Year 1 (2003/04				Year 2 (2004/05)												Year 3 (2005/06)												Year 4 (2006/07)					
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1) Inception phase	x	x	x	x	x	x	x																											
2) Literature review		x	x	x	x	x	x	x	x	x	x																							
3) Resource audits								x	x	x	x	x	x	x	x	x	x	x	x															
4) Development of platforms and models														x	x	x	x	x	x															
5) Development of DSS																				x	x	x	x	x	x									
6) Analysis of scenarios																						x	x	x	x	x	x	x						
7) Development of guidelines and training materials																				x	x	x	x	x	x	x	x	x	x	x	x			
8) Reporting and dissemination of results and of guidelines								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9) Management, M&E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Key milestones																																		
1) Inception report							x																											
2) Literature review											x																							
3) GIS systems and reports																			x															
4) Strengthened groups and initial frameworks																			x															
5) Decision support systems																									x									
6) Analysis of scenarios																												x			x			
7) Guidelines/ training materials																																		x
8) Information products							x						x						x						x						x			x
9) Progress reports							x			x						x						x						x						x

Annex 8 Revised responsibility matrix

3.8 Responsibility Matrix

Project title		Facilitating negotiations over water conflicts in peri-urban catchments (NEGOWAT)				
Version number (for DFID office use only)						
Main		Responsibility for completion				
		Lead	Support 1	Support 2	Support 3	Supp
Bolivia						
1	Inception phase	NRI	UMSS.AGUA	CIRAD	CERES	
2	Literature review	UMSS.AGUA	All partners			
3	Resource audits	UMSS.AGUA	CERES	NRI	CIRAD	
4	Development of platforms and models	UMSS.AGUA	CERES	NRI	CIRAD	
5	Development of DSS	UMSS.AGUA	CERES	NRI	CIRAD	
6	Analysis of scenarios	UMSS.AGUA	CERES	NRI	CIRAD	
7	Development of guidelines and training materials	NRI	All partners			
8	Reporting and dissemination of results and of guidelines	NRI	All partners			
9	Management, M&E	NRI				
India						
1	Inception phase	MIDS	IRC			
2	Literature review	MIDS	IRC	NRI		
3	Resource audits	MIDS	WRM	IRC		
4	Development of platforms and models	MIDS	IRC			
5	Development of DSS	MIDS	IRC			
6	Analysis of scenarios	MIDS	IRC			
7	Development of guidelines and training materials	MIDS	IRC	NRI		
8	Reporting and dissemination of results and of guidelines	IRC	MIDS	NRI		
9	Management, M&E	IRC	MIDS			
	Overall coordination	NRI				

Annex 9 CVs for additional research team members

1. Personal Details

Family name	First name
SRINIVASSAN	SUNDAR RAMAN

2. Degrees (include subject, class, university and date)

B.E(Agricultural Engineering), Tamil Nadu Agriculture University, Coimbatore, 1995

M.E(Soil and Water Conservation Engineering), Tamil Nadu Agriculture University, Coimbatore, 1997

3. Posts Held (with dates)

February 2004 to Current: Research Associate (Negowat project), Madras Institute of Development Studies, Chennai, India.

May, 2001 – January 2004: Assistant Project Director, District Capacity Building Centre, Andhra Pradesh Rural Livelihood Project, District Water Management Agency, Anantapur, Andhra Pradesh, India.

March 1999 – December 2000: Scientist, Water management, Nagarjuna Agricultural Research and Development Institute, Secunderabad, Andhra Pradesh, India.

November, 1997 – February, 1999: Senior Research Fellow in NWDPRA and ICAR Project at Water Technology Centre, Tamil Nadu Agriculture University, Coimbatore, India

4. Duties and Responsibilities

Assistant Project Director, DCBC-APRLP, DWMA, Anantapur,
Responsible for co-ordinating and monitoring the implementation of APRLP programme in 100 new watersheds for developmental and livelihood activities and for livelihood activities in 400 ongoing and completed watersheds. Incharge for developing training calendars and schedules, Facilitation and training secondary stake holders as well as primary stakeholders, Developing monitoring formats and assisting in developing monitoring tools, Monitoring of activities and impacts in watersheds and capacity building. Water resource audit in one mandal was conducted and was the co-ordinator for the programme and also responsible for implementing watershed programme in two mandals.

Scientist, Water management, NARDI, Secunderabad
Responsible for developing fertigation schedules for different crops under drip irrigation, conducting experiments for evaluation, design and layout of different micro irrigation systems, product evaluation of the manufactured materials and newly developed systems, development of software for irrigation scheduling under micro irrigation systems.

Senior Research Fellow
Development of irrigation schedules for drip irrigated cotton and Tapioca, evaluation for maximum yield under different spacing, planting and irrigations. Demonstration trials to explain the farmers regarding various cropping pattern, rainfed farming, soil and water conservation methods etc.

5. Recent Publications

S.Manivannan, R.Shanthi and **S.Sundar Raman (1999).** Performance of Command Area Development Programme in Cauvery Delta of Tamil Nadu, Journal of Indian Water Resources Society, 19(5), No.1, 33-36

S.Sundar Raman, R.Shanthi and S.Manivannan(1999). Duty of Water in Lower Bhavani Project Command Area under Urbanization- A case Study, Journal of Indian Water Resources Society, 19(5), No.1, 37-40

S.Manivannan, R.Shanthi and **S.Sundar Raman,(1999).** Applicability of Soil Conservation Service Runoff model for small tank catchments in Tamil Nadu, Journal of Applied Hydrology, XII (4), 29-34.

S.Sundar Raman, K.M.Dakshinamurthy, G.Ramesh, SP.Palaniappan and S.Chelliah,(2000). Effect of Fertigation on Growth and Yield of Gherkins, Vegetable Science, 27(1): 64-66

Sundar Raman, S., R. Shanthi and S. Senthilvel,(1998). Impact of Urbanisation on Duty of Water in Lower Bhavani Project Command – A Case Study, Abstract In: Sovenir and Abstracts of XIII National Convention of Agrl. Engineers, Pg.45, TNAU, Coimbatore.

Sundar Raman. S., R. Shanthi and S. Manivannan(1998). Prospectus and Perspectives for Additional Irrigation Potential in Lower Bhavani Project Command, Abstract In: Sovenir and Abstracts of XIII National Convention of Agrl. Engineers, Pg.47, TNAU, Coimbatore.

Sundar Raman, S.,R. Shanthi and P. K. Selvaraj(1998). A Critical Study on Water Use Efficiencies in Lower Bhavani Project Ayacut, In : XXXIII Annual Convention of ISAE, Bhopal.

Shanthi, R., O. Padmakumari,**S. Sundar Raman**,(1998). Emitter Clogging – Causes and Control – A Case Study, In : National Seminar on Micro Irrigation Research in India: Status and Perspectives for 21st Century, WTC, Bhubaneswar, Pg.73-78.

Shanthi, R. and **S. Sundar Raman,**(1999). A Study on Clogging of Emitters in Drip Irrigation Systems, Abstract In : Proc. National Seminar on Irrigation in 2050 – Challenges Ahead, IMTRI, Trichy.

Manivannan, S, Ramaswamy,K and **Sundar Raman,S(1999).** Comparison between Green-Ampt and Curve number run-off prediction, Abstract In:Souvenir and abstract volume of National seminar on Water Resources and Sustainable Development in Next Century and XVIII Annual Convention, Pg.13, Dept. of Geology, Shivaji University, Sholapur

Andhra Pradesh Rural Livelihoods Programme Water Audit: Report published by Andhra Pradesh Rural Livelihood Programme, Govt of Andhra Pradesh.

6. Countries of Work Experience (include length of time)

India – 7 years

7. Capacity and Experience Relevant to this Proposal

7 years of practical experience in water management, implementation of water conservation techniques and micro irrigation systems working in co-ordination with NGO's and Government in rural development and implementation of livelihood activities and watershed development activities. Thesis work in the following areas during post graduate and graduate studies:

M.E. (Ag): Impact of urbanisation on water allocation and water use efficiency of Lower Bhavani Project Command Area.

B.E. (Ag): Study on Tank irrigation and its Econo-Socio aspects.

Has knowledge on use of Bayesian network models.

1. Personal Details

Family name	First name
JAMES INBANATHAN	**SACRATEES**

2. Degrees (include subject, class, university and date)

B.A. Economics, University of Madras, 1992
M.A Economics, University of Madras, 1995
M.Phil Economics, University of Madras, 1996
Ph.D. University of Madras, 2002

3. Posts Held (with dates)

April 2004 to Current: Research Associate (Negowat Project) at Madras Institute of Development Studies, Chennai, India
September 2003 to November 2004: Research Investigator (Evaluation of Thadco Welfare Programes) at Madras Institute of Development Studies, Chennai, India
June 2002 to May 2004: Junior Research Fellow, Department of Economics, University of Madras, India
September 1999 to December 2002: Full time Research Scholar (Ph.D.), Department of Economics, University of Madras, India

4. Duties and Responsibilities

Responsible for carrying out review of literature in the field of water, air and environment related issues. Data processing and analyzing the data with various statistical tools.

5. Recent Publications and Participation

"Marine Product Export Performance in TamilNadu"- Paper presented in the National Seminar on, "Sustainable Coastal Resource Development" held on 14th and 15th Dec.1999.
"Liberalisation, Poverty and Unemployment- An Overview"- Paper presented in the UGC Sponsored National Seminar on "A decade of Trade Liberalisation Economic Growth and Social Justice", held on 9th and 11th Feb.2001.
"Economic Growth Versus Environmental Impact of Industrial Effluent of River Cauvery"- paper presented in the 84th Annual Conference of the Indian Economic Association held at Vellore Institute of Technology, Deemed University, Vellore during December 28,29&30,2001.
Participated in the 22nd Annual Conference of the "Association of Economists of TamilNadu" seminar held on" Water Resource Management in India"- organised by Dept. of Economics, Arul Anandar College (Autonomous), Karumathur, Madurai, held on 15th and 16th Dec.2001.

6. Countries of Work Experience (include length of time)

India – one year

7. Capacity and Experience Relevant to this Proposal

Ph.D- Economic Valuation of the impact of air pollution on human health

M.Phil – Environmental Hazards in Sugar Industry

1. Personal Details

Family name	First name
Vincent	Prabahar Gnanakkan

2. Degrees (include subject, class, university and date)

B.A. Economics, Madurai Kamaraj University, 1988
M.A Economics, Madurai Kamaraj University, 1990
M.Phil Economics, University of Madras, 1991

3. Posts Held (with dates)

December 2003 to Current: Research Assistant (Negowat project), Madras Institute of Development Studies, Chennai, India.
January 2002 to November 2003:Research Officer, MSE, Chennai: Monitoring and Evaluating the International Labour Organisation's International Programme for the Elimination of Child Labour (ILO_IPEC) Action Programme in Tirupur and Sivakasi in Tamil Nadu"
July 2000 to December 2001: Lecturer in Economics, Aditanar College of Arts and Science, Tiruchendur, Tamil Nadu
January 2000 to June 2000: Research Officer, MSE, Chennai: Monitoring and Evaluating the International Labour Organisation's International Programme for the Elimination of Child Labour (ILO_IPEC) Action Programme in Tirupur and Sivakasi in Tamil Nadu"
July1999 to December 1999: Lecturer in Economics, Loyola College, Chennai
July 1996 to June 1999 **:** Research Assistant**,** Madras Institute of Development Studies (MIDS), Chennai – 20.
May 1993 to June 1996: Research Associate**,** Centre for Research in Economic and Social Development (CRESD), Chennai-20
October 1992 to January 1993:Research Associate, Institute for Techno Economic Studies (ITES), Chennai.

4. Duties and Responsibilities

Research Officer, MSE, Chennai in ILO project

As the **project leader** for the above project, I am responsible for developing a model system of monitoring and evaluation, periodically reporting about the progress of this programme to the International Labour Organisation, and the respective District Collectors and also interacting with implementing and executing agencies; communicating progress and pitfalls to all concerned authorities through meetings and technical reports; preparing final evaluation reports; and overall supervision and management for effective monitoring and evaluation of the entire project.

Lecturer in Econimics, Aditanar College of Arts and Science, Tiruchendur

Handled Undergraduate, Postgraduate and M.Phil courses in Economic Planning and Development, Quantitative Techniques, Statistics, Mathematical Methods, and Entrepreneurship Development. G*uided two M.Phil research scholars for their dissertation.*

Research Assistant in MIDS, Chennai

Projects worked in include:
i) Operations Research Project on Maternal Anemia among Urban poor in Tamil Nadu
ii) Capacity –21 – Natural resource accounting of water resources

Skills for working on these projects included writing papers, designing the

questionnaire, conducting primary and secondary survey, analyzing the data and presenting the research.

5. Recent Publications

Presented a paper on ***" Status of Domestic Water supply in the Lower Bhavani River Basin"*** at the 3rd Steering Committee Meeting held by the Madras Institute of Development Studies, Chennai-20 on December 2, 1997.

Evaluation report of the ILO-IPEC Project in Tirupur, Coimbatore District, Tamil Nadu, Madras School of Economics,2003

Economic modeling for Agro forestry in Tamil Nadu, SIDA report, 1995.

Farmer's Perception and Market realities with special reference to Marketing of wood crops in Tamil Nadu, SIDA report, 1996.

6. Countries of Work Experience (include length of time)

India – 12 years

7. Capacity and Experience Relevant to this Proposal

Has an extensive research experience in various economic related issues and analys of livelihood activities of rural poor and assisted in planning various developmen programmes. Did an extensive study on Rural water supply in Lower Bhavani Basin.

1. Personal Details

Family name	First name
GOVINDARAJAN	**JOTHI**

2. Degrees (include subject, class, university and date)

B.A. English Literature, University of Madras, 1973

3. Posts Held (with dates)

February 2004 to Current: Research Assistant (Negowat Project) at Madras Institute of Development Studies, Chennai, India

November 1997 to January 2004: Research Assistant (Local Options for Water Supply and Conservation Management (International Development Research Council (IDRC) at Madras Institute of Development Studies, Chennai, India

January 1997 to October 1997: Research Assistant (History of Tamil Cinema) at Madras Institute of Development Studies, Chennai, India

June 1996 to December 1996: General Guidance (Environmental Issues in Chennai City – a study collaborated with Ph.D. Swedish Scholar) at Madras Institute of Development Studies, Chennai, India

January 1996 to June 1996: Project Supervisor, Solid Waste Management in Selected Areas in Madras (Environmental Resource Management England and MIDS) at Madras Institute of Development Studies, Chennai, India

June 1993 to December 1995: Research Assistant, Adjustment and Development – Agrarian Changes: Social Welfare and Markets in South India, 1973-1993 at Madras Institute of Development Studies and Oxford University, Chennai, India

January 1990 to June 1990: Research Assistant and data processing, Village Level Surveys for the Installation and Commissioning of Desalinization plants under the National Drinking Water Mission, SESS, New Delhi,

July 1989 to December 1989: Research Assistant, Electoral Behavior in the Ensuring General Elections to the Tamilnadu Legislative Assembly-1989, conducted by LBS Academy Mussourie.

October 1986 to June 1989: Research Assistant, Management of Irrigation and its Effects on Productivity under Different Environmental and Technical Conditions (Central Planning Commission, New Delhi) at Madras Institute of Development Studies, Chennai, India

July 1986 to September 1986: General Guidance, Collection of Folklore for a Swiss Scholar, Tamil University, Thanjavur

April 1986 to June 1986: Researcher, Kisan Movement in Tiruchirapalli District collaborated with Cambridge University Scholar

January 1985 to March 1986: Research Assistant, Match Industries in Tamil Nadu (Child Labour Aspects), at Madras Institute of Development Studies, Chennai, India

July 1984 to December 1984: Research Assistant, Comparative Study of Irrigation Institutions under Selected Tanks in Tamilnadu (NABARD study), Centre for Development Studies, Thiruvananthapuram, India

January 1984 to June 1984: Research Assistant, (Gangaikondan Village Resurvey:

Thirunelveli District) at Madras Institute of Development Studies, Chennai, India

July 1983 to December 1983: Research Assistant, Rural Development Policy Implementation in Tamilnadu collaborated with Australian National University Scholar

April 1982 to June 1983: Research Assistant, Social Forestry in Tamilnadu (SIDA) at Madras Institute of Development Studies, Chennai, India

June 1981 to March 1982: Research Assistant, Dusi Village Resurvey: Thiruvannamalai District at Madras Institute of Development Studies, Chennai, India

July 1980 to May 1981: Research Assistant, Tank Irrigation in Tamilnadu (ILO Study) at Madras Institute of Development Studies, Chennai, India

April 1980 to June 1980: Research Assistant, Iruvelpattu Village Resurvey: Cuddalore District at Madras Institute of Development Studies, Chennai, India

February 1979 to March 1980: Research Assistant, Production Relations in Agriculture collaborated with Lund University, Sweden and MIDS, at Madras Institute of Development Studies, Chennai, India

4. Duties and Responsibilities

Responsible for carrying out research interviews and collection of data related to both primary and secondary literature, field visits, Data processing and analyzing the data with various statistical tools.

5. Recent Publications and Participation

"Avala Nilayil Thamizhaga Arugal" (Poor Conditions of Tamilnadu Rivers), book published in Local language in the year 2003 Assistant to the Editor

Participated in various Public Hearings, Seminars and Workshops Conducted by NGOs, Research Institutes, Trade Unions

Paper presented in various Public Hearings, Seminars and Workshops Conducted by NGOs, Research Institutes and Trade Unions

Articles published in local journal, net journal on different issue

7. Countries of Work Experience (include length of time)

India – 25 years