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*Department for International Development, UK*

**Workshop – Thursday 17 November 2005**
**UNICEF Conference Room No 2 – New Delhi**

**Water demand management in areas of groundwater over-exploitation**

# Strategy Formulation

# REPORT ON WORKSHOP

**BLACK & VEATCH, UK**
**in association with**
**VRV Consultants, Chennai**

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# REPORT ON WORKSHOP

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# REPORT ON WORKSHOP

## 1. Backgound

### 1.1 Purpose of Workshop

The Workshop was held to discuss the outcome of the Research Project on "Water Demand Management in Areas of Groundwater Over-exploitation".

The project has been undertaken and funded as part of the UK Department for International Development (DFID)'s Knowledge and Research Programme. The initial concept for the research was developed by Black & Veatch Consulting Ltd in 2003 in line with the DFID agenda on poverty alleviation and within the context of the UN Millennium Development Goals.

The purpose of the research has been to:

- develop water demand management strategies for controlling groundwater abstraction in areas where aquifers are being over-exploited, ensuring the long-term livelihoods of the vulnerable and poor are safeguarded; and to

- discuss and disseminate the findings with potential end users of the research (Donor agencies, Government and agencies involved in water management).

A number of studies have been undertaken by the Consultants in developing water demand management strategies. These include: a Knowledge Review; Case Studies in India and Jordan during 2004; and workshops and meetings with stakeholders in Chennai and Amman in November 2004. The Knowledge Review was submitted to DFID, UK in June 2004 and The Case Study Report in January 2005. During 2005 the Consultants developed an approach to Strategy Formulation and additional studies were undertaken in Pondicherry and Andhra Pradesh to test the approach.

The purpose of the Workshop was to present, discuss and test the proposed approach which is described in the document "Water Demand Management Strategy Formulation (Draft), September 2005" and which had been circulated to participants. The Main Report describes the background and overall approach to formulating a water demand management strategy. Annex A discusses poverty and vulnerability; Annex B summarises the case studies undertaken in India and Jordan; and Annex C describes water demand management measures and water supply options.

The Workshop Programme is given in Section 2.

### 1.2 Participating organisations

Black & Veatch Ltd, UK has led the research, providing inputs on water resources, hydrogeology, economics, community participation, poverty and gender issues. The principal research collaborators have been: VRV Consultants (P) Ltd. and the Centre for Poverty Alleviation (CUPA), Chennai, India; and Jouzy & Partners and JOHUD, Queen Zein Al Sharaf Institute (ZENID) in Jordan.

The following Government institutions, donor and other agencies have provided advice and access to data in support of the studies and we acknowledge with thanks the assistance they have given:

In Tamil Nadu: The Ministry of Finance; The Department of Public Works; The Department of Municipal Administration and Water Supply; Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB); The Institute of Water Studies, Chennai; Madras School of Economics; the Deputy British High Commission, Chennai; and several NGOs in Tamil Nadu.

In Pondicherry: Public Works Department; Water Resources Division, Department of Agriculture.

In Andhra Pradesh: Municipal Administration and Water Supply Department; Department of Rural Water Supply; Madanapalle Municipality; Raychoty Municipality

In Delhi, India: DFID, UK; TheWorld Bank; Asian Development Bank; New Delhi.

In Jordan: The Ministry of Planning; The Ministry of Water and Irrigation; The Ministry of Agriculture; UNDP, USAID, EU, GTZ, and The University of Jordan

A list of Workshop participants is given in Appendix A.

## 2. Programme

The Workshop programme is given below:

**Morning – Presentation and discussion of Strategy Formulation Report**

**10.00 a.m. 1st. Morning Session** Chairman – Mr S Ramakrishnan

10.00 - 10.05 a.m. Chairman's Introduction

10.05 - 10.10 a.m. Stephen Young, Senior Infrastructure & Urban Development Adviser, DFID

10.10 – 11.20 a.m. Presentation of Strategy Formulation Report

10.10 – 10.20 a.m. Introduction to the DFID funded Research Project (David Stacey)
Water demand management in areas of groundwater over-exploitation

10.20 – 10.40 a.m. Case studies in India and Jordan
The Case Study Areas (Dr V.R.Visweswaran & John Petrie)
Poverty & Livelihoods (Dr. Elizabeth Mann & Louis Menezes)
Economic studies (T.K. Thanh & Kandaswamy Barathan)

10.40 – 10.50 a.m. Questions and comments

10.50 – 11.25 a.m. Strategy Formulation Report
Introduction (David Stacey)
Poverty, vulnerability and water (Dr. Elizabeth Mann)
Strategy formulation and implementation
- Water demand management (David Stacey)
- Value, impact and evaluation of water demand management measures (John Petrie & Dr. Elizabeth Mann)

- Water strategy formulation (David Stacey)

11.25 – 11.45 a.m. Tea/Coffee Break

**11.45 a.m. 2nd. Morning Session**

11.45 – 11.50 a.m. Chairman's introduction

11.50 –1.00 p.m.. Comments and responses on Strategy formulation document

1.00 p.m. – 2.30 p.m. Lunch Break

**Afternoon – Project related discussions and application of strategy**

**2.30 p.m. Afternoon Session**

2.30 – 2.35 p.m. Chairman's introduction

2.35 – 2.40 p.m. Conclusions from Morning Session (Consultants)

2.40 – 3.30 p.m. Project studies in Andhra Pradesh and Pondicherry

2.50 – 3.00 Introduction (Dr V.R.Visweswaran)

3.00 – 3.20 Studies in Andhra Pradesh and Pondicherry (Dr V.R.Visweswaran)

3.20 – 3.35 Socio-economic studies, Andhra Pradesh and Pondicherry (Dr Kandaswamy Barathan)

3.35 – 3.55 Presentations on Mandanapalle, Andhra Pradesh
Mr E.J. Manohar Lal, Municipal Water Supply Engineer, Madanapallee
Dr S Siddiraju, Environmental Promotion & Community Awareness Society, Madanapalle, Andhra Pradesh

3.55 – 5.00 Application of Water Strategy to Madanapalle, Andhra Pradesh (facilitated by Consultants)

5.00 p.m. Workshop closed

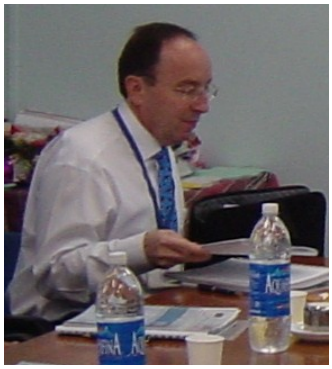
## 3. Presentation of Strategy Formulation Report

### 3.1 Chairman's introductory remarks

The presentations this morning result from studies done in two areas, Chennai, India and Jordan. In both places water has been important from time immemorial. Two thousand years ago a Tamil poet wrote "Our world would not have been formed without water" and fourteen centuries ago, the prophet Mohammed quotes Allah as saying "All living things are formed from water". The studies to be discussed today

represent the search for strategies to husband this scarce resource carefully.

### 3.2 Stephen Young, DFID, introductory remarks



Water management is a central theme in the story of India. Increasingly groundwater is being over-exploited. 70-80% of irrigation in some states is groundwater based. 60% of the aquifers in Punjab and Haryana are over-exploited.

The purpose of the present study develops a sorely needed framework for formulation of water management strategies. The study particularly emphasizes the need to include socio-economic criteria in the evaluation of water demand management measures as the poor are more vulnerable to water stress.

The seminar today is to appraise a project which is part of a centrally sponsored DFID program that examines approaches to water rights and water management across the world. The research project to be discussed at the workshop recognises that water demand management is a key measure in addressing water related issues in the future.

### 3.3 The Consultants presentations

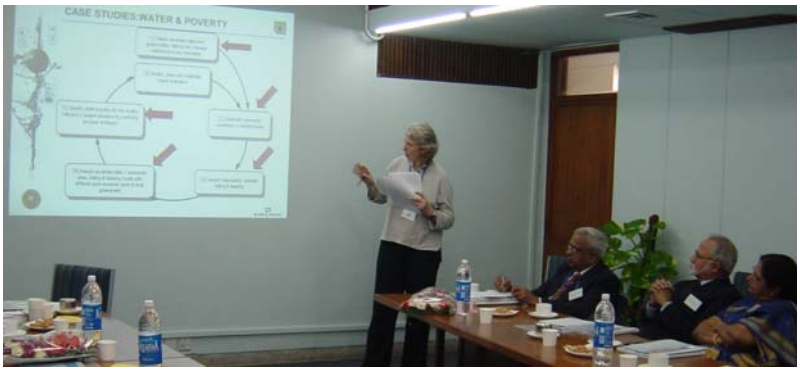
The Consultants presentations were based on the results of the studies undertaken and reported in the "Case Studies Report (January 2005)" and the "Water Demand Management Strategy Formulation (Draft, September 2005)". The PowerPoint presentations are given in Appendix B.

#### *Introduction*

David Stacey introduced the project to the audience in terms of its objectives and scope of work, the work undertaken in the period 2004 to date and the context of water demand management.

#### *The Case Studies*

Dr Visweswaran then described the Case Studies areas and water resources issues of the study areas of Chennai, India and in Shoubak and Al Jafr in Jordan.




Dr. Elizabeth Mann presented examples of the social issues relating to water supply and water demand management in the Case Study indicating the issues faced by the poor and vulnerable and how these groups may be identified.

Tran Kim Thanh then summarised economic aspects that should be considered in evaluating water demand management measures.

***Comments of Case Studies by participants***

Comments were then invited from the participants. These are summarised below together with those made after the presentation of the Strategy Formulation Report.

***The Strategy Formulation Report***

The Strategy Formulation Report was subsequently presented by David Stacey, John Petrie and Elizabeth Mann as follows.

Introduction (David Stacey)
Poverty, vulnerability and water (Elizabeth Mann)
Strategy formulation and implementation

- Water demand management (David Stacey)
- Value, impact and evaluation of water demand management measures (John Petrie)
- Water strategy formulation (David Stacey)

PowerPoint presentations are given in Appendix B.

### 3.4 Comments and discussion

A lively discussion ensued and the principal contributions are given below. The Consultants responded to a number of the comments below during the discussion period. However, the bulk of the comments below have a validity which will be taken into account in updating and finalising the Strategy Report which will be submitted to DFID in early - 2006.

***Mr. Louis Menezes,****, Consultant, Centre for Urban Poverty Alleviation (CUPA), Chennai*

Water is in a state of crisis. It is clear the government needs to act. The question is can it and will it? What are the costs of failing to act?

The Tamil Nadu Groundwater Regulation Act was launched with much fanfare in the 1970s but has never been enforced. The tendency of the government is to pass legislation but fail to even take the next step of notifying those affected.

Failure to recycle wastewater and systematic over extraction of aquifers (North and South of Chennai) by Metrowater has resulted in desertification of the area. The impact is the most severe on the poor and vulnerable. Enlightened polices for urban poor are required such as a form of security of land tenure, community management of resources. There has been a major policy failure and a failure of governance.

The multiple failures of the government include:

- Failing to enforce legislation
- Failing to take action on the recommendations of consultants
- Failing to recycle water
- Overdrawal of precious water in the aquifers to the north and south of Chennai resulting in salt-water intrusion and desertification
- Failing to give consideration to the needs of the most vulnerable groups through security of land tenure and means to cope and adapt to stress

***Dr. Saleem Ramaneh**, Chairman, Central Groundwater Board, Government of India*

Chennai has an extremely complex hydrogeology. Any policy formulation must include improving the understanding of the aquifer system. Is the salinity problem due to upconing, pollution or salt-water intrusion? Is there water in deeper unexploited water bearing layers? Dr Salameh felt that the awareness of technological options for ground water management was needed by planners. It was important to identify problems and design suitable solutions. Secondly, policies must take into consideration the problem of inter-agency co-operation

***Ms. Lizette Burgers,** Chief Water & Environmental Sanitation Section, UNICEF, India*

The vision needs to be defined more clearly.

Many consultants have made recommendations, but little is understood about why implementation fails. Perhaps we have too much of a European model in our approach? The assumption that policy formulation will be implemented is not valid in India.

So what is the problem? Is it a lack of political commitment? Do politicians understand that commitments (such as the UN Millenium Development Goals) have implications? Do they clearly understand the issues involved? Are there non-negotiables in addressing this issue? We need to define the overarching principles and how you organize your demand management around that.

Moreover, any strategy formulation must incorporate the equity angle that so often drives political will.

***David Stacey**, Technical Director, Black & Veatch*

Yes, we need to go through a process which defines the political and institutional boundaries. It is difficult to tell government it needs to reform before anything will work. We need to define what is and is not acceptable within the current institutional and political framework before recommending change.

***Mr. Paul Deverill**, Project Officer, Water and Environmental Sanitation, UNICEF India*

asked about how the:

- costing for land and crops belonging to farmers was taken into account when land-use changes were evaluated

Mr. Thanh clarified that the costs for land were taken for the national economy in the economic analysis of the cost of water saved or made available for other consumers and that financial pricing aspects (related to farmers and farm labour) were considered in the water demand management impact evaluation for the proposed measure.

***Ms. Lizette Burgers,** Chief Water & Environmental Sanitation Section, UNICEF, India*

Any recommendations may be perceived as both an opportunity and threat by the government.

This means we need to develop policy and take action at the same time. As a result, the policy becomes defined by the success and failure of actions.

For instance, if you are introducing the concept of water demand management to managers you need to recognize that they have their own considerations. Only a policy that makes a water manager look good will be acceptable. It takes time and patience to work through those measures.

***Mr. Javier Zuleta**, Senior Water Resources Specialist, The World Bank, New Delhi*

Any discussion of groundwater management needs to consider electricity supply. Cheap electricity is a major driver of groundwater exploitation. A sound policy must draw attention to what the government is doing on the energy supply in terms of price and availability.

Government needs reliable information on how perversely the system works. Subsidies are exploited by the rich, the poor suffer the consequences. Efficiency of pumpsets is another major issue on the electricity side. Scope for improvement in this area is massive.

***David Stacey**, Technical Director, Black & Veatch*

This is a useful comment and the issues of subsidies should be considered in introducing some water demand management measures. The "Case Study Report" (3 volumes) submitted to DFID in January 2005 has some comments on this.

***Mr. Paul Deverill**, Project Officer, Water and Environmental Sanitation, UNICEF India*

We need to re-examine the definition of demand management to include equitable distribution.

The words supply management and demand management themselves are confusing. Rainwater harvesting though usually seen as a supply augmentation option, viewed from the perspective of piped supply may also be thought of as a demand management option. Moreover, the word demand management is a turn off to the supply oriented bureaucracy. "Optimizing water management" may be a more acceptable term in that it can include measures for the social allocation of water.

It is also useful to develop a social benefit indicator of the water saved. Is the water saved used by the rich to wash their cars or by poor grannies living in high rises or slum dwellers? How would the concept of water saving in poor households and at an urban level be equitably distributed at the local level? This he suggested could be captured by social benefit indicators for the use of saved water. He felt the need for some degree of social inclusion to be made in the definition of WDM.

How do municipalities build capacity to manage the details of any policy recommendation? What are the incentives that would lead to compliance?

***Dr. Anup Wadhavan**, WSP, The World Bank, Delhi*

Pricing mechanism is a very effective and underutilized tool – without a huge intrusive policy which will never get it right anyway.

No amount of management will overcome distorting price signals. As long as water is free, it will be overused and there is no way around it. Focus should therefore be on whether there is a way to reconcile equity needs without sending distorting signals?

The impact of pricing adjustments and their role in WDM should be understood to utilize them in strategy formulation. He also felt that though equity was at the heart of the matter, concerns on efficiency need not be sacrificed in accommodating equity.

***Mr. Stephen Young**, Senior Infrastructure & Urban Development Adviser, DFID*

Quotas and allocations are a fairly blunt instrument. The integration element seems to be missing in the document. For instance the cost measures look at the overall cost/$m^3$ but haven't been reconciled with the vulnerability studies.

Need to clarify: Who benefits and who loses for each measure?

***Ms. Lizette Burgers,** Chief Water & Environmental Sanitation Section, UNICEF, India*

What are the critical issues? Need to have a prioritization of measures proposed. How much of the vulnerable population lives in high rise buildings and slums? Which measures will produce the biggest bang for your buck? Who are the winners? Need to focus on a few actions which will contribute significantly to solving the critical solution. What is the take-away message?

***Mr. Paul Deverill**, Project Officer, Water and Environmental Sanitation, UNICEF India*

"Critical Issues" and "Winners" are very much the way that UNICEF does business, because UNICEF is very much in the business of trying to change government.

***Ms. Veena Srinivasan** Research Scholar, Interdisciplinary Programme in Environmental Resources, Stanford University, USA*

When considering demand management measures, there is also the need to distinguish between drought year phenomena and long term sustainability.

***Mr. Kandaswamy Barathan**, Consultant Economist, VRV Consultants (Pvt) Ltd., Chennai*

One of the key critical issues is increasing urbanization. Supply of water has remained more or less static. Demand has been accentuated by increasing construction, migration, and increasing standard of living.

***John Petrie**, Chief Hydrogeologist, Black & Veatch*

In applying a water resources strategy, it is the evaluation of alternative measures and understanding of the interaction and implementation of the measures. What are the primary

barriers to implementation that pose a problem? Perhaps the Chairman could give a view on that.

***Mr. S. Ramakrishnan IAS (retd),*** *Chairman of Workshop*

There is a need to take the political situation as a given. We are willing to work around so many (physical) constraints, why not this one? There is no point in taking the high moral ground when it comes to political will.

In any political situation – determine the balance of benefits that a politician can get.

However, I admit that this is easier said than done! Whatever you do there is bound to be an opposing party which takes the opposite stand. Try and understand the balance.

***Mr. Louis Menezes,*** *Consultant, Centre for Urban Poverty Alleviation (CUPA), Chennai*

It is widely acknowledged that in the Tamil Nadu model, the policy maker, regulator and service provider are the same. This kind of an institutional setup will never be responsive to consumers' needs.

In fact, in Tamil Nadu all decisions are made at higher levels, in this case at the level of Chief Minister. There is no such thing as a water manager. Every single decision is made on political grounds. Even the water distribution to the poor is controlled. In such a context who is the water manager you are addressing the policies to?

Political life cycle is too small. When it comes to policy selection, policies that take time always lose out vis-à-vis large "quick-fix" infrastructure projects. The reasons for this preference are clear (alluding to corruption). But the World Bank perpetuates this tendency by preferentially funding large infrastructure based projects over longer term community based ones involving gradual building of social capital over time.

A rare exception is the communitization of public services in Nagaland. This has been a very progressive policy. There the government handed over education, water management and even electricity distribution to community groups. The tribes own the resources and are doing a much better job. In Tamil Nadu, however, politicians do not want to empower local bodies.

***Dr. Elizabeth Mann****, Consultant Sociologist, Black & Veatch*

Multiple problems need multiple solutions. In the 1970s, NGOs were the "enemy". Now government and NGOs are much better at working hand-in-hand. Government even takes credit for work implemented by NGOs. These things take time.

With regard to the need to present the cost-benefits of water demand management measures in a social way, the original case studies report has some cost-benefits which might satisfy some of the concerns of the participants. Perhaps the best place to start is with policies that are non-threatening.

***Summary of suggestions made to consulting team***

The following gives a summary of the main suggestions that were made to the Consultants during the discussion:

- Define the critical issues clearly. Pick a few specific policies which are the "big winners"
- Workout the implementation details is crucial – information, incentives, funding capacity?

- Identify drivers of political commitment and drivers for change. What are the "acceptable boundaries" within which policy can be formulated? Can we suggest policies that are "non-threatening"?
- Consider inter-sectoral linkages such as how electricity tariffs affect groundwater overexploitation
- Incorporate equity considerations into the definition of demand management. What happens to the "water saved"? Who are the winners and losers? Emphasis on poor and vulnerable.
- Need to explore supply management as a water management tool
- Take into account measures that are required at times of severe drought conditions
- Integrate the economic cost-benefit analyses with the vulnerability and socio-economic impacts studies?

David Stacey emphasised that the studies had revealed that water demand management measures must be seen in the context of an overall water resources strategy which includes supply and water augmentation options. He thanked the participants for their valuable contributions during the morning and said that these would be taken onto account in finalising the Strategy Report.

**Lunch break**

## 4. Afternoon Session - Project related discussions and application of strategy

### 4.1 Introductory remarks

The purpose of the afternoon workshop was to present the results of studies of water resources and related socio-economic aspects of Mandanapalle and Rayachoty in Andhra Pradesh and of Pondicherry and then to apply the proposed Strategy Formulation methodology to one of these areas. In the event the Workshop was well represented by those with knowledge of the Madanapalle area and this was used as the test area in the second part of the afternoon.

### 4.2 Studies in Andhra Pradesh and Pondicherry

The Consultants presentations were based on the results of the studies undertaken in the period April to August 2005.

Dr. Visveswaran described how the three study areas (two in Andhra Pradesh and at Pondicherry) had been selected after a preliminary scan of areas where groundwater was being over-abstracted, which included aquifers in Rajasthan, Gujarat, Andhra Pradesh, Tamil Nadu and Kerala.

He presented the demographic and water resources aspects of studies in Pondicherry and in Madanapalle and Rayachoty, Andhra Pradesh.

Kandaswamy Barathan then presented the socio-economic aspects of the areas selected including the assessment of groups that were vulnerable to shortages of water, using the criteria identified by the Consultants from earlier studies. He presented a comparative assessment of the related water issues in these study areas.

Copies of the PowerPoint presentations are given in Appendix B.

Presentations were then made by Mr E.J. Manohar Lal, Municipal Water Supply Engineer, Madanapalle, Andhra Pradesh and Dr S Siddiraju, Environmental Promotion & Community Awareness Society, Madanapalle, Andhra Pradesh. Mr Manohar Lal described the status of water supply in Madanapalle. Dr Siddiraju presented some of the historical context and socio-economic conditions in the town.

Summaries of their presentations are given in Appendix B.

### 4.3 Policy and strategy formulation – application to Madanapalle:

In the second session it was decided to use Madanapalle to test the strategy framework developed by the Consultants. Dr. Visweswaran, Mr. Manohar Lal and Dr. Siddharaju's extensive knowledge on the ground were to provide the necessary background information.

The following figures and tables were referred to during the discussions (copies are given in Appendix C):

- Policy Review and Strategy Development (Figure 5.1, Strategy Formulation Report)
- Water Demand Management Measures (Table 4.1, Strategy Formulation Report)
- Supporting and Enabling Measures (Table 4.2, Strategy Formulation Report)
- Water Supply and Augmentation Options (Table C1, Strategy Formulation Report)

- Water Quality Improvement Options (Table C2, Strategy Formulation Report)
- Water demand management measures – evaluation process

Although policy and strategy formulation is a lengthy process involving many stakeholders, the workshop participants examined the steps needed to develop policy objectives and formulate a strategy. The first step was to identify the development context and water policy objectives.

### 4.3.1 Water Resources Policy Review

***Legal and Institutional Context:***

The main legal framework governing natural resources extraction in the state was the Andhra Pradesh Water, Land and Trees Act (WALTA) 2002. The various areas under the jurisdiction of the Act were listed.

The Rules for this Act have been formulated as recently as January 2005. So the Act is in the early stages of implementation. Although Government Agencies have been briefed regarding the rules, there is very little awareness in the general population. According to the Act, the Revenue Department headed by the District Collector is responsible for implementing the Act.

The institutional framework for the specific area viz. "Registration of Wells" covered by WALTA was discussed. The rules governing registration of wells specify the following procedures.

- No-objection certification needs to be obtained from Revenue Dept.
- Approval of electrical connection
- Insurance
- Geologists Feasibility Certificate (A geologist's certificate certifying that the well will not harm the aquifer, after considering the hydrogeological conditions in the area, has to be obtained).

A consumer wishing to drill a well must apply to the Revenue Department with payment of a fee and insurance. The Act requires the Department to verify that well spacing norms have been adhered to. The norms are 160 m between private wells and 220 m between a Government borewell to private borewell.

***Community and Stakeholders***

Total population 100,000 (2001 Census) of which 27% are poor. The poor are spread over several villages and constitute landless labour, daily wage earners etc.

The rest of the 73,000 people typically work in small and medium industries (cotton weaving, sericulture, farmers, etc.) and pensioners.There appears to be a significant retirement community in Madanapalle attributable to the pleasant climate.

The main Institutional Stakeholders are the Municipality and the Revenue Department.

***Water Balance***

Madanapalle is a highly drought prone area. Droughts are the norm. Surplus rainfall (floods) occurs only one in 8 years.

Although a piped water distribution system exists, it has been abandoned for many years because of poor rains. Tanker supply is the primary source of supply. 30- 40 l/c/d has been supplied to all income groups.

This year, because of the good rains, piped supply has been resumed. Currently, piped supply is being given every third day. The piped supply system is very leaky. The problem of lack of supply at the tail-end of the distribution system remains. The problem is compounded by the fact that the tail-end of the system comprises of hill slopes, populated by poor migrant labour. Two percent of households have their own borewells.

In the last years, there has been no supply to commercial businesses through the public supply system. Businesses have had to arrange private means of meeting their needs, typically borewells or private tankers purchasing water from agricultural wells. The cost of a tanker has been about Rs 350. Many farmers gave up cultivation and exclusively sold water during the drought. The aquifer used by farmers remains over-utilised.

Although the government has tried to curb growing of water intensive crops in this drought prone region, this has met with stiff resistance. Any such action by the government is likely to have a major impact as paddy is a very labour intensive crop.

To augment supply to Madanapalle, the Government of Andhra Pradesh proposed a summer storage tank. However, this met with resistance as cultivable land would be submerged. Detailed land acquisition proposals have been made. Almost 80 percent of farmers have agreed to sell, but the remaining 20 percent are still bargaining about the price.

There are a number of old tanks that could be used but these are no longer connected because of siltation. The main reason for these broken links is lack of maintenance.

***Critical Issues identified***

The following critical issues were identified

- Unsustainable Water Use Practices
- Attitudes of farmers (refusal to change crops)
- Technical capacity

***Policy Objectives***

The next step was to identify key policy objectives faced by the population of Madanapalle. Mr. Manohar Lal and Dr. Siddharaju were asked to identify the key objectives. They identified these to be:

- Ensuring equal distribution of water
- Getting access to a more reliable (all-season) source of supply
- Stabilizing the groundwater table
- Improving the quality of water supply
- Regulating the quantity of supply

- Keeping agricultural livelihoods stable

### 4.3.2 Water Strategy Development

The next step was to identify the appropriate measures for each policy objective from the matrix developed by the Consultants.

- Water Demand Management Measures
- Water Supply and Augmentation Options
- Water Quality Improvement Options
- Supporting and Enabling Measures

In the time available, it was possible to identify some of the supply, demand management and water quality improvement measures which would meet the policy objectives and to get an indication of costs for some of the proposed measures.

| Policy Objective | Measure | Cost |
|---|---|---|
| Ensuring equal distribution of water | SD5: Improve/Extend the Distribution System (Infrastructure)<br><br>SD6: Improve/Extend the Distribution System (Tankers)<br><br>DT1: Reduce water losses | \$0.1/ $m^3$<br><br><br><br>\$0.5/ $m^3$ |
| Getting access to a more reliable water source | SD 10: Rainwater harvesting<br><br>SD 11: Interbasin transfers (e.g. HNSS canal from Krishna Basin) | |
| Stabilizing the groundwater table | AA1:Inter-sectoral water quotas and allocations<br><br>SD7: Retention dams and reservoirs<br><br>SD8: Aquifer recharge<br><br>SD 10: Rainwater harvesting | |
| Improving quality of water supply | QA1: Pollution control in agriculture<br><br>QD2: Construction of sewage treatment plants<br><br>QD5: Control landfills | |
| Regulating the quantity of supply | SD5: Improve/extend the water distribution system (metering)<br><br>DA4:Water Tariffs | |
| Keeping agricultural production stable | AT1: Reduce losses from surface water irrigation systems<br><br>AS1: Water User Associations<br><br>AS3*: Migration<br><br>*: Not necessarily desirable | |

This exercise provided a trial of the first steps in the development of water strategy and with more time would have led to use of the evaluation and comparison of alternative measures and their impact on poor and vulnerable sections of the community.

Substantial progress was achieved within a limited time frame substantiating the utility of the framework as strategy tool. The exercise proved useful in identifying a range of options which could be considered for the area which included supply, water demand management and water quality improvement options and will help the Consultants in refining the step-by-step process outlined in the Strategy Document.

### 4.4 Concluding remarks

Mr. Stephen Young thanked the participants for their valuable inputs which could be used for improvement of the Strategy Formulation Report. He commended the Consultants for bringing together a substantive framework for water resources development which had generated considerable interest.

David Stacey thanked the participants for their active participation, suggestions and comments. He said that a report on the Workshop would be distributed to participants at the end of November 2005. Suggestions and comments by participants will be reviewed and incorporated in developing the final Strategy Report which will be submitted to DFID in January 2006.

The meeting ended with a vote of thanks from the Chair for disciplined and valuable contributions by the participants which had simplified the Chairman's job.

## ANNEX A
## LIST OF PARTICIPANTS

**Mr S. Ramakrishnan IAS (retd),** Chairman of Workshop (formerly Principal Secretary Tamil Nadu Government and Chief Executive Chennai Metropolitan Development Area)

**Mr Stephen Young**, Senior Infrastructure & Urban Development Adviser, DFID

**Dr Saleem Ramaneh**, Chairman, Central Groundwater Board, Government of India

**Mr Javier Zuleta**, Senior Water Resources Specialist, The World Bank, New Delhi

**Dr Anup Wadhavan**, WSP, The World Bank, Delhi

**Ms Pronita Chakrabarti Agrawal**, Consultant (Economic Analyst), WSP, The World Bank, New Delhi

**Ms Shobha Iyer**, Project Coordinator CAG ( Citizen Consumer Action Group), Chennai

**Mr E.J. Manohar Lal**, Municipal Water Supply Engineer, Madanapalle, Andhra Pradesh

**Dr S Siddiraju**, Environmental Promotion & Community Awareness Society, Madanapalle, Andhra Pradesh

**Mr Paul Deverill**, Project Officer, Water and Environmental Sanitation, UNICEF India

**Ms Lizette Burgers**, Chief Water & Environmental Sanitation Section, UNICEF, India

**Mr Palash Srivastava**, Assistant Vice President, Wilbur Smith Associates, New Delhi

**Ms Archana**, Consultant, Environment & Urban Development, New Delhi

**Ms Veena Srinivasan** Research Scholar, Interdisciplinary Programme in Environmental Resources, Stanford University, USA

**David Stacey**, Technical Director, Black & Veatch

**Dr Elizabeth Mann**, Consultant Sociologist, Black & Veatch

**John Petrie**, Chief Hydrogeologist, Black & Veatch

**Tran Kim Thanh**, Consultant Economist, Black & Veatch

**Dr V.R.Visweswaran**, Water Management Consultant, Managing Director, VRV Consultants (Pvt) Ltd., Chennai

**Louis Menezes**, Consultant, Centre for Urban Poverty Alleviation (CUPA), Chennai

**Kandaswamy Barathan**, Consultant Economist, VRV Consultants (Pvt) Ltd., Chennai

## ANNEX B
## POWER POINT PRESENTATIONS

**STRATEGY FORMULATION**

- Introduction
- Case Studies
- Strategy formulation

**PROJECT STUDIES IN ANDHRA PRADESH AND PONDICHERRY**

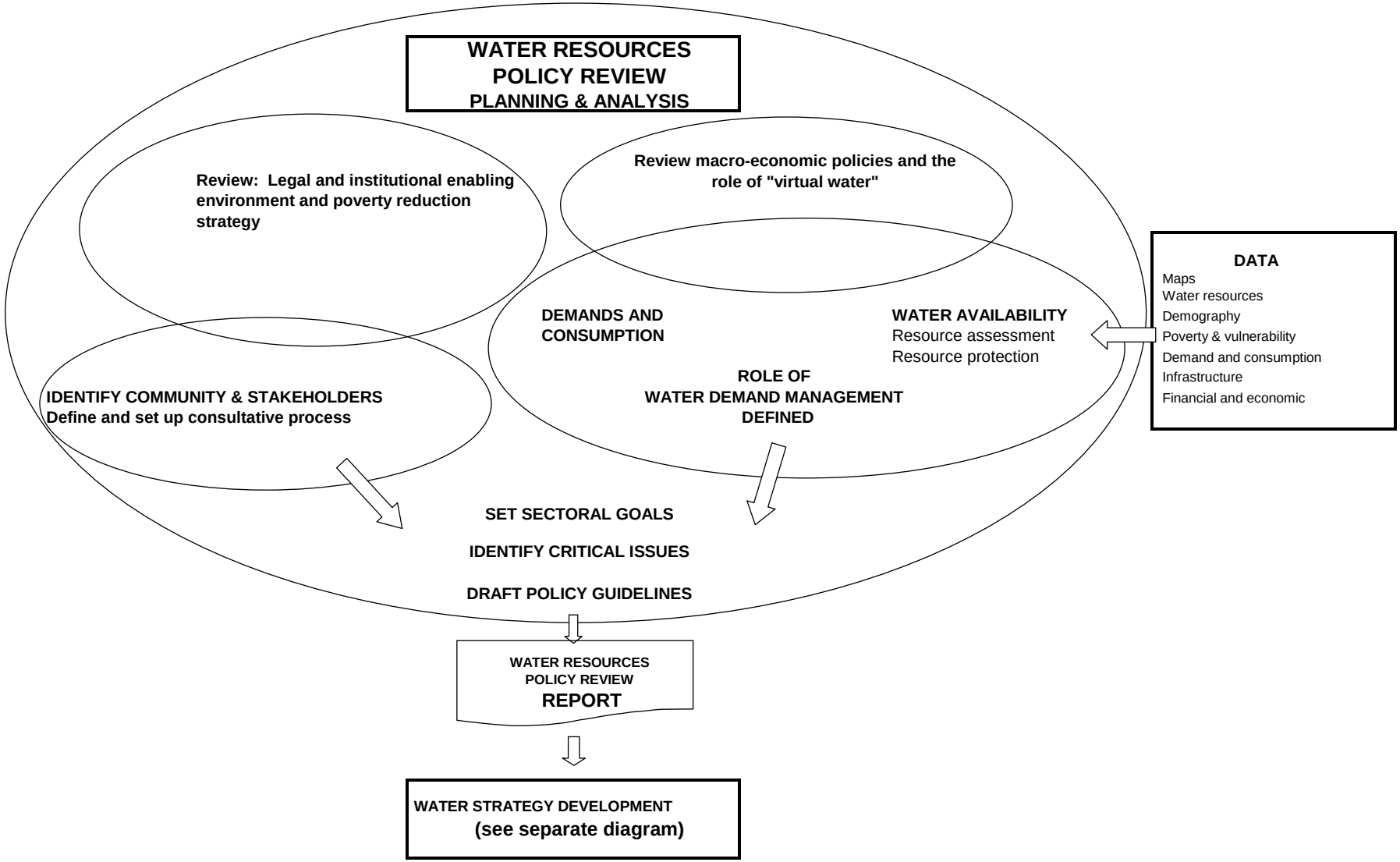
- Studies in Andhra Pradesh and Pondicherry
- Socio-economic studies, Andhra Pradesh and Pondicherry
- Presentations on Mandanapalle, Andhra Pradesh

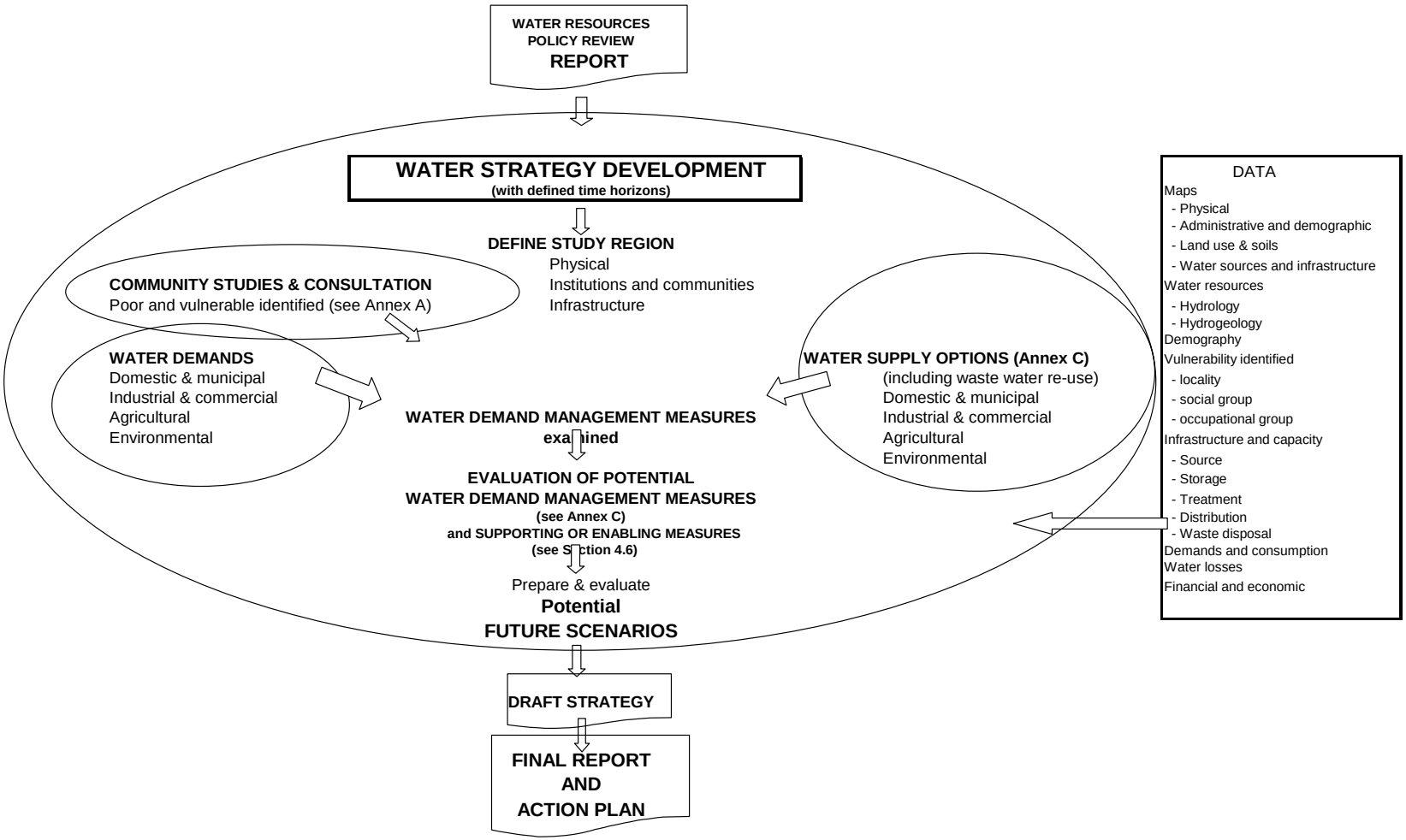
  Mr E.J. Manohar Lal, Municipal Water Supply Engineer, Madanapallee

  Dr S Siddiraju, Environmental Promotion & Community Awareness Society, Madanapalle, Andhra Pradesh

**ANNEX C**
**SUPPORTING PAPERS USED IN APPLICATION OF WATER STRATEGY TO MADANAPALLE STUDY AREA**

- Policy Review and Strategy Development (Figure 5.1, Strategy Formulation Report)
- Water Demand Management Measures (Table 4.1, Strategy Formulation Report)
- Supporting and Enabling Measures (Table 4.2, Strategy Formulation Report)
- Water Supply and Augmentation Options (Table C1, Strategy Formulation Report)
- Water Quality Improvement Options (Table C2, Strategy Formulation Report)
- Water demand management measures – evaluation process


WATER RESOURCES
POLICY REVIEW
PLANNING & ANALYSIS
Review: Legal and institutional enabling environment and poverty reduction strategy
Review macro-economic policies and the role of "virtual water"
DEMANDS AND CONSUMPTION
WATER AVAILABILITY
Resource assessment
Resource protection
ROLE OF
WATER DEMAND MANAGEMENT
DEFINED
IDENTIFY COMMUNITY & STAKEHOLDERS
Define and set up consultative process
DATA
Maps
Water resources
Demography
Poverty & vulnerability
Demand and consumption
Infrastructure
Financial and economic
SET SECTORAL GOALS
IDENTIFY CRITICAL ISSUES
DRAFT POLICY GUIDELINES
WATER RESOURCES
POLICY REVIEW
REPORT
WATER STRATEGY DEVELOPMENT
(see separate diagram)


WATER RESOURCES
POLICY REVIEW
REPORT
WATER STRATEGY DEVELOPMENT
(with defined time horizons)
DEFINE STUDY REGION
Physical
Institutions and communities
Infrastructure
COMMUNITY STUDIES & CONSULTATION
Poor and vulnerable identified (see Annex A)
WATER DEMANDS
Domestic & municipal
Industrial & commercial
Agricultural
Environmental
WATER DEMAND MANAGEMENT MEASURES
examined
WATER SUPPLY OPTIONS (Annex C)
(including waste water re-use)
Domestic & municipal
Industrial & commercial
Agricultural
Environmental
EVALUATION OF POTENTIAL
WATER DEMAND MANAGEMENT MEASURES
(see Annex C)
and SUPPORTING OR ENABLING MEASURES
(see Section 4.6)
Prepare & evaluate
Potential
FUTURE SCENARIOS
DRAFT STRATEGY
FINAL REPORT
AND
ACTION PLAN
DATA
Maps
- Physical
- Administrative and demographic
- Land use & soils
- Water sources and infrastructure
Water resources
- Hydrology
- Hydrogeology
Demography
Vulnerability identified
- locality
- social group
- occupational group
Infrastructure and capacity
- Source
- Storage
- Treatment
- Distribution
- Waste disposal
Demands and consumption
Water losses
Financial and economic

| | WATER DEMAND MANAGEMENT | | | |
|---|---|---|---|---|
| | | **Domestic/municipal** | | **Agriculture** |
| **Developmental and technical measures** | DT1 | Reduce water losses | AT1 | Reduce losses from surface irrigation systems |
| | DT2 | Water saving devices and fittings | AT2 | Introduce sprinkler/drip systems<br>a) with subsidy<br>b) without subsidy |
| | DT3 | Recycling of industrial water | | |
| | DT4 | Use of "grey" water | | |
| **Distributive, financial and market based measures** | DA1 | Inter-sectoral water quotas and allocations | AA1 | Inter-sectoral water quotas and allocations |
| | DA2 | Intra-sectoral water quotas and allocations | AA2 | Intra-sectoral water quotas and allocations |
| | DA3 | Land development control | AA3 | Change land use by:<br>a) land purchase<br>b) re-zoning/classification<br>c) well buy-out (transfer of water rights) |
| | DA4 | Water tariff:<br>a) progressive<br>b) differential | AA4 | Crop area prohibition |
| | | | AA5 | Change cropping patterns by:<br>a) extension<br>b) tax<br>c) market support |
| | | | AA6 | Introduce water markets |
| | | | AA7 | Water tariffs:<br>a) volumetric<br>b) on power to pumps<br>c) area based |
| **Other socio-economic measures** | DS1 | Community level management | AS1 | Water users associations |
| | DS2 | Population distribution | AS2 | Population distribution |
| | DS3 | Migration | AS3 | Migration |

| | | **Domestic/municipal** | | **Agriculture** |
|---|---|---|---|---|
| **Supporting or enabling actions** | SD1 | Community mobilisation (DS1) | SA1 | Increase Extension Services (AT1, AT2, AA5) |
| | SD2 | Public-Private-Community Participation (DS1) | SA2 | Public awareness (AT2, AA1, AA2, AA4, AA5, AA6) |
| | SD3 | Public awareness campaign to reduce wastage (DT1, DT2, DT4, DA1 & DA2) | SA3 | Subsidy introduction (AT2a) |
| | SD4 | Encourage industry to recycle water (DT3) | SA4 | Metered agricultural wells (AA1, AA2, AA7) |
| | SD5 | Metered water supply (DA3) | SA5 | Legislation & regulation (AA1, AA2, AA3, AA4, AA5, AA6, AA7) |
| | SD6 | Legislation & regulation (DT2, DT3, DA1, DA2, DA3, DS2) | SA6 | Monitoring and enforcement (AA1, AA2, AA4, AA7) |
| | | | SA7 | Licensing/registration, water rights and associated legislation (AT1, AT2, AA1, AR2, AR3, AR7) |

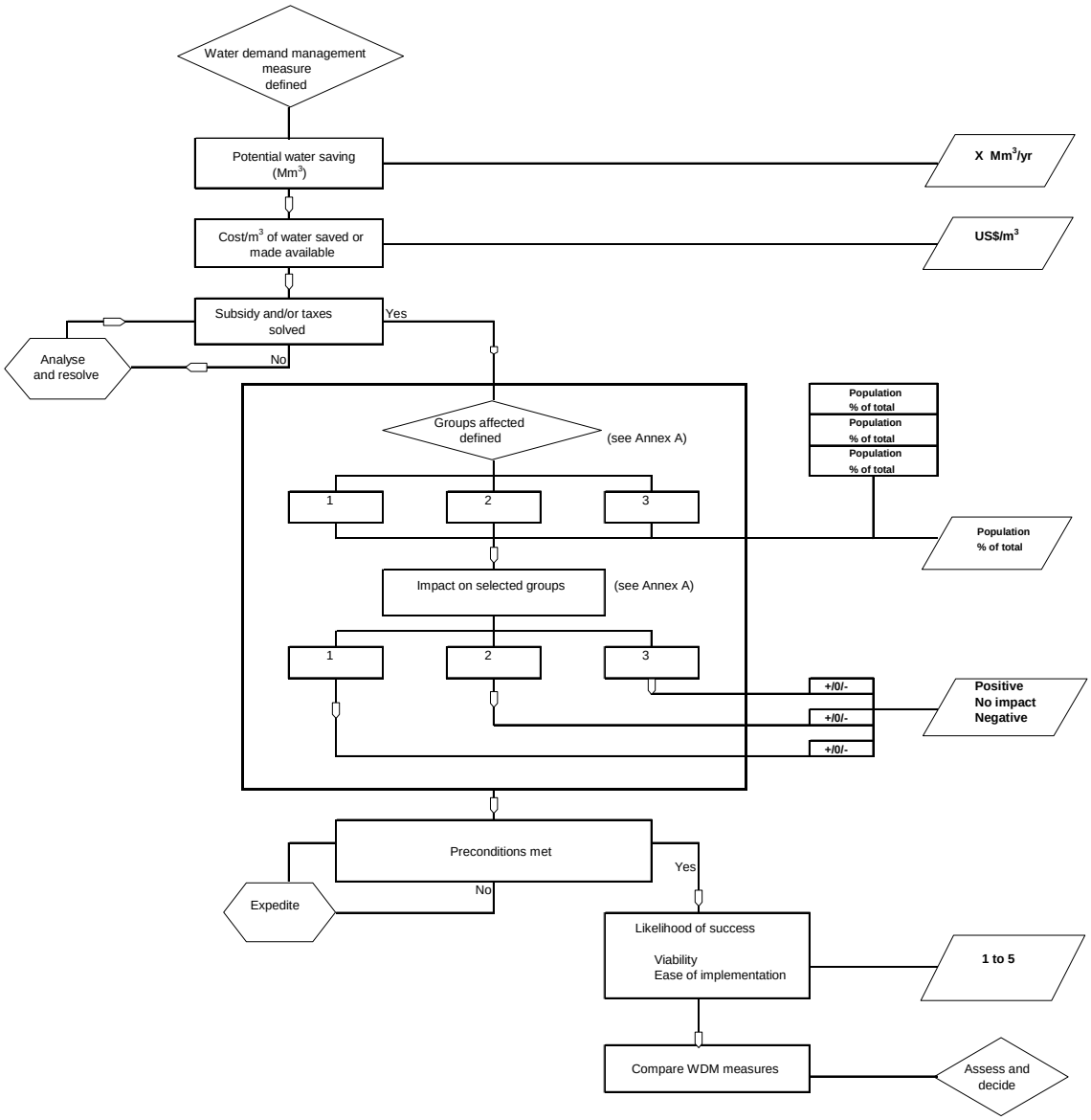
## WATER SUPPLY AUGMENTATION

| | | Domestic/municipal | | Agriculture |
|---|---|---|---|---|
| Developmental and technical measures | SD1 | Develop additional groundwater (wellfield) | SA1 | Develop additional groundwater (wellfield) |
| | SD2 | Desalination<br>(a) seawater<br>(b) brackish water | | |
| | SD3 | Blending of water supplies | | |
| | SD4 | New water treatment facilities | SA2 | Treat/use wastewater |
| | SD5 | Improve/extend water distribution system (fixed infrastructure) | SA3 | Improve/extend water distribution system |
| | SD6 | Improve/extend water distribution system (water tankers) | | |
| | SD7 | Retention dams & reservoirs | SA4 | Retention dams & reservoirs |
| | SD8 | Aquifer recharge:<br>a) dam/tank<br>b) well | SA5 | Aquifer recharge:<br>a) dam/tank<br>b) well |
| | SD9 | Increased abstraction from surface water sources | SA6 | Increased abstraction from surface water sources |
| | SD10 | Rainwater harvesting | SA7 | Rainwater harvesting |
| | SD11 | Trans basin water transfer (import) | SA8 | Trans basin water transfer (import) |
| | | | SA9 | Cloud seeding |

## WATER QUALITY IMPROVEMENT

| | | Domestic/municipal | | Agriculture |
|---|---|---|---|---|
| Developmental and technical measures | QD1 | Sewage collection/reticulation system | QA2 | Pollution control (reduction in use of pesticides/fertilisers, control on pollutant disposal) |
| | QD2 | Construct sewage treatment plant | | |
| | QD3 | Wellfield protection zones<br>(a) Community source protection<br>(b) Government implemeted | | |
| | | **Industrial/commercial** | | |
| | QD4 | Pollution control by:<br>a) providing collection stations | | |
| | QD5 | Control landfill and tipping | | |
| | QD6 | Pollution control by:<br>a) disincentives for polluters<br>b) incentives for clean technology | | |

**Water demand management measures**
**Evaluation process**



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# Water Demand Management in areas of Groundwater Over-exploitation

## Workshop, New Delhi - 17th November 2005

## Strategy formulation

## INTRODUCTION


**David Stacey**

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# OBJECTIVES OF RESEARCH PROJECT

- **Identify water demand management strategies where aquifers are being over-exploited,** *ensuring the long-term livelihoods of the vulnerable and poor are safeguarded*

- Discuss and disseminate results and encourage uptake of recommended strategies

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# RESEARCH TEAMS

## Black & Veatch Ltd, UK

## Collaborating Organisations (India)

- Dr V.R.Visweswaran (VRV Consultants)
- Louis Menezes (Centre for Urban Poverty Alleviation)
- Tamil Nadu Government
- Andhra Pradesh and Pondicherry Governments

## Collaborating Organisations (Jordan)

- Jouzy & Partners (Consultants)
- Queen Zein Al Sharaf Institute (ZENID)
- University of Jordan

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# RESEARCH PROJECT - PROGRAMME

- **November 2003:** **Consultants appointed**
- **June 2004:** **Knowledge Review**
- **Feb - Aug 2004:** **Case Studies** (Tamil Nadu & Jordan)
- **November 2004:** **Workshops & Review Meetings (Chennai and Jordan)**
- **January 2005:** **Case Studies Report**
- **May – July 2005:** **Supporting studies** (AP & Pondicherry)
- **March - July 2005:** **Strategy formulation**
- **November 2005:** **Consultation & Workshop, New Delhi**
- **January 2006:** **Strategy finalisation**

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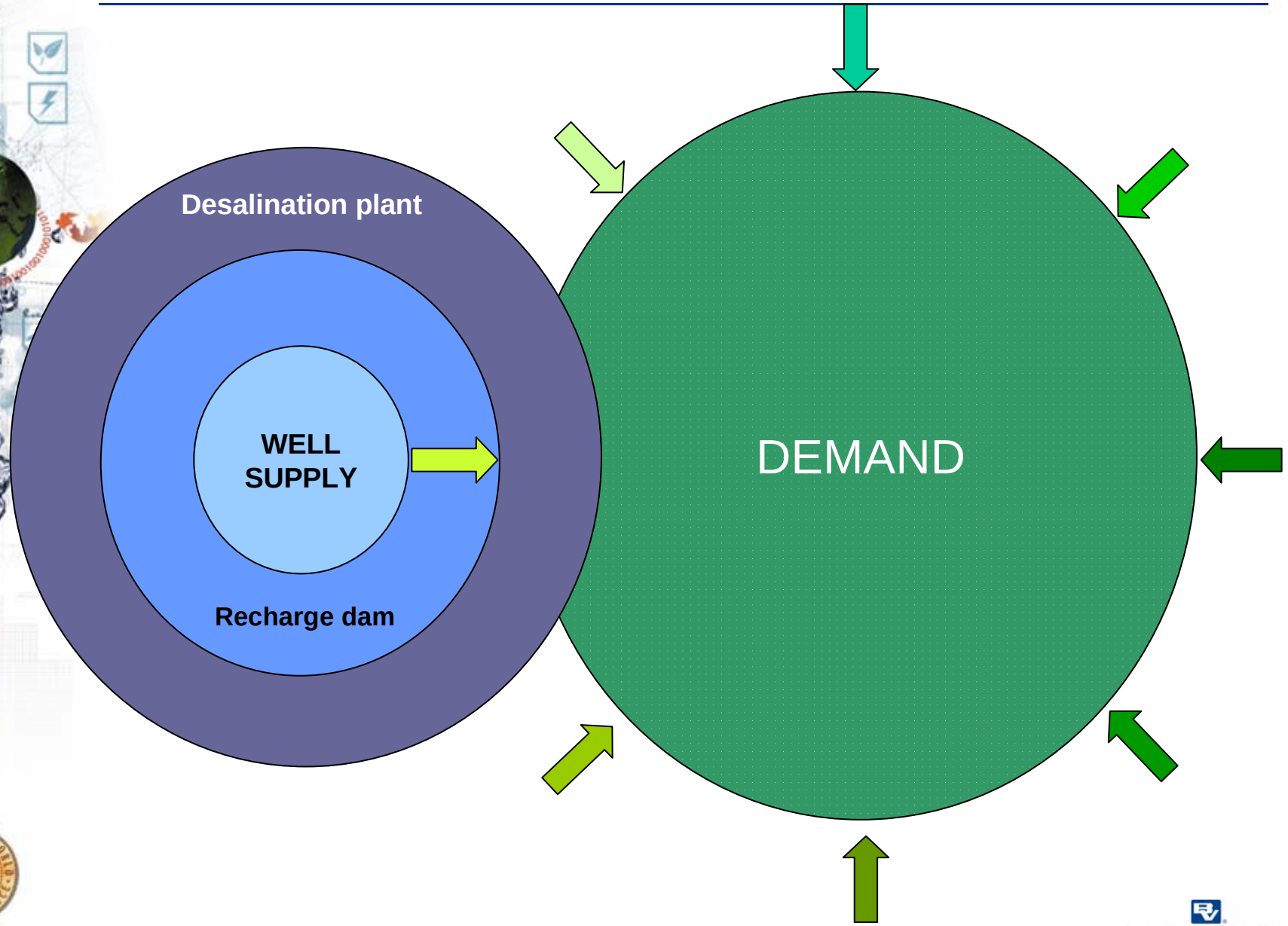
# DEMAND AND SUPPLY

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# WHAT IS WATER DEMAND MANAGEMENT?

- " … the use of price, quantitative restrictions and other devices to limit the demand for water" - FAO/WB/UNDP, 1995

" … the implementation of policies or measures which serve to control or influence the amount of water used" – UKWIR/ESA, 1996

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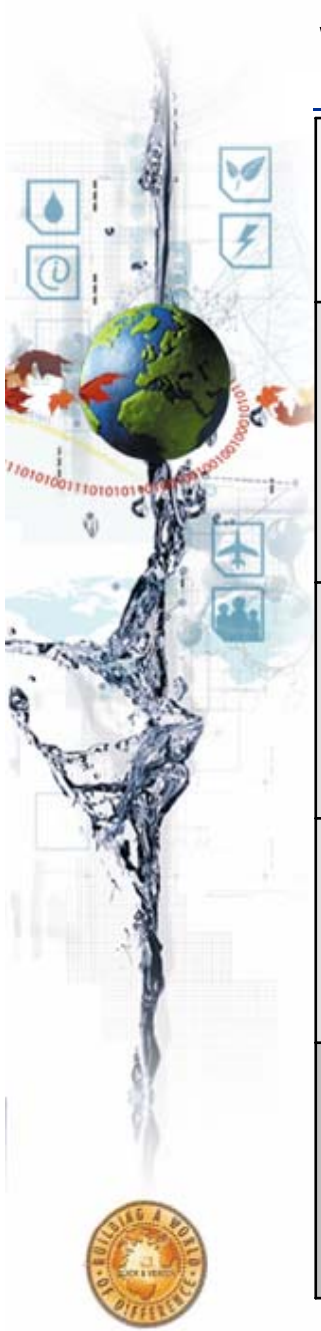

# WATER DEMAND MANAGEMENT MEASURES

| | | |
|---|---|---|
| | **Domestic/municipal** | **Agriculture** |
| **Developmental and technical measures** | **DT** Physical changes to the infrastructure which reduce losses | **AT** Physical changes to the irrigation infrastructure and improved water management which reduce water consumption. |
| **Allocative, financial and market based measures** | **DA** Water quotas and allocations, water tariffs | **AA** Water quotas and allocations, land use and cropping pattern changes, water tariffs and water markets |
| **Other socio-economic measures** | **DS** Community level management of water and measures relating to population | **AS** Water users' associations to improve water management and measures relating to population |
| **Supporting or enabling measures** | **SD** Measures required in support of the implementation of those above | **SA** Measures required in support of the implementation of those above |

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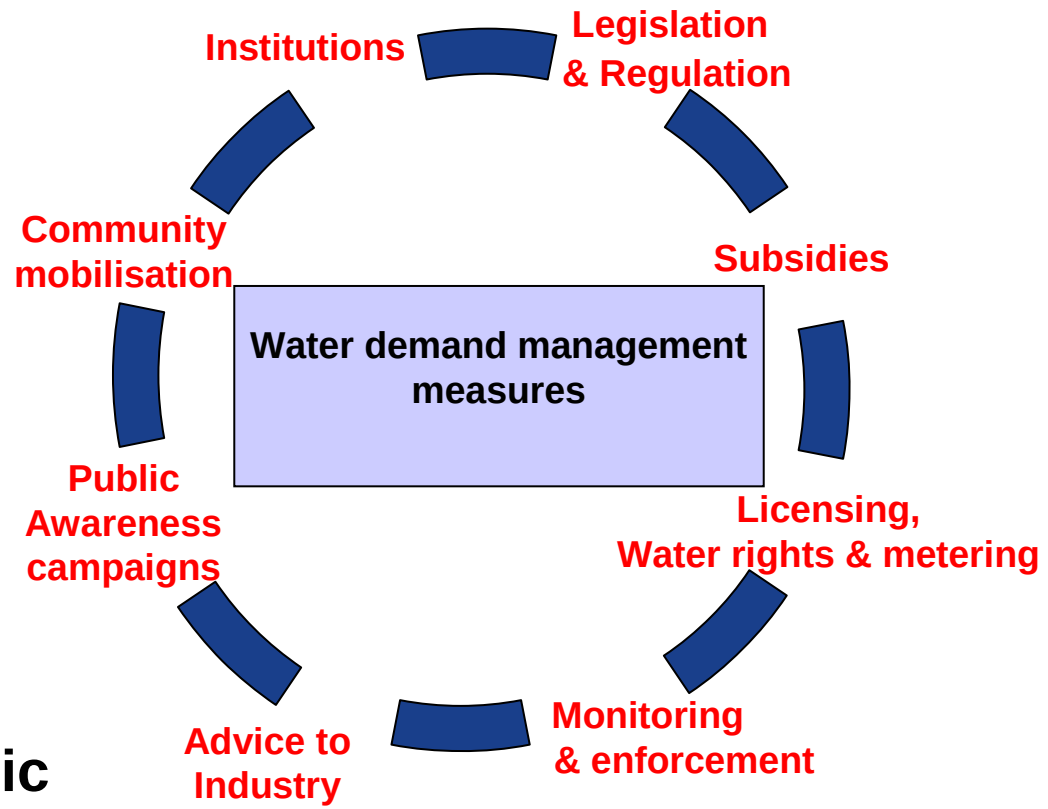
# WATER DEMAND MANAGEMENT - CONTEXT




**Strategic water security and supply options**

**Macro-economic & sectoral policy initiatives**

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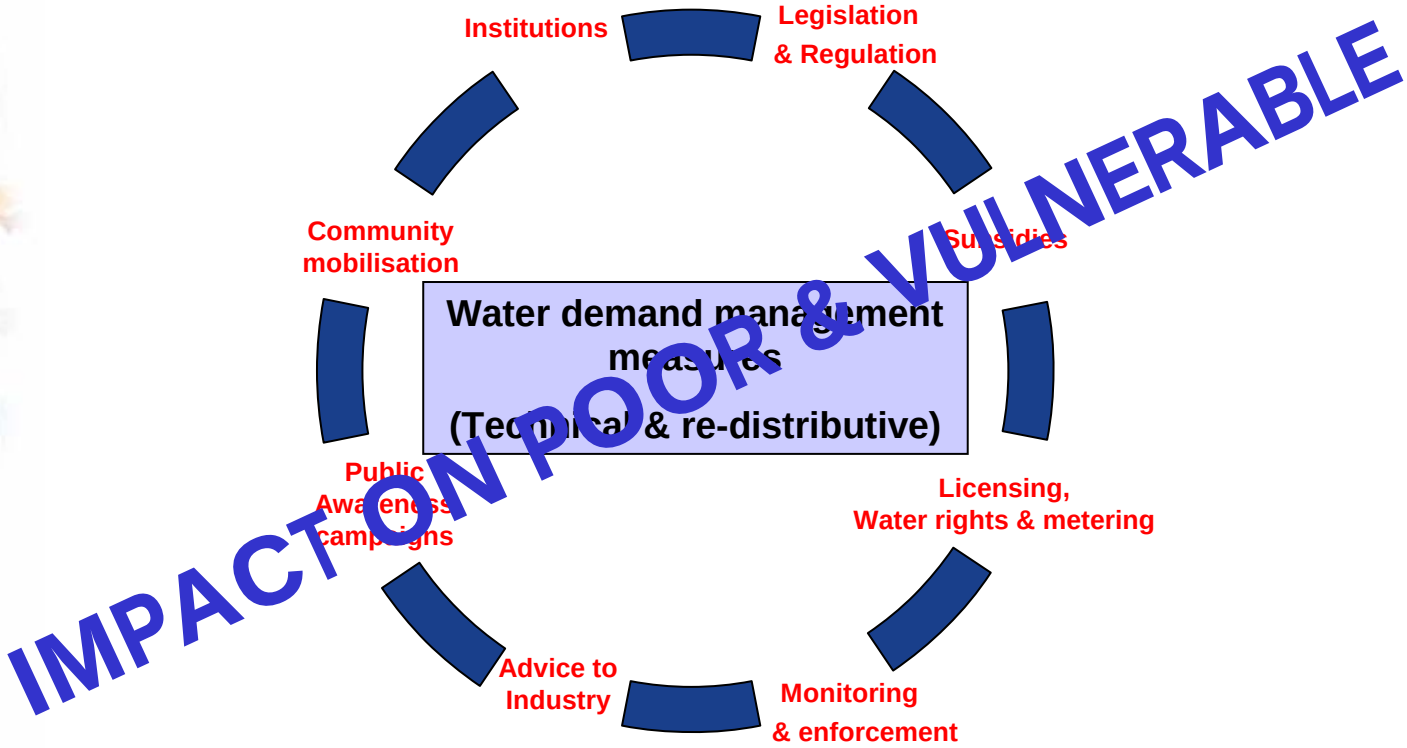
# WATER DEMAND MANAGEMENT - CONTEXT




**Strategic water security and supply options**

**Macro-economic & sectoral policy initiatives**

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# THIS MORNING'S PROGRAMME

- **Case studies in India and Jordan**
  - The Case Study areas
  - Poverty & Livelihoods
  - Economic studies
- **Strategy Formulation Document**
  - Approach to strategy formulation
  - Poverty, vulnerability and water
  - Water demand management
  - Value, impact and evaluation of water demand management measures
  - Water strategy formulation

**Tea/Coffee Break**

- **Comments & responses on Strategy Formulation document**

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# Water Demand Management in areas of Groundwater Over-exploitation

## Workshop, New Delhi - 17th November 2005

## Strategy formulation

## CASE STUDIES IN INDIA & JORDAN


**Dr Visweswaran, Dr Elizabeth Mann,**
**Tran Kim Thanh & John Petrie**


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# CASE STUDIES


India


Jordan

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# CASE STUDY AREA COMPARISONS

## Population

- CHENNAI
  - 7 Million, 4.5 Million in the Chennai metropolitan area
- AL JAFR, SHOUBAK
  - 12000 in AL JAFR, 13000 in SHOUBAK

## Rainfall

- CHENNAI
  - 1215mm/year annual precipitation
  - Recent years failure of monsoon
- AL JAFR, SHOUBAK
  - 250mm/year on high ground in Shoubak
  - Less than 40mm/year in Al Jafr

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# CASE STUDY AREA COMPARISONS

## Water Sources

- **CHENNAI**
  - Surface water runoff collection
  - Ground water abstraction
  - Major river transfer schemes
- **AL JAFR, SHOUBAK**
  - Ground water abstraction
  - Small number of spring sources in the higher ground
  - Major pipeline transfers proposed through the area

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# CASE STUDY AREA, CHENNAI TAMIL NADU

## Demand management - potential options

- Water quotas and allocations
  - Inter – sectoral
    - Domestic/Industrial and Agriculture
  - Intra – sectoral
    - Domestic/Industrial and Agriculture
- Agriculture
  - Change land use
  - Crop area prohibition
  - Change cropping patterns
  - Introduce water markets
  - Water tariffs

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# CASE STUDY AREA, CHENNAI TAMIL NADU

- **Demand management - potential options**
  - **Domestic/Industrial**
    - **Reduce consumer water losses**
    - **Recycling of industrial water**
    - **Water tariffs**
    - **Community level management**

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# CASE STUDY AREA, CHENNAI TAMIL NADU

- **Demand management – supporting measures**
  - **Domestic/Industrial**
    - **Legislation and regulation**
    - **Metered water supply**
    - **Community mobilisation**
  - **Agriculture**
    - **Legislation and regulation**
    - **Metered water supply**

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# CASE STUDY AREA, AL JAFR - SHOUBAK

## Demand management - potential options

- Water Resources Management Master Plan (2001)
  - Domestic and Industrial demand given priority
  - Agricultural demand from groundwater exceeds renewable resources
  - Components
    - Quantitative
    - Water Resources Development
    - Qualitative management
    - Water allocation plan
    - Risk management

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# POVERTY, VULNERABILITY & WATER

- Who is poor & vulnerable?
- What are their livelihoods?
- How they are affected by current WDM strategies
- What are their current water priorities?

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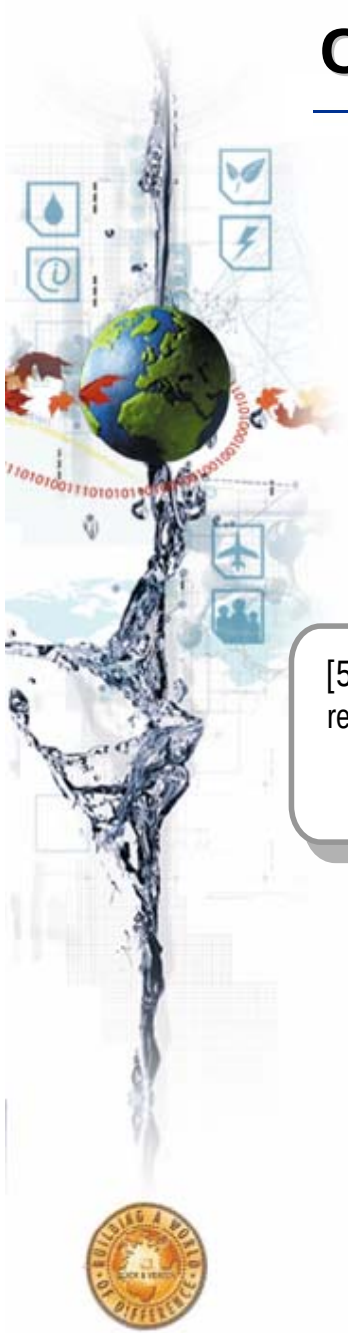
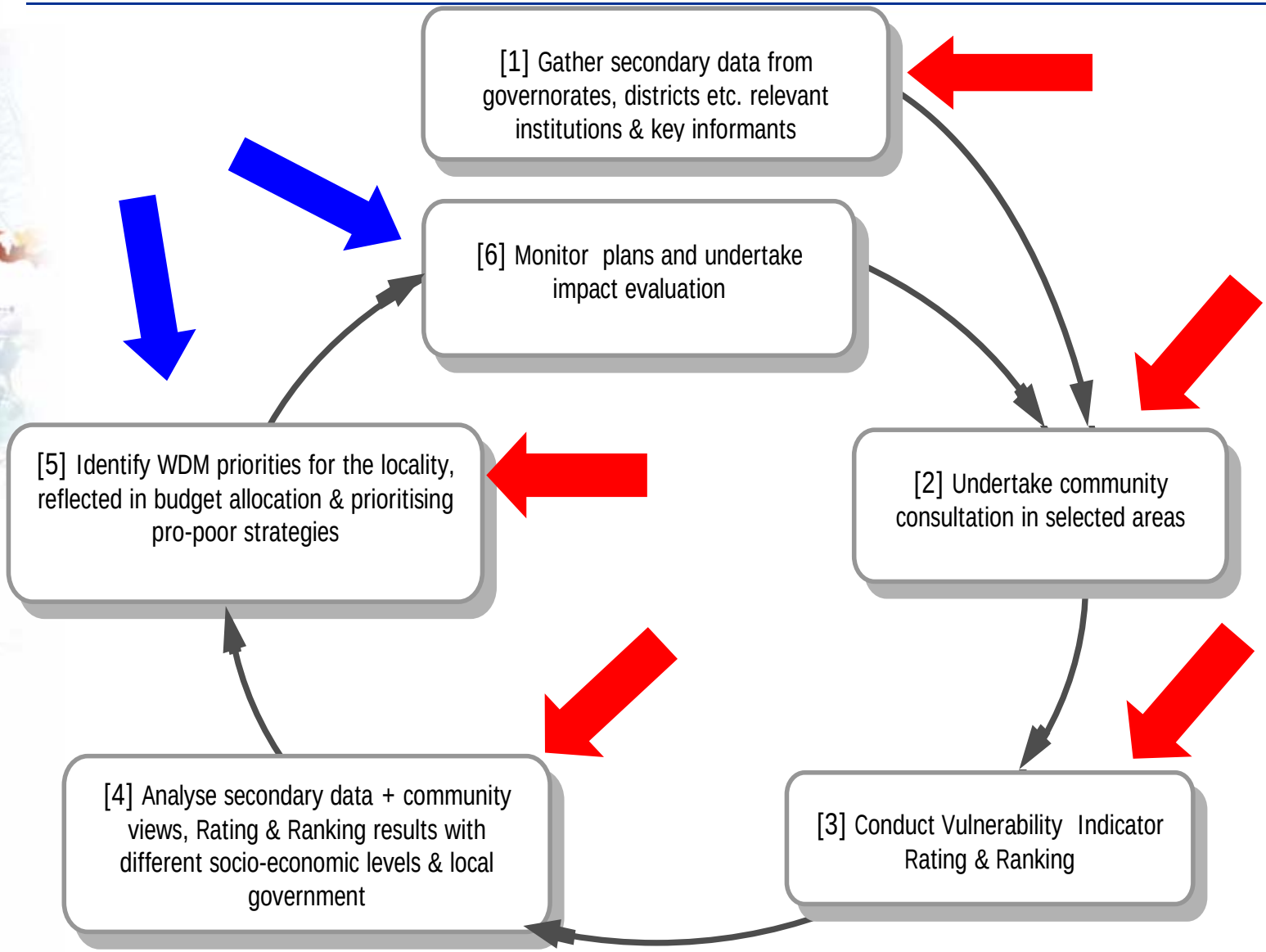
# CASE STUDIES:WATER & POVERTY



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# POOR & VULNERABLE AS STAKEHOLDERS

## Poor & vulnerable found among

- Urban and rural domestic consumers (J/I), *the elderly, women-headed HHs, those with no adults, daily wage earners, non-formalised slum dwellers*
- Agricultural users of irrigation water (J/I), *marginal farmers (c.<4acres), landless labour*
- Occupational consumers (I) *washermen, dyers, tanners*
- Those whose livelihoods are directly affected by the decisions of others, rather than their own decisions (J/I)
- Those who cannot afford to pay to overcome the shortcomings of the supply system (J/I)
- Location-specific (J/I)

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# KEY LIVELIHOOD IMPACTS

## AGRICULTURAL:

- low prices for poorer quality crops
- water & labour shortage leading to under-utilisation of land
- distress sales of assets
- defaults on bank loans
- quitting the land
- selling land

## URBAN:

- wages loss waiting for water delivery
- work opportunity loss
- work loss via water-related illness
- reduced labour capacity/poor nutrition
- higher expenditure for medicines
- higher cost to purchase meals
- higher expenditure purchasing water

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# MAKING THE LINK – some examples

## STATUTORY MEASURES:

- demand forecasting
- rainwater harvesting
- targeted delivery to poor neighbourhoods
- approval and/or implementation of legislation
- formulation of water policy
- pricing for water services & electricity
- de-salination

## VOLUNTARY MEASURES:

- demographic controls
- water-saving devices
- domestic/industrial wastewater recycling
- excessive labour requirements
- power-broker distribution
- water-saving agricultural techniques
- indirect source protection (garbage)
- domestic supply community management
- community support for poor households

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# ECONOMIC ASPECTS

## Methodology

- Identifying costs of measure
- Identifying amount of water saved/produced
- Comparison costs and amount of water saved using discounting techniques
- Estimating unit cost of water saved/produced

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# ECONOMIC ASPECTS

## Data and information

- Focus Group Discussions
- Results from research/study/master-plan
- Data from projects/proposals
- Other secondary data and sources

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# ECONOMIC ASPECTS

## Cost of Water Saved (US$/m$^3$)

| WDM Measures | India | Jordan | Oman |
|---|---|---|---|
| Leakage control | - | 0.31-0.35 | 0.98 |
| Water saving devices | - | - | 0.20 |
| Recycling of water | 0.8 | 0.52 | 0.27-0.44 |
| Use of grey water | - | - | 0.18 |
| Water tariff | - | - | 0.26 |
| Reduce losses from surface irrigation | 0.012 | - | 0.008-0.013 |
| Introduction of sprinkler | 0.08-0.24 | - | 0.01-0.12 |
| Introduction of drip | 0.22-0.29 | - | 0.01-0.12 |
| Change land-use | 0.002 | 0.03-0.94 | 0.002-0.08 |
| Change cropping patterns | - | - | 0.02-0.09 |

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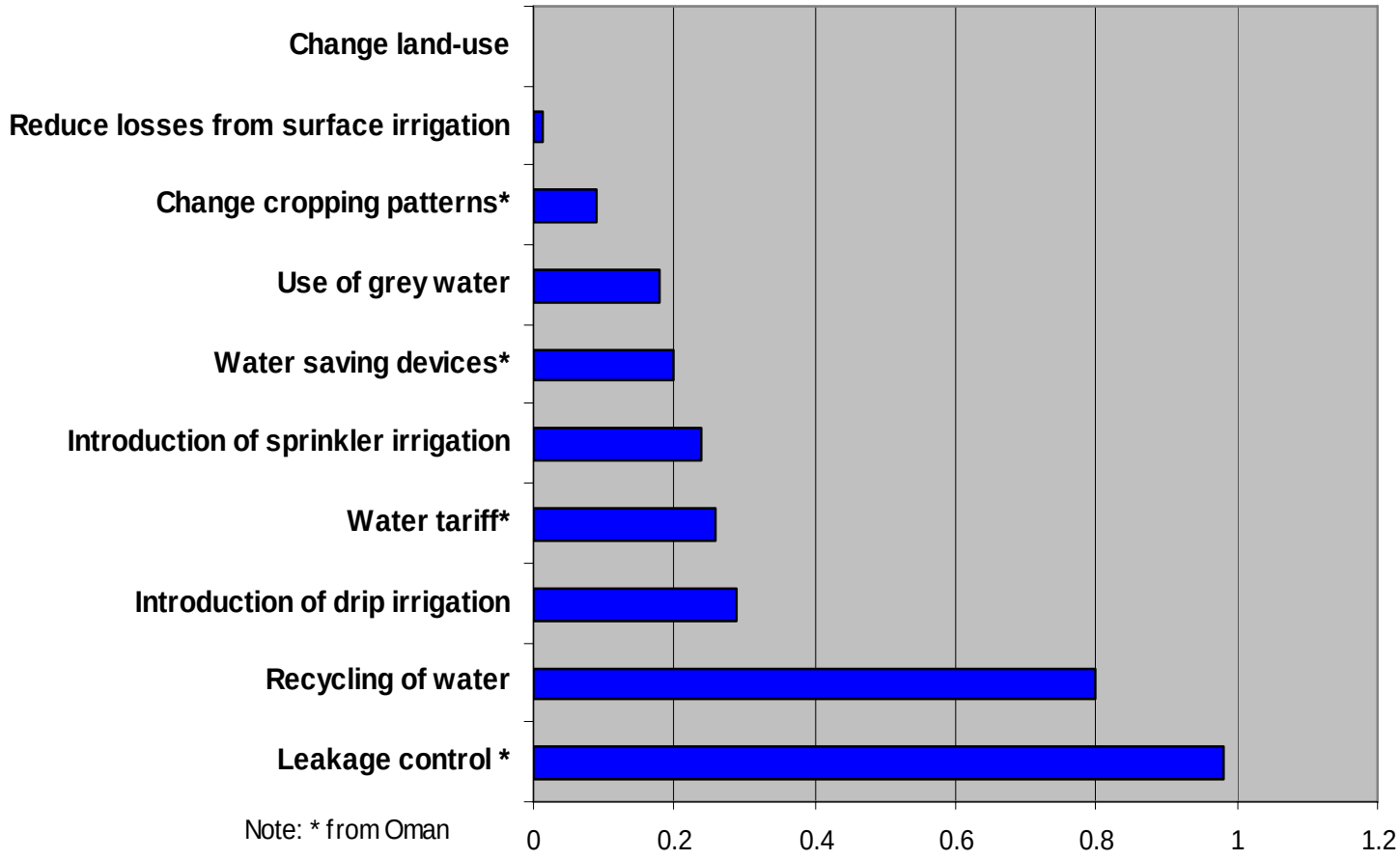
# ECONOMIC ASPECTS

## Ranking unit cost of WDM Options (US$/m3)




Note: * from Oman

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# ECONOMIC ASPECTS

## Cost of Water Produced (US$/$m^3$)

| Supply Measures | India | Jordan |
|---|---|---|
| Additional ground water (Well) | 0.14 | 0.09-0.12 |
| Desalination | 1.01 | 1.00-1.97 |
| New treatment facilities | 0.06 | - |
| Extend water distribution | 0.16 | 0.92 |
| Retention dams/reservoirs | 0.24 | 3.66 |
| Aquifer recharge (dam) | - | 0.12 |
| Trans basin water transfer | - | 0.67-1.63 |
| Treat/reuse waste water | 0.06 | 0.51 |

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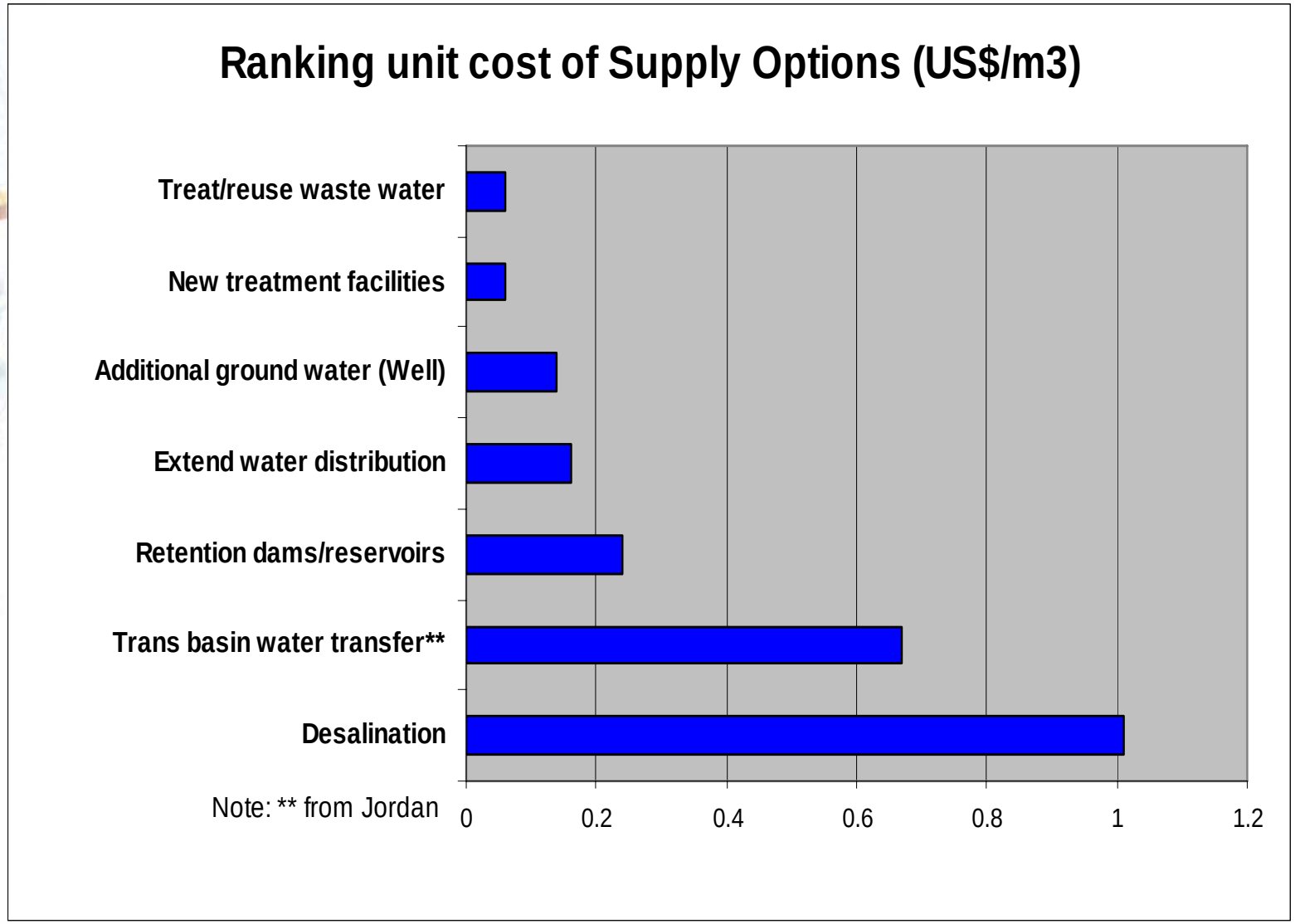
# ECONOMIC ASPECTS

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# Water Demand Management in areas of Groundwater Over-exploitation

## Workshop, New Delhi - 17th November 2005

## Strategy formulation

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Water Demand Management
in areas of Groundwater Over-exploitation

Workshop, New Delhi - 17th November 2005

# Strategy formulation

# STRATEGY FORMULATION

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# STRATEGY FORMULATION DOCUMENT

- Approach to strategy formulation
- Poverty, vulnerability and water
- Water demand management
- Value, impact and evaluation of water demand management measures
- Water strategy formulation

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# STRATEGY FORMULATION

- Approach to strategy formulation

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# INTERNATIONAL PERSPECTIVE

- Earth Summit: Rio de Janeiro, 1992;
- FAO/World Bank/UNDP initiatives, 1990s
- World Water Forums:
  Marrakech 1997, The Hague, 2000; Kyoto 2003
- UN Millennium Development Goals
- World Summit on Sustainable Development, 2002

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# POLICY AND STRATEGY FORMULATION

- Water sector strategies

- World Bank/UNDP/FAO Land & Water Bulletin No 3

  "Water sector policy review and strategy formulation, a general framework" (1995)

- Development of strategy to include:
  - Needs of the poor and vulnerable
  - Sustainability issues
  - Water demand management

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# STRATEGY FORMULATION

- Poverty, vulnerability and water

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# STRATEGY FORMULATION

- Poverty, vulnerability and water

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# APPROACH TO POVERTY/VULNERABILITY ANALYSIS

**INITIAL IDENTIFICATION**

Define community & stakeholders

Define consultation processes in water strategy development

**COMMUNITY STUDIES & CONSULTATION**

Site selection criteria
Units of assessment

Poor and vulnerable identified

Role of community defined
Issues & preferences rated and ranked

**EVALUATION OF POTENTIAL WATER DEMAND MANAGEMENT MEASURES & THEIR IMPACTS ON THE POOR & VULNERABLE**

(WDM measures assessed against community ratings)

**FEEDBACK TO COMMUNITY & STAKEHOLDERS ON SELECTED WDM MEASURES**

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# DEVELOPING A STRATEGY

## VULNERABILITY ASSESSMENT - INDICATORS

1. Access to water
2. Quality of water
3. Affecting livelihood
4. Affordability
5. Sense of empowerment
6. Health

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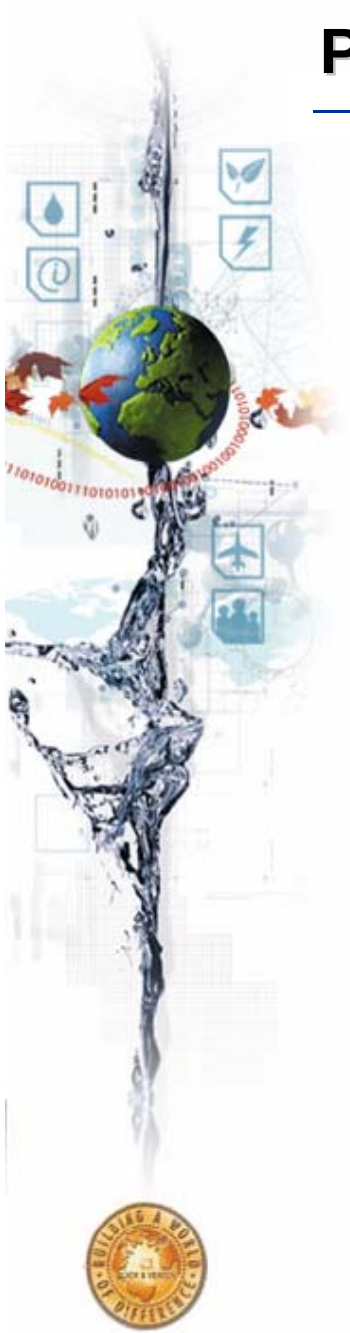

# POVERTY, VULNERABILITY & WATER

- **How to link stakeholder priorities to proposed WDM strategies**

## STRATEGY FORMULATION - MAKING THE LINK BETWEEN STAKEHOLDER PRIORITIES AND WDM STRATEGIES

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# POVERTY, VULNERABILITY & WATER

| INDICATOR PRIORITY - CHENNAI | COMMUNITY REASONS |
|---|---|
| | i. High rise flat dwellers rarely have piped water; the disabled and elderly who cannot afford to pay for labour to carry water up flights of stairs are very vulnerable |
| | ii. All water sources are heavily contaminated by sewage leakage, industrial waste disposal and random garbage dumping. Water users must find diversified water sources for different uses (e.g. a source used for bathing is not potable water) |
| ACCESS | iii. Inner city lanes are not accessible to water tankers |
| | iv. Non-formalised slum dwellers or squatters have no official water supply |
| | v. Tanker supply distribution is often controlled by local power brokers |
| | vi. Daily wage workers may not have someone at home to wait for tanker supplies or timed handpump releases; they must spend evenings and nights travelling to find other pumps |
| | vii. Rapid urbanisation has constructed over former groundwater recharge areas, reducing levels and contaminating existing sources, thereby reducing traditional sources of supply |

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# STRATEGY FORMULATION

- Water demand management

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# SOME DEVELOPMENT ISSUES

- The increasing demand for water
- The scarcity and cost of providing good quality water
- Water used by agricultural sector
- Competition for water

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# WATER SECTOR PLANNING

- Improve the supply of good quality water
- Augment and conserve water resources
- Manage the demand for water

BLACK & VEATCH

# WATER DEMAND MANAGEMENT MEASURES

- Developmental and technical measures to improve water use efficiency and reduce losses
- Allocation, financial and market-based measures
- Other socio-economic measures

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# DEVELOPMENTAL & TECHNICAL MEASURES

- **Measures to improve water use efficiency**

  (e.g. more efficient irrigation, reduction of water losses)

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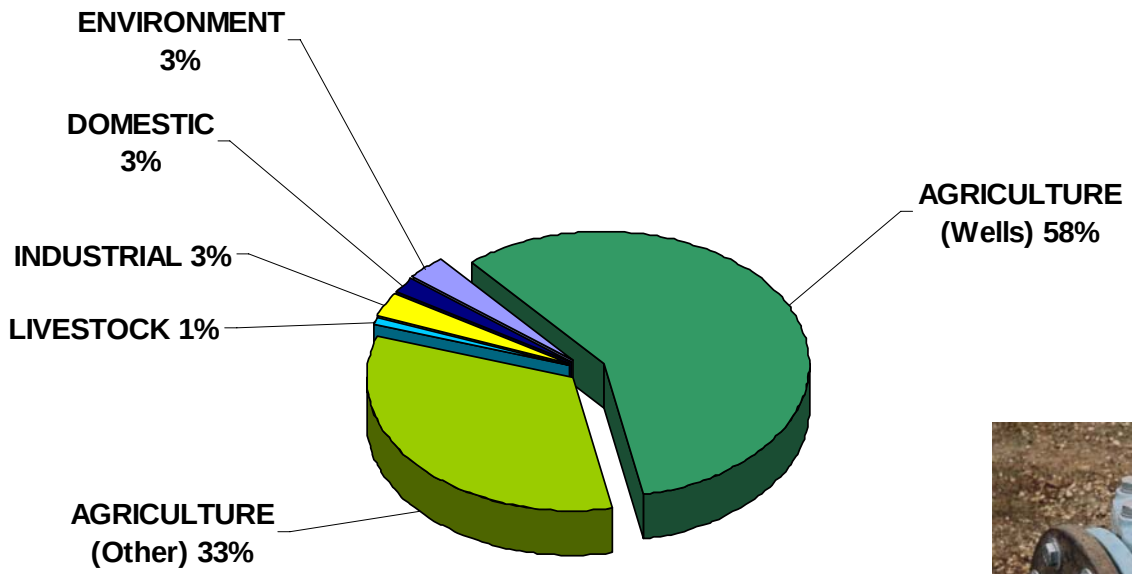
# ALLOCATION, FINANCIAL & MARKET BASED MEASURES

## (i) Allocations and quotas

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# ALLOCATION, FINANCIAL & MARKET BASED MEASURES

## (ii) Financial and market-based measures

### *Domestic/Industrial*

Land development control

Water tariffs

(a) progressive

(b) differential

### *Agriculture*

Land use changes

(a) purchase

(b) re-zoning/classification

(c) transfer of water rights

Crop restriction & changes

Water markets

Water tariffs

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# SOCIO-ECONOMIC MEASURES

- **Socio-economic measures**

  (e.g. community level management, water-users groups, population control/migration/resettlement

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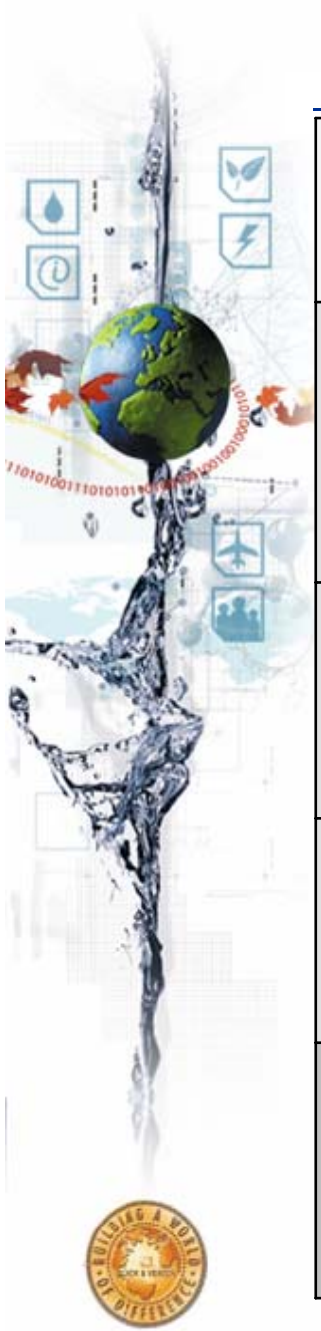
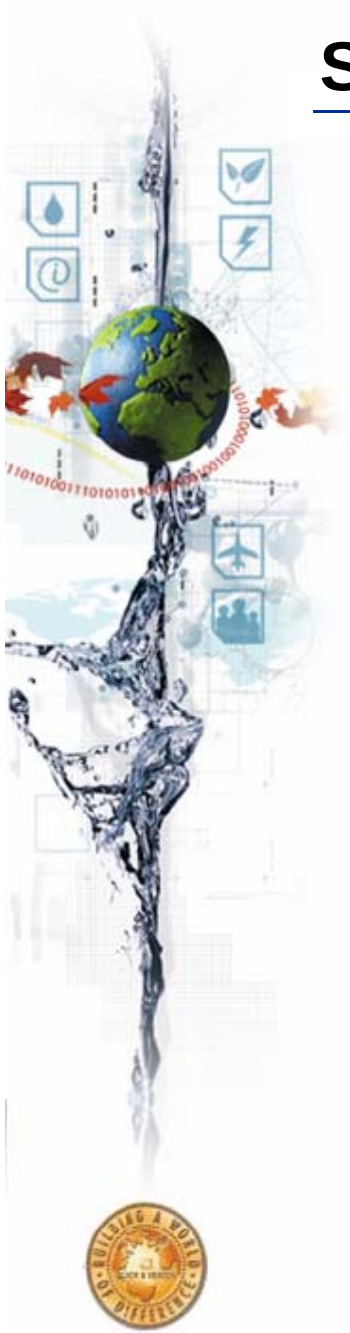
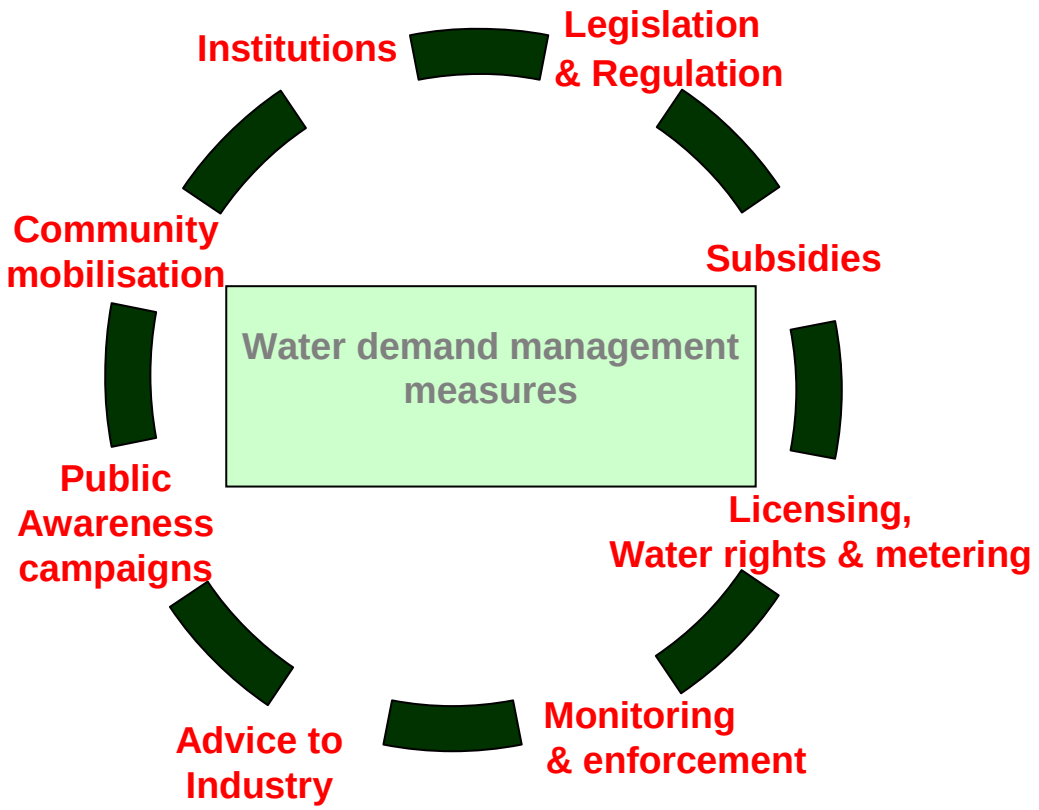


# SELECTION OF MEASURES

| | Domestic/municipal | Agriculture |
|---|---|---|
| **Developmental and technical measures** | **DT** Physical changes to the infrastructure which reduce losses | **AT** Physical changes to the irrigation infrastructure and improved water management which reduce water consumption. |
| **Allocative, financial and market based measures** | **DA** Water quotas and allocations, water tariffs | **AA** Water quotas and allocations, land use and cropping pattern changes, water tariffs and water markets |
| **Other socio-economic measures** | **DS** Community level management of water and measures relating to population | **AS** Water users' associations to improve water management and measures relating to population |
| **Supporting or enabling measures** | **SD** Measures required in support of the implementation of those above | **SA** Measures required in support of the implementation of those above |

# SUPPORTING MEASURES



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# STRATEGY FORMULATION

- Value, impact and evaluation of water demand management measures

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# IMPACT OF WATER DEMAND MANAGEMENT

- WDM MEASURE
  - WHAT DOES IT DO? — POTENTIAL WATER SAVING
  - COST OF WDM MEASURE — COST/$M^3$ WATER SAVED
  - HOW DOES IT AFFECT THE COMMUNITY?
    - FARMER/FARM LABOUR
    - URBAN DOMESTIC USER
    - RURAL DOMESTIC
    - INDUSTRIAL LABOUR

DFID

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# IMPACT OF WATER DEMAND MANAGEMENT - AN EXAMPLE

**Water quotas (agricultural wells)**

**Controls, abstraction through licence, metering & monitoring**

**Reduction in water consumed of say 5%**

**COST US$0.1/M$^3$ WATER SAVED**

**HOW DOES IT AFFECT THE COMMUNITY?**

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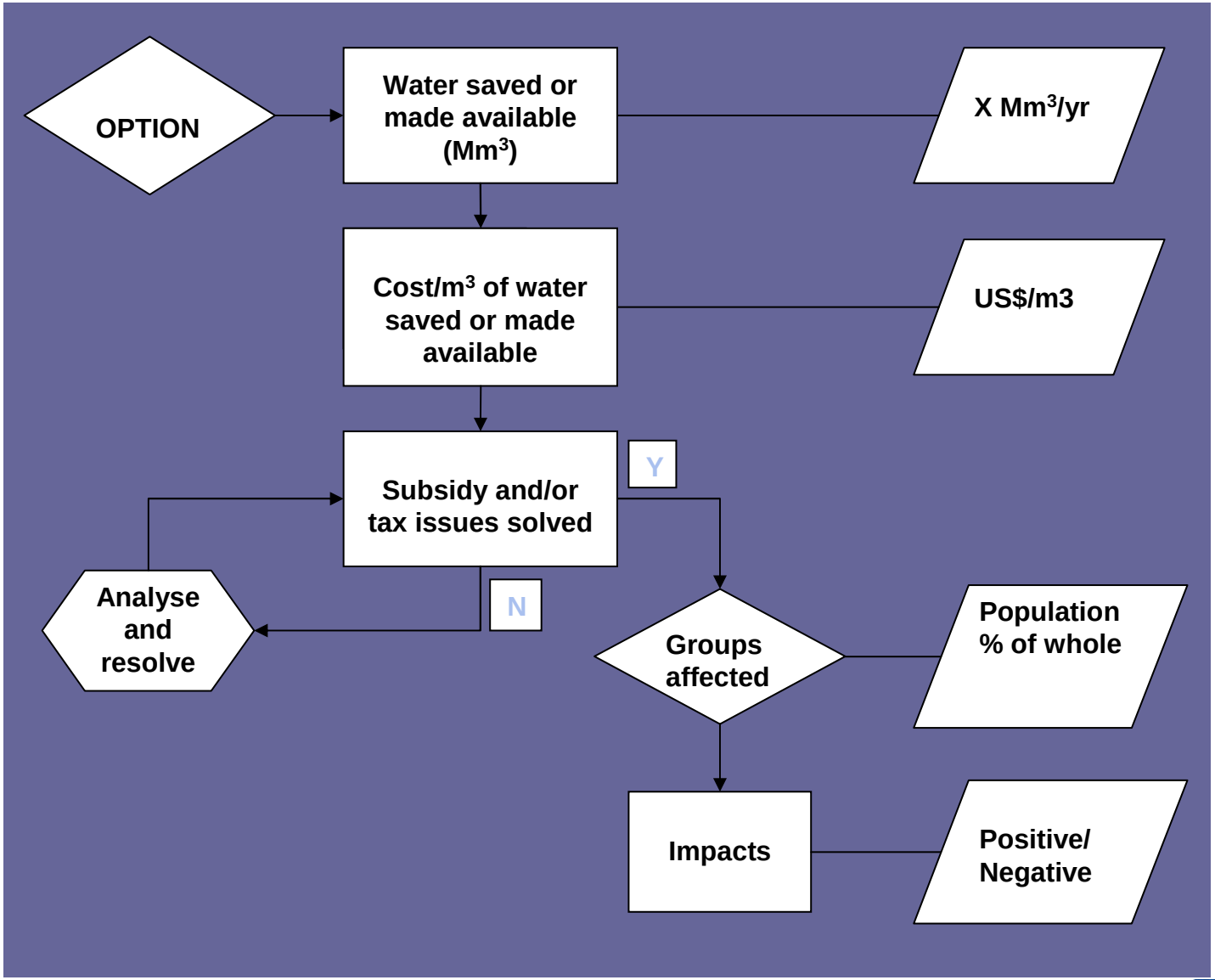
# ASSESSMENT OF MEASURE

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# PRE-CONDITIONS TO IMPLEMENTATION

Some examples

- The will of implementing agencies
- The appropriate legislation and regulations being in place
- Availability of funding
- Availability of appropriate technology

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# LIKELIHOOD OF SUCCESS

- Viability
  - the stakeholders and consumers likely future compliance with legislation and regulations
  - maintenance of new infrastructure and equipment e.g. water meters
- Ease of implementation
  - the likely resistance of consumers to implementation of the measure
  - the institutional changes required and introduction of new financial systems
  - the effectiveness of participatory approaches.

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# STRATEGY FORMULATION

- Water strategy formulation

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# STEP- BY STEP APPROACH

**WATER RESOURCES POLICY REVIEW**

Legal & Institutional framework

Community and stakeholders defined

Water balance

**Critical issues defined**

**Policy guidelines**

**Report**

**WATER STRATEGY DEVELOPMENT**

[ Demands defined ] [ Supply/augmentation options ]

Evaluation of potential water demand management and supporting measures

Community studies

**Potential future scenarios &**

**Draft Strategy**

**STRATEGY FINALISATION**

**Final Report and Action Plan**

DATA

- Maps
- Water resources
- Demography
- Vulnerability
- Infrastructure
- Demands & consumption
- Water losses
- Financial & Economic

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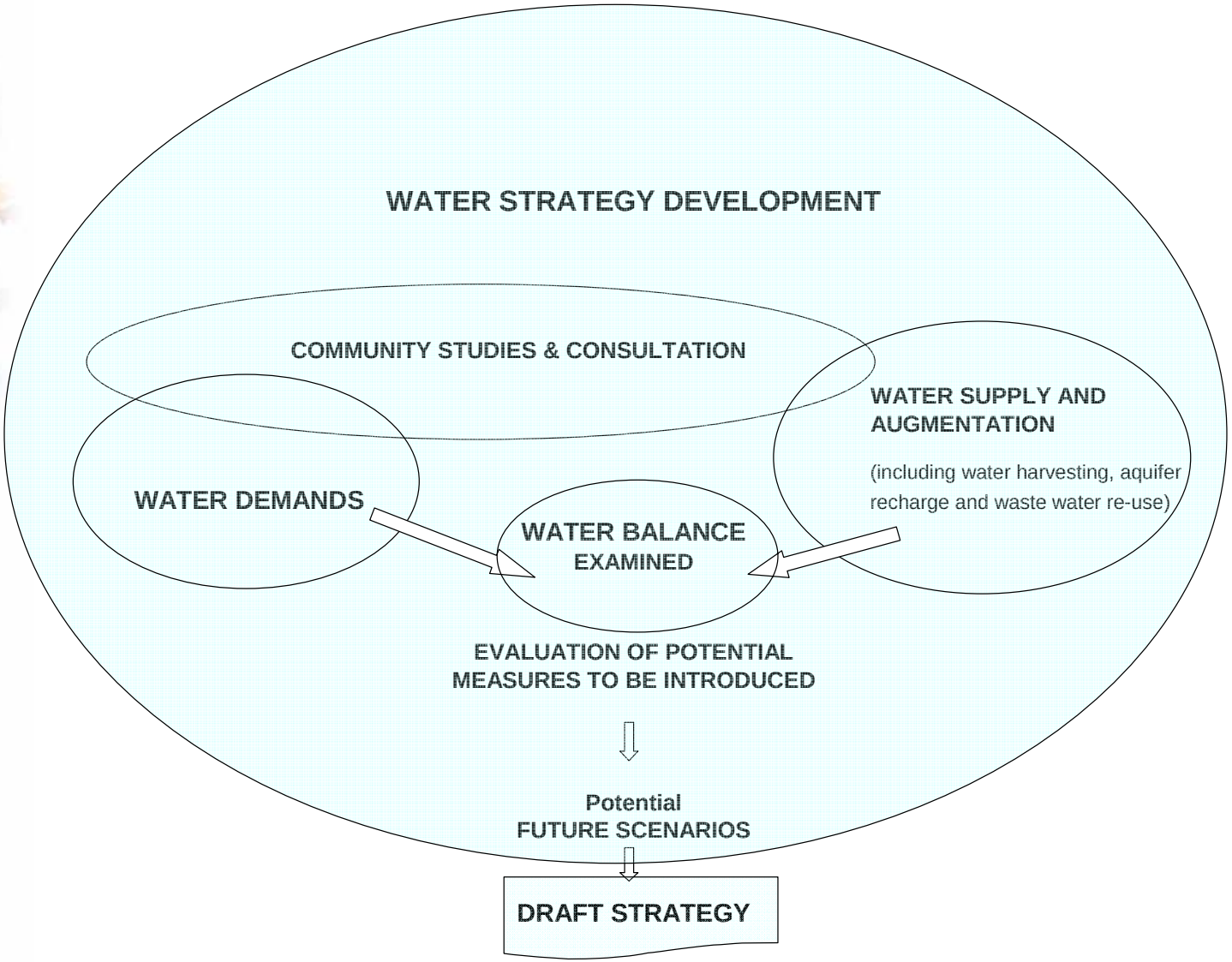
# WATER STRATEGY DEVELOPMENT

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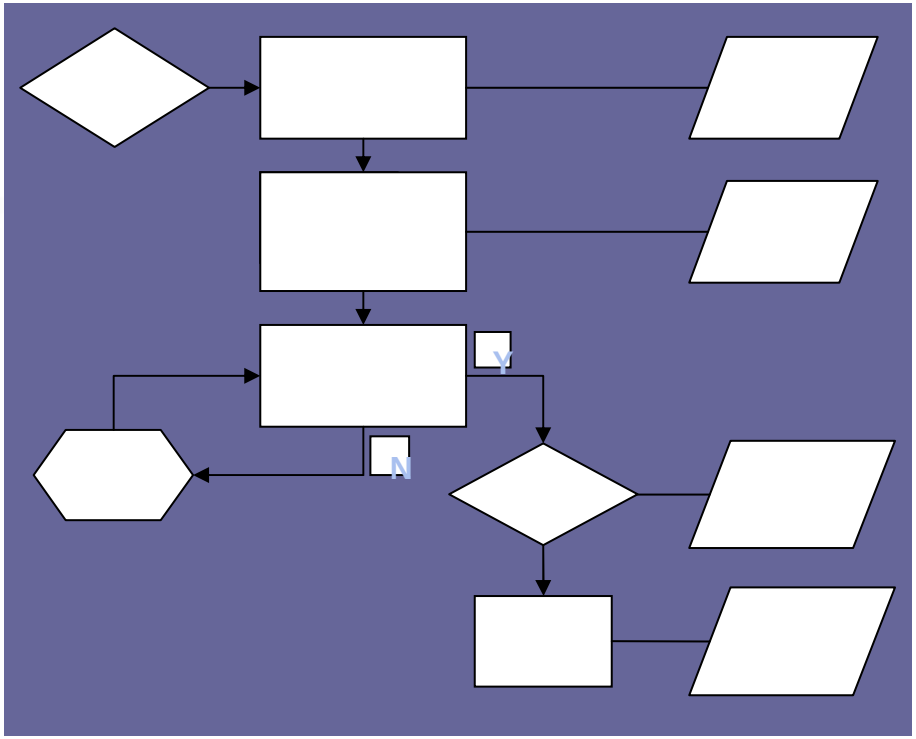
# COMPARISON OF MEASURES




- Use of data sheets

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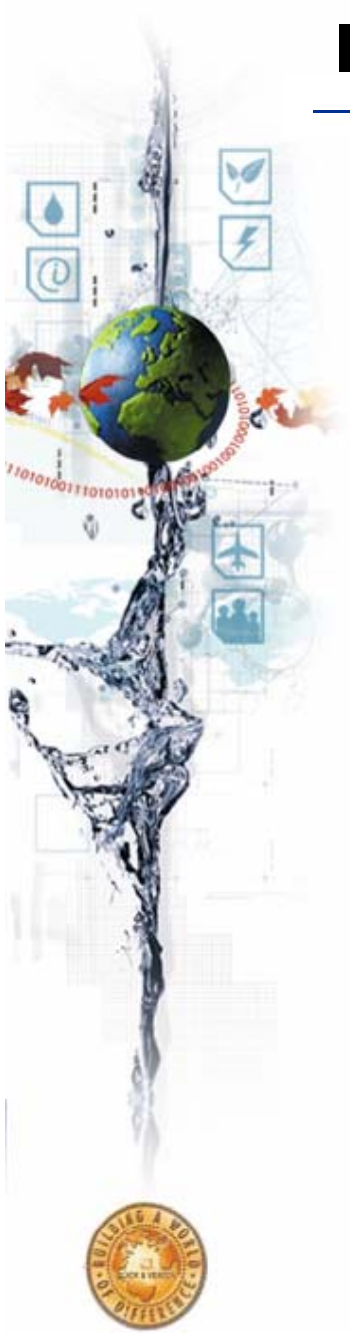
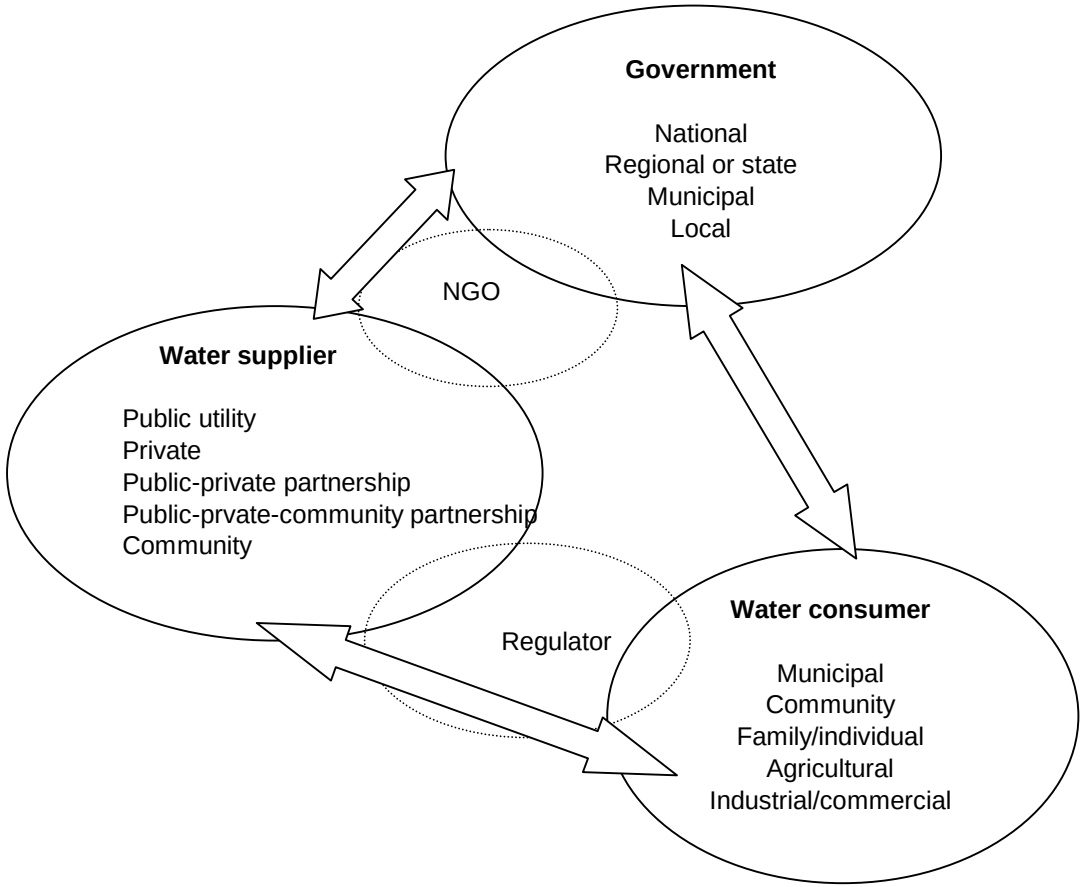
# IMPLEMENTATION: STAKEHOLDERS



**IMPLEMENTING AGENCIES & STAKEHOLDERS**

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Department for
International Development

# Water Demand Management in areas of Groundwater Over-exploitation

## Workshop, New Delhi - 17th November 2005

## Strategy formulation

BLACK & VEATCH


MAHARASHTRA
KARNATAKA
GOA
ANDHRA PRADESH
TAMIL NADU
KERALA
INDIA
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
MADANAPALLEE
CHENNAI
BANGALORE
HYDERABAD
MYSORE
PONDICHERRY
KAVARATTI I.
LAKSHADWEEP SEA
Hi! tours
SAY HELLO TO THE WORLD
SOUTH INDIA MAP
LEGEND
CHENNAI State Headquarters
MYSORE District Headquarter
Kolar Gold Fields Other Towns
State Boundary
District Boundary
Railway Line
National Highway With No.
Major Roads
Other Roads
40 Distance in Kilometres

DFID–BV - VRV

# WATER DEMAND IN OVER-EXPLOITED (GROUND WATER) AREAS AND SOCIO-ECONOMIC IMPACTS

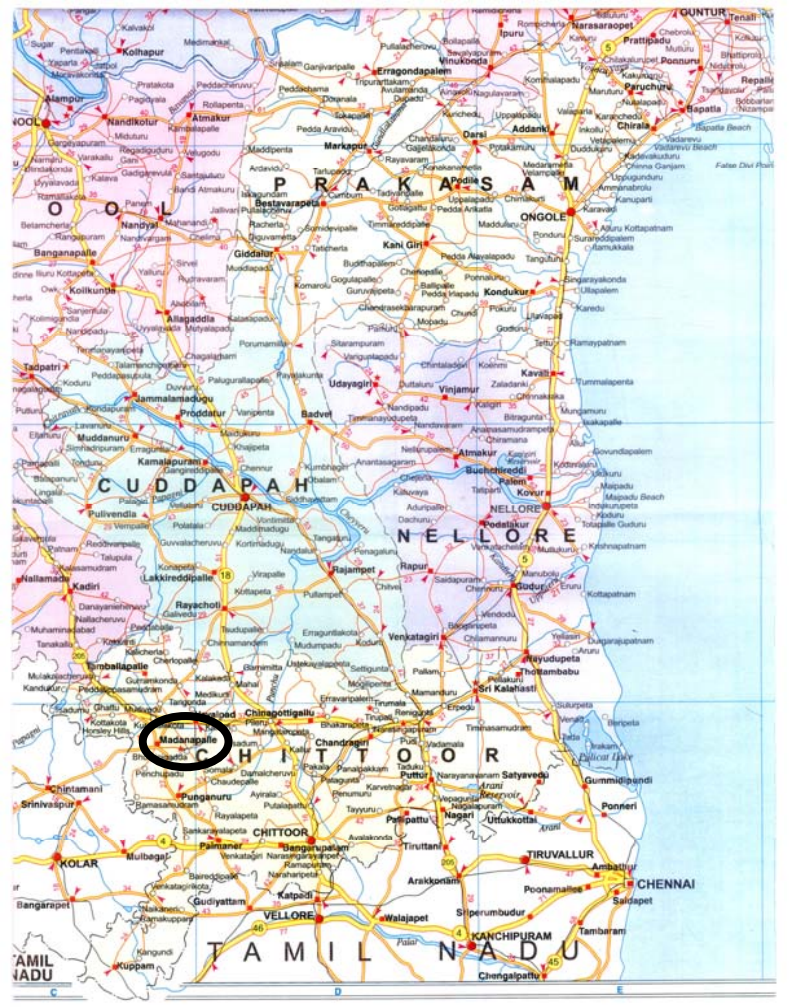
## MADANAPALLE (AP)

## AND ITS ENVIRONS

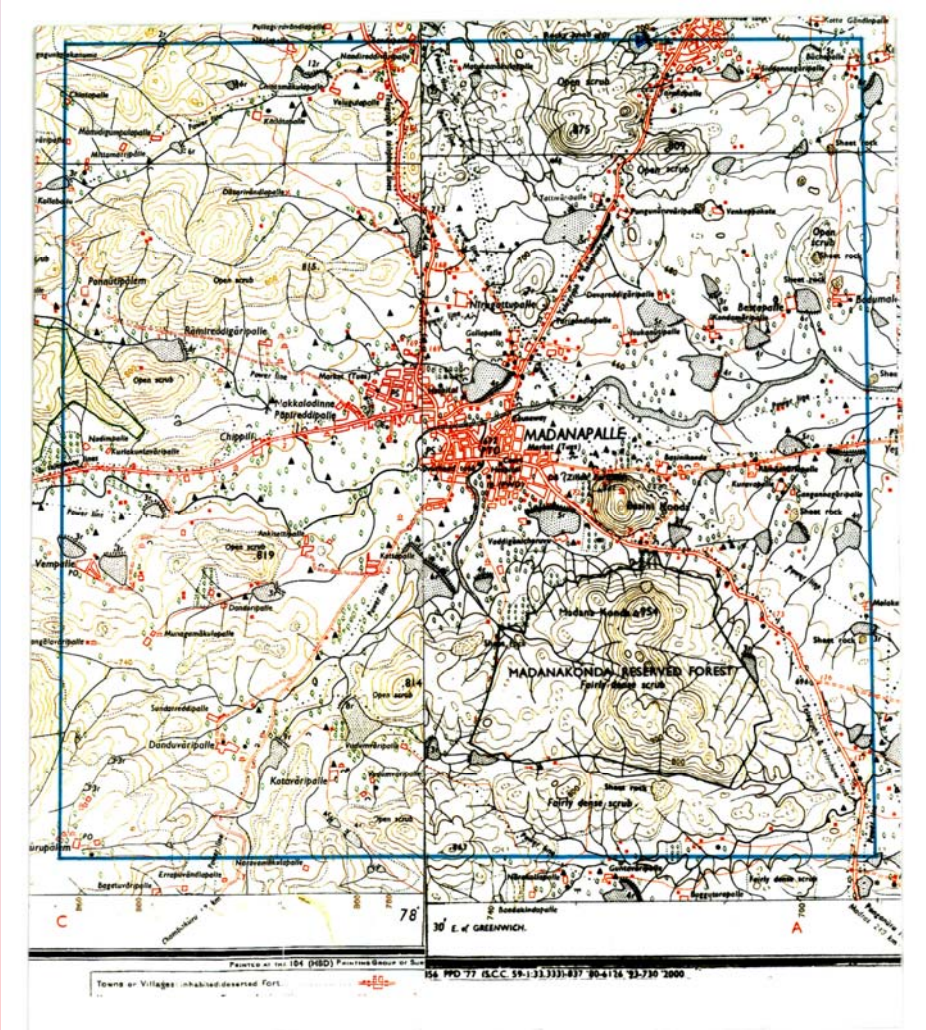
**Dr. V.R. VISWESWARAN**
**Dr. B. KANDASWAMY**

# WR-2

## Location of Madanapalle




## Study Area




DFID–BV - VRV

# LOCATION, TERRAIN AND CLIMATE

| | | |
|---|---|---|
| Study area | - | 100 sq.km. |
| Longitude | - | 78°27’20” to 78°33’00 |
| Latitude | - | 13°30’20” to 13°35’40” |
| Madanapallee Municipality | - | 14 sq.km. |
| Annual Average Rainfall | - | 740 mm |
| Temperature | - | 14°C to 36°C |
| Elevation | - | 660 to 760 m |

## GEOLOGY

- The study area consists of Archaen terrain
- Alluvium is limited to Bahuda river course – thickness ranges from 10 to 15 m below ground level
- Lineaments trending to NW – SW and NE – SW
- Weathered rock thickness extends upto 25 m below ground level

# WATER RESOURCES, SUPPLY AND DISTRIBUTION

- Surface water sources only for agriculture use
- Groundwater is the main source for domestic use
- Only Madanapallee town has organized water supply from 5 infiltration galleries and 10 borewells
- Surrounding villages get groundwater from borewells fitted with hand/power pumps
- 11.5 MLD during winter and 4.13 MLD during summer.
- Present supply is 5.13 MLD – from hired agriculture wells by tankers.

WR-6

## PUMPING STATION FOR MUNICIPAL WATER DISTRIBUTION SYSTEM

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# WR-7

**WATER IS BEING FILLED IN WATER TANKER FROM AGRICULTURE WELL**

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# WR-8


**WATER IS BEING SUPPLIED IN THE STREET**

WR-9

**BOREWELL FITTED WITH POWER PUMP FOR DRINKING WATER SUPPLY**

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# WATER LEVEL AND QUALITY

- 3 to 8m in shallow aquifer during normal monsoon years
- 25 to 35 m in deeper aquifer during normal monsoon years.
- Present average water level is 200 m.
- Main recharge is from Bahuda river.
- Water quality potable during winter season.
- During summer hardness, fluoride and nitrate contents are high.

# RAIN FALL

| Year | Normal Rain fall in mm. | Actual Rainfall in mm. |
|---|---|---|
| 2000 | 740 | 751 |
| 2001 | 740 | 669 |
| 2002 | 740 | 651 |
| 2003 | 740 | 173 |
| 2004 | 740 | 329 |

# SEWERAGE DISPOSAL SYSTEM

There is no organized sewerage disposal system in the study area. The domestic sewage is let into the streets and it is flowing in small ditches.

# AGRICULTURE USE

- Surface water from nearby tanks and groundwater from borewells being used.
- The main crops - paddy, groundnut and tomato.
- Sericulture farming is prominent.
- The groundwater meant for agriculture is being used for domestic purpose during drought years.
- There is good cooperation in sharing of water for agricultural and domestic needs.

# INDUSTRIAL USE

- No Large scale industries.
- Small scale industries - flour mills, cotton mills, plastic mills, groundnut oil mills and sericulture.
- Small scale cotton spinning mills, silk power-looms and reeling centers are present in the residential area - provides employment.
- Do not require a large quantity of water for these industries.

## WATER MANAGEMENT MEASURES IMPLEMENTED

- 10 check dams across the Bahuda river. (But now in bad shape).
- Percolation ponds

WR-16

# PERCOLATION POND

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# FUTURE MANAGEMENT MEASURES

- Re-engineering of damaged check dams.
- Proposed to construct a surface storage tank of 90 mcft capacity across Yatal Vanka.
- Proposed to use surface water source from two tanks namely Kanikala Cheruvu (108 mcft) and Chenamma Cheruvu (40 mcft).
- Proposed to convert some of the surface storages as percolation ponds.
- Proper implementation of Rain Water Harvesting structures.
- To use treated sewage for agriculture use/recharge.

WR-18

# WATER DEMAND IN OVER-EXPLOITED (GROUND WATER) AREAS AND SOCIO-ECONOMIC IMPACTS

## ROYACHOTY (AP)

## AND ITS ENVIRONS

DFID–BV - VRV

## LOCATION

| | | |
|---|---|---|
| Study area | - | 64 sq.km. |
| Royachoty Municipality | - | 8 sq.km. |
| Population | - | 1 lakh |

## GEOLOGY

- Mixed lithological formations
- Cuddapah formation, Vempelle shales, Pulivendala Quartzites, Limestone.
- Granites in some places.

# WATER SOURCES

- Only groundwater source.
- Surface water from two reservoirs only used only as recharge source
- Mandavi river runs across this area - 5 to 10 ft. of alluvium.

WR-21

# KANCHALAMMA KANDI LAKE

DFID–BV - VRV

# WATER SUPPLY AND WATER DISTRIBUTION SYSTEM

- Upto year 2002 the Rayachoty town had water supply system, from infiltration galleries in Cheyyaru river
- Present supply to Rayachoty and surrounding villages depends on borewells with hand pumps / power pumps (5 to 7.5 HP)

WR-23

**HAND PUMP FOR DRINKING WATER**
**BORE WELL FITTED WITH HAND PUMP**

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WR-24

BOREWELL FITTED WITH POWER PUMP

DFID–BV - VRV

WR-25

## WATER TANKER - SUPPLYING WATER TO A RESIDENCE

DFID–BV - VRV

# WATER LEVEL AND WATER QUALITY

- 15 m during winter
- 60 m during summer
- 90 m at present
- Water quality generally not within potable limit.

# SEWAGE DISPOSAL SYSTEM

There is no organized pipeline system to dispose domestic sewage. In Rayachoty town the sewage is being let into the Mandavi river. In all other areas it is let into the streets and flows through small ditches.

WR-28

SEWAGE FLOW IN THE MANDAVI RIVER

DFID–BV - VRV

## AGRICULTURE AND INDUSTRIAL USE

- Agriculture mainly depends on groundwater.
- Main crops are paddy and groundnut.
- No major industries.
- Few small scale industries – PVC pipe manufacturing units and groundnut oil producing factories.

# WATER DEMAND MANAGEMENT IN OVER-EXPLOITED AREAS AND THEIR SOCIO-ECONOMIC IMPACT - PONDICHERRY

**Dr. V.R. VISWESWARAN**
**Dr. B. KANDASWAMY**

## LOCATION

- The study area - latitude 12º 59' to 11º 50' N and longitude of 70º 45' to 79º 52`E.

## POPULATION

- The total population is about 6,07,600
- Rural population is 2,06,263 - 33.95%
- Urban population is 4,01,337 - 66.05%.
- The density of population is 2073 per $Km^2$.
- Intensive agriculture, population growth and rapid industrialization - resulted in the increased usage of water.

# TOPOGRAPHY

WR-32

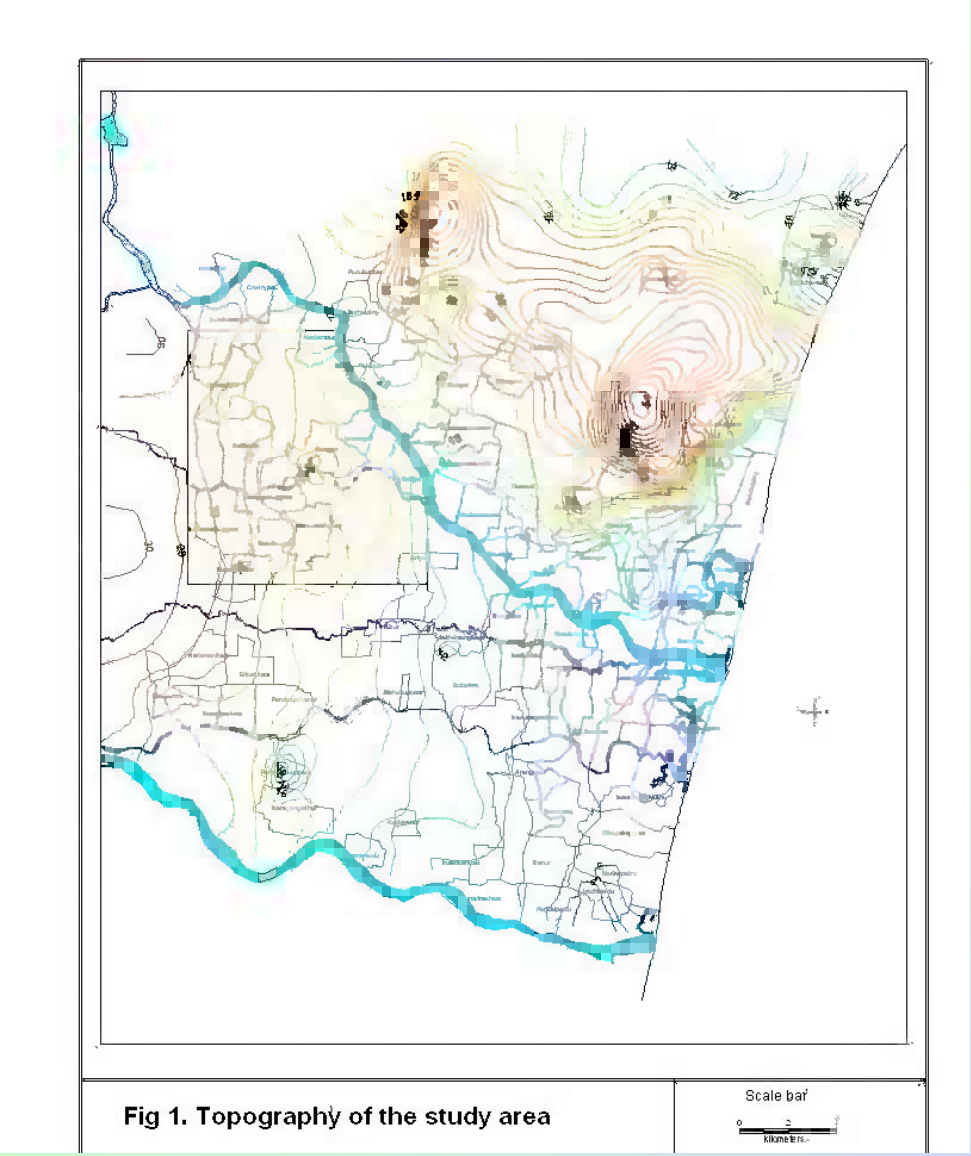
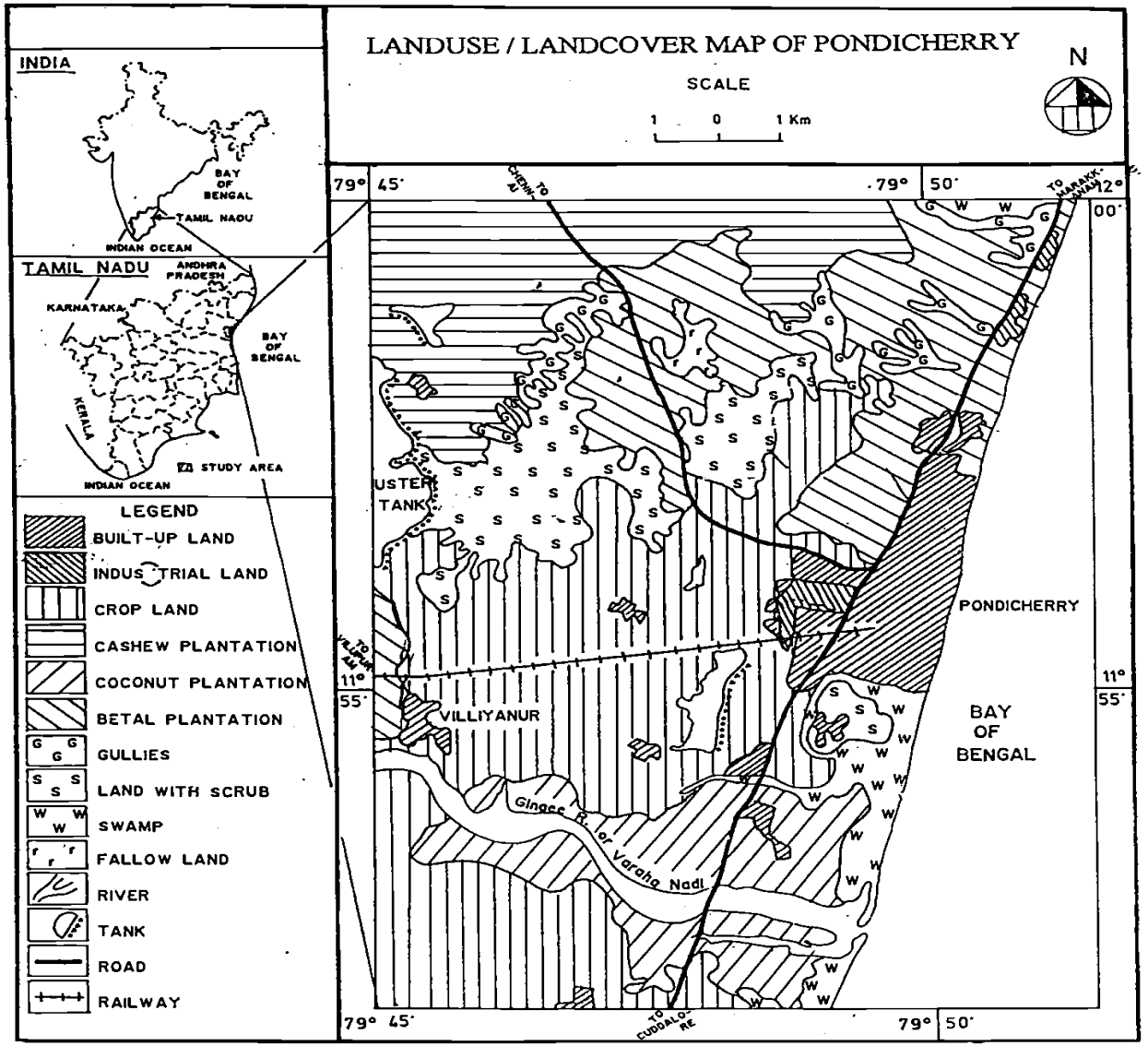



Fig 1. Topography of the study area

# LAND USE MAP

**WR-33**




DFID–BV - VRV

# DRAINAGE MAP

**WR-34**

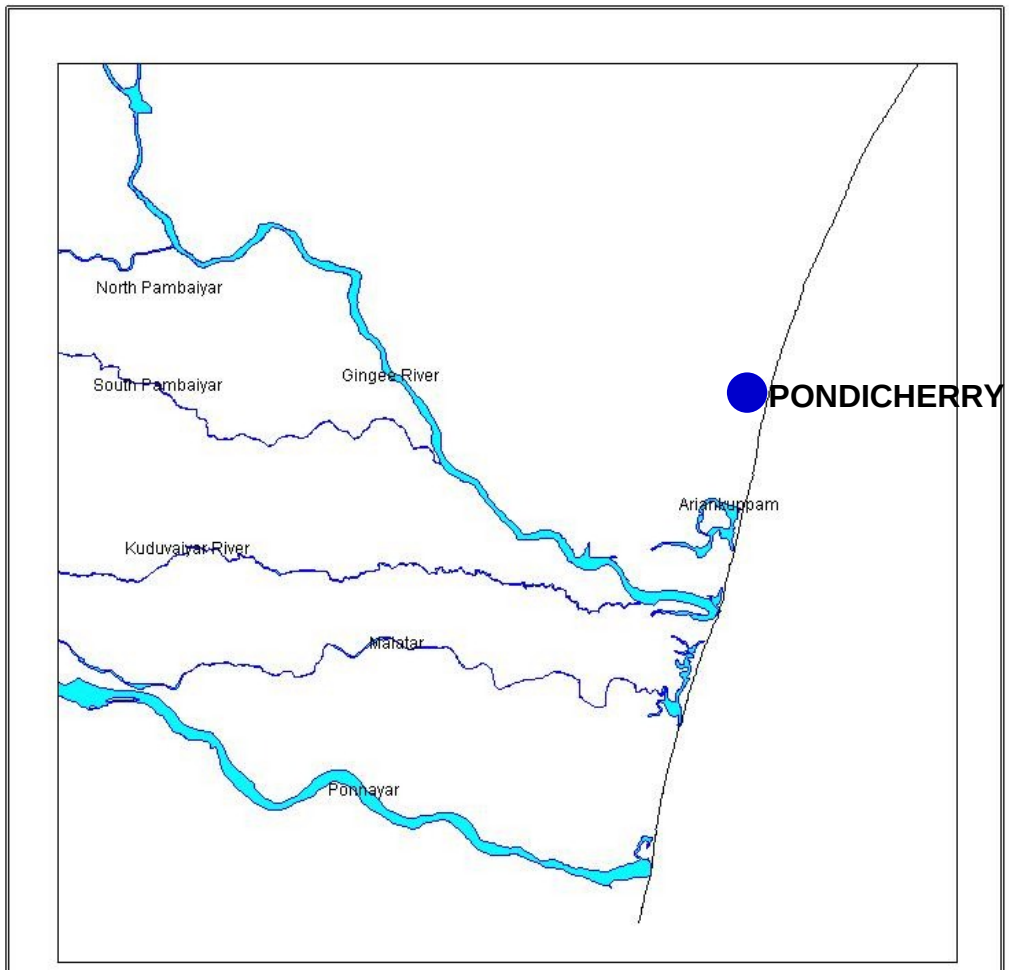



Fig 3. Drainage map of the study area

River Gingee

Ossudu Lake

# Rainfall



- The average annual rainfall is 1205 mm.
- Rainfall during south-west monsoon is 27% and north east monsoon is 63%.

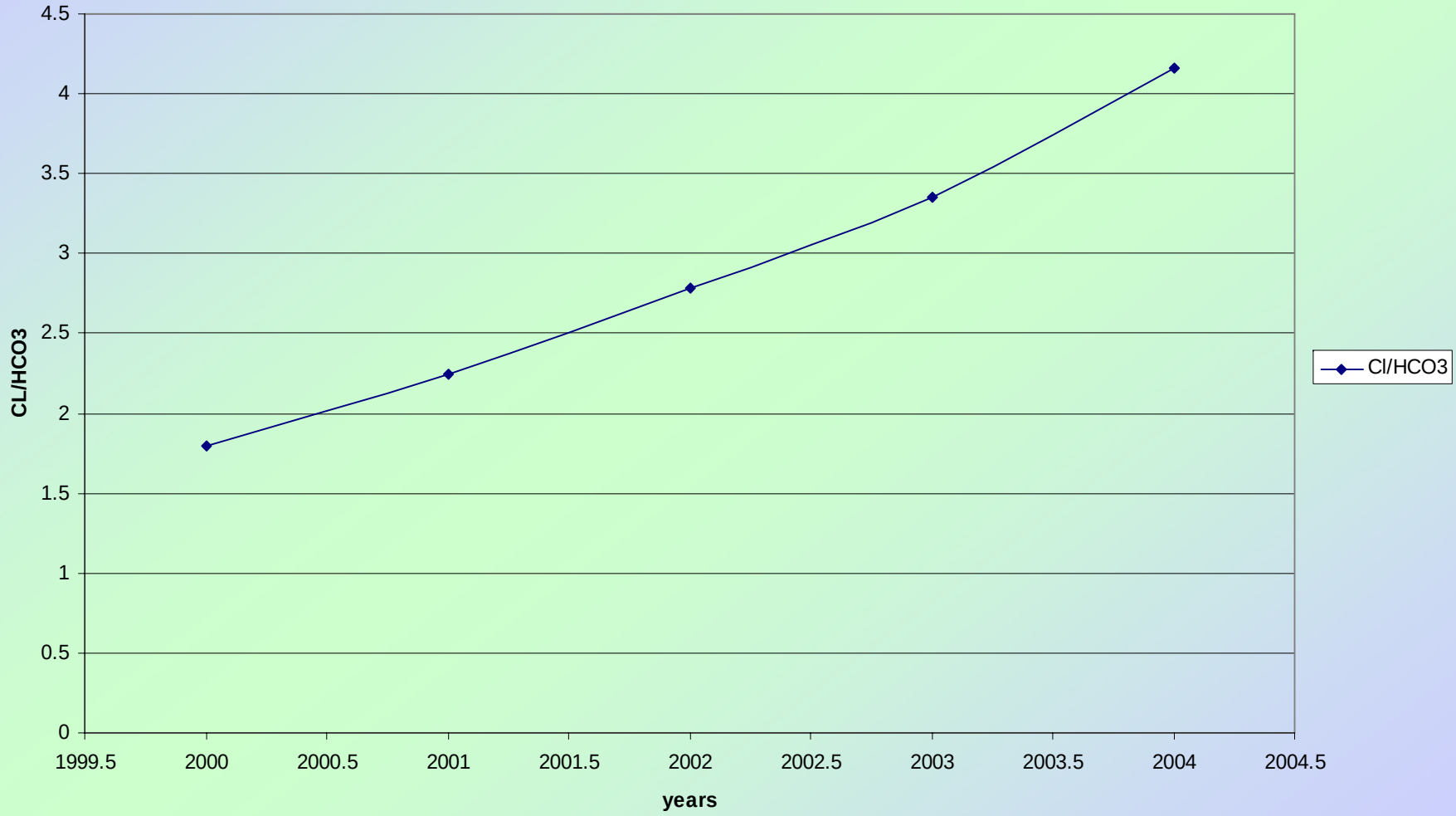
| Year | Annual Rainfall |
|---|---|
| 1990 | 1565 |
| 1991 | 1219 |
| 1992 | 957 |
| 1993 | 1682 |
| 1994 | 1249 |
| 1995 | 924 |
| 1996 | 2043 |
| 1997 | 2127 |
| 1998 | 2019 |
| 1999 | 1432 |
| 2000 | 1122 |
| 2001 | 819 |
| 2002 | 1054 |
| 2003 | 1059 |
| 2004 | 423 |
| 2005 | 626 |

# Water level - Water Quality

- The piezometric surface indicates the large scale extraction of groundwater towards the central and north western parts.
- Average elevation of piezometric surface ranges between +10m and -20m with respect to MSL.
- Coastal belt - Kirumampakkam has a negative gradient resulting in sea water intrusion.
- Threat of industrial pollution in groundwater in industrial areas - PIPDIC industrial estates namely, Manapakkam, Sethurapet and Kirumampakkam.

# WR-38

**Fig. 4 Salt water intrusion at Kirumampakkam - Pondicherry**




**DFID–BV - VRV**

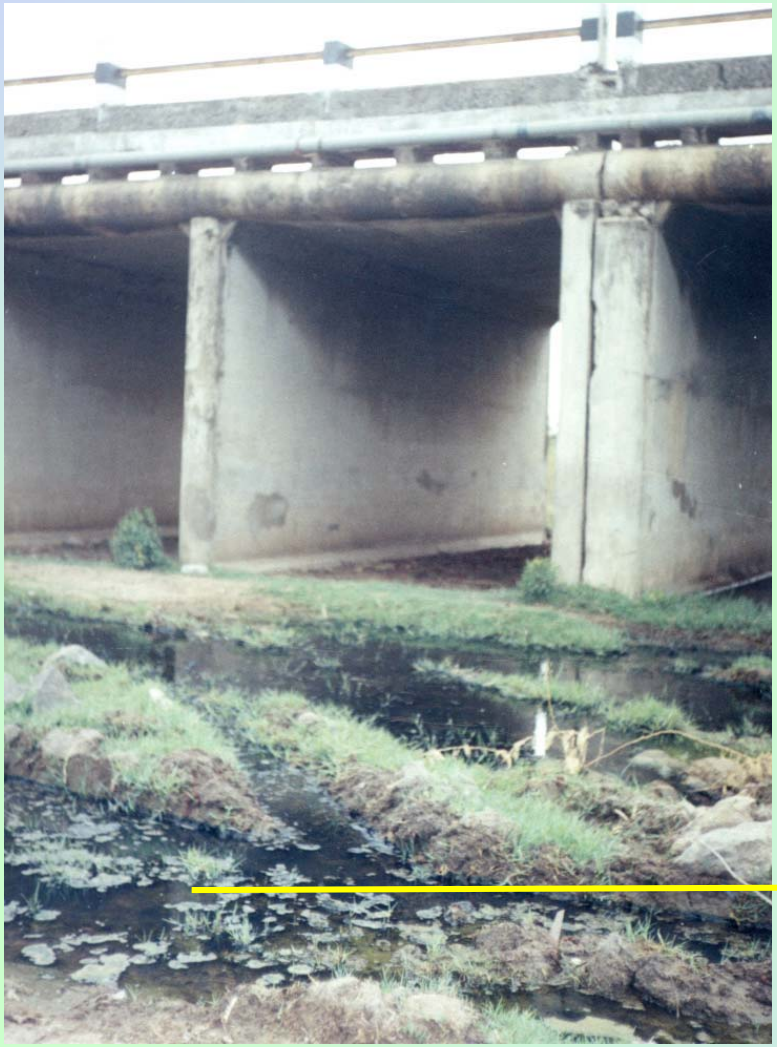
**Land affected due to salinity in ground water**

# WATER DISTRIBUTION SYSTEM

- Divided into nine Zones.
- 50 Over Head Tanks are available.
- Facilities have been installed in all 164 villages/ habitations in 5 Panchayats with a per capita supply of 40-70 lpcd.
- 185 deep bore wells to supply 80 MLD.
- Groundwater is potable and is supplied to the public and individual houses through a pipe line system after suitable disinfection.

# SEWAGE SYSTEM

- Presently 65 MLD of domestic sewage is being generated.
- The effluents from the industries are treated by their own ETP's of which only a few are effective.
- Over flow of the effluent joins the common drain.



Effluents - Over flow

# Industrial effluents from PIPDIC

# WATER DEMAND AND MANAGEMENT MEASURES

- Urban population is expected to reach 10 lakhs in next 20 years.
- Demand for water will be doubled i.e. 150 MLD.
- Future demand cannot be fully met from the groundwater resources alone.
- Restriction on large scale water consuming industries.
- Sinking of deep borewells within a distance of 6 km from the sea coast is prohibited.

**Dried pond indicating the initiation of water scarcity**

# FUTURE MANAGEMENT MEASURES

- Reuse of treated effluent and sewage for industrial use and for agriculture use
- Recharging the aquifer
- Optimum utilization of surface water (Ossudu Lake)
- Need for Desalination plant
- Modernisation of tanks
- Rain Water Harvesting
- Interlinking of rivers and ponds

# SOCIO ECONOMIC IMPACT STUDY SE (1)

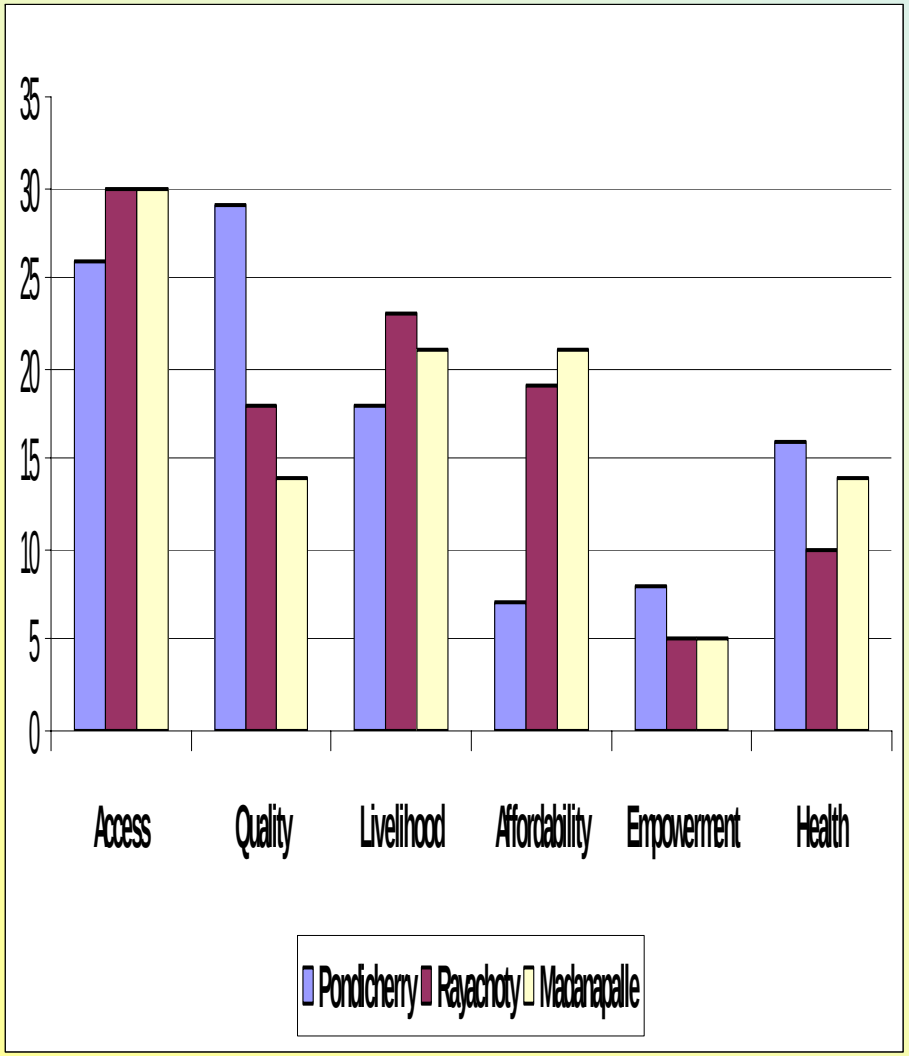
- Six indicators of vulnerability Assessment are identified
- The six indicators are :
  - Access to water source
  - Quality of water
  - Livelihood Impact
  - Affordability
  - Empowerment
  - Health

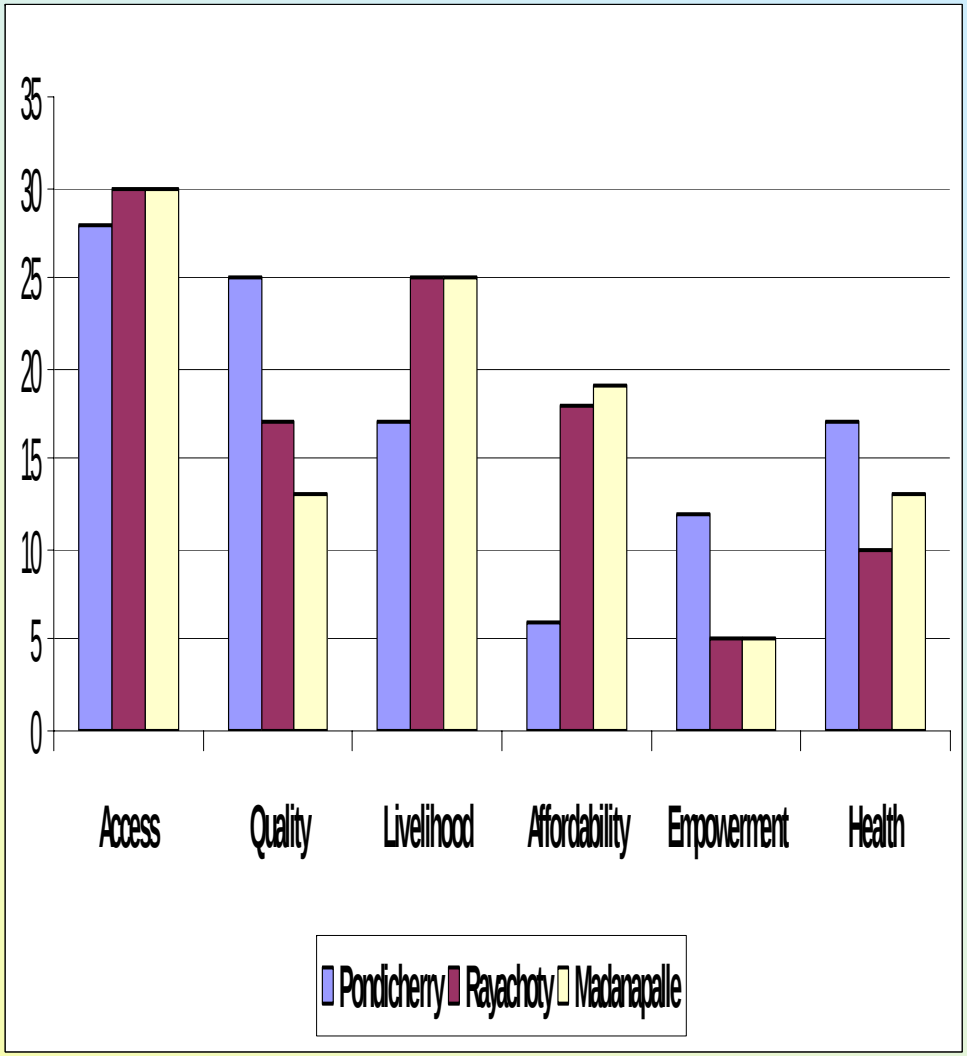
# MEANING OF INDICATORS SE (2)

- Access to water source in terms of :
  - Quantity of supply
  - Frequency of supply and source of supply whether more or less accessible
- Quality of water – Good or Bad?
- Livelihood Impact – Impact of water shortage on people's livelihood
- Affordability – Can people pay for water ?

  Can they afford storage tanks, water saving devices?
- Empowerment – Is water distribution to the community fair or not?
- HEALTH – Any Water Borne Disease

# RESULTS OF VULNERABILITY ASSESSMENT – RICH/POOR FEEDBACK SE (3)



# WATER, LAND AND TREE ACT 2002
# ANDHRA PRADESH – INDIA SE (4)

- An act to promote
- water conservation
- Tree cover
- Prevention of over exploitation
- Protection  conservation of water sources

# WATER, LAND AND TREE ACT 2002
# ANDHRA PRADESH – INDIA SE (5)

**SALIENT FEATURES OF THE ACT ABOUT GROUNDWATER.**

- Registration of wells.
- Prohibition of groundwater extraction in certain areas.
- Need for permission to sink wells near drinking water source.
- Prohibition of commercial exploitation in certain areas.
- Prohibition for development in over-exploited areas.
- Protection of public drinking water sources.
- Registration of drilling rigs.
- Closure of wells in case of contravention of any of the provisions of the act.
- Promoting rainwater harvesting.
- Re-use of water.
- Prohibition of water contamination.
- WALTA-2004 (amendments).
- Provision for Divisional set-up.
- Scientific investigations mandatory.
- Insurance cover for bore wells before drilling mandatory.

# COMPARATIVE STUDY SE (6)

| Factors | Chennai | Pondicherry | Madanapalle |
|---|---|---|---|
| 1. Study Area (in sq.km) | 1600 | 85 | 100 |
| 2. Topography | Coastal Plain | Coastal Plain | Undulating terrain surrounded by many hillocks |
| 3. Geology | Araniyar, Koratalaiyar Basin consists of alluvium followed by Gondwana. In Chennai city alluvium is restricted to the coastal area. Inland is mainly made up of clay, sandstone and shale. Southern part of Chennai is made up of crystalline rocks. | Generally made up of alluvium | Rocky terrain (granite, biotite granite gneiss). Alluvium is limited to 10 m. |
| 4. Rivers | Adayar and Cooum rivers in Chennai city. Araniyar and Koratailaiyar in AK Basin | Ginjee River | Bahuda River |
| 5. Average Annual Rainfall | 1200 mm | 1200 mm | 740 mm |
| 6. Average water level | Winter 5.0 m Summer 15.0 m | Winter 3.0 m<br>Summer 10.0 m | Winter 6.0 m<br>Summer 8.0 M |

| Factors | Chennai | Pondicherry | Madanapalle |
|---|---|---|---|
| 7. Ground water Quality | Generally potable in AK basin. Rarely potable in Chennai City | Generally potable | Contains high fluoride content |
| 8. Water source | Surface water from 4 lakes – for domestic use. Ground water from AK basin for Industrial use | Depends on groundwater from borewells | Depends on groundwater, from borewells |
| 9. Average water supply | 300 million litres per day | 80 million litres per day | 15 million litres per day |
| 10. Population (approximately) | 6 million | 0.5 million | 0.20 million |
| 11. Distribution system | Residential supply through pipe lines | Residential supply through pipe lines | Only Madanapalle town has residential supply. The surrounding villages get groundwater from borewells fitted with hand / power pumps. |
| 12. Agriculture use | Mostly depends on groundwater | Depends only on groundwater | Depends only on groundwater |
| 13. Industrial use | Major industries depend on groundwater supplied by CMWSSB | Only small scale industries. Have their own borewells | Only small scale industries/ depend on municipal supply |
| 14. Sewage disposal system | Well organized pipeline system with treatment plants | Well organized sewage disposal system. | No sewage system. Let into the streets |

| Factors | Chennai | Pondicherry | Madanapalle |
|---|---|---|---|
| 15. Water Management measures to improve the water source | 1. Construction of check dams across river.<br>2. Groundwater act<br>3. Telugu Ganga Project<br>4. Veeranam surface / groundwater projects<br>5. Installation of rain water harvesting structures | 1. Rain water harvesting structures<br>2. Construction of check dams | 1. Installation of rain water harvesting structures<br>2. Groundwater act |
| 16. Existing supply situation | Present water supply is only enough to meet drinking and cooking needs even during normal rainfall years. For all other needs depends on dug/bore well | Present supply is enough to meet all domestic needs.<br>But quality is slightly bad.<br>• Industrial pollution<br>• Seawater intrusion | Presently supply is enough only during rainy season. Quality is bad due to high fluoride content. |
| 17. Additional Management measures that have to be implemented | 1. Reuse of grey water (bathing and cloth washing)<br>2. Fixing water meters and charging according to usage.<br>3. Construction of some more check dams.<br>4. Inter-linking of Araniar and Koratalaiyar rivers.<br>5. Monitoring the maintenance of installed Rainwater harvesting structures.<br>6. Installation, operation and maintenance of water gauging station and flow meters for accurate measurements<br>7.Auditing for accountability | 1. Construction of check dams.<br>2. Monitoring the maintenance of installed Rain water harvesting structures.<br>3. Fixing of water meters and charging according to usage. | 1. Construction of check dams<br>2. Installation of proper rain water harvesting structures<br>3. Rejuvenation and renovation of surface water sources.<br>4. Construction of percolation ponds. |

# MADANAPALLE MUNICIPALITY

## WATER DEMAND MANAGEMENT IN AREAS OF GROUND WATER OVER - EXPLOITATION STRATEGY

## DEVELOPMENT - PRESENT WATER SUPPLY & PROPOSALS

Prepared & Submitted By
Er. E.J. Manohar Lal,
Deputy Excutive Engineer,
Madanapalle Municipality,
Chittoor (Dist), A.P.

# INTRODUCTION

- Municipality - An Over view
- Madanapalle was built in 1618 AD by Sri Ahobila Naidu.
- It was contituted to Municipal Level with effect from 01-04-1961, with an area of 14.20 sq kms covering their revenue villages.
- The population of the town is 99967 as per 2001 census.
- Municipality is having 17 revenue wards divided in to 35 election wards.
- Poor Setlments - 32 notified poor setlements and 10 non - notified poor setlments.

# ECONAMIC BASE OF THE TOWN

- The Madanapalle Town is the only urban Center for vast region covering 175 villages depending on for marketing their agricultural produces and providing their consumer needs.
- The main crops of hinter land are paddy, groundnut and Sericulture.
- Tomato growing and Sericulture forms are main Agricultural activities under commercial crops.
- Cotton Spanning mills and silk power looms, reeling centers are good potential zones for providing employment to thousands of people in every day.

# URBAN POOR

- There are 32 notified poor settlements with a population of 27592, which constituted 27.69 % of the total population of town as per 2001 census.
- There are 10 non-notified poor settlements in the town
- For the past 5 to 6 years due to severe drought conditions in and around Madanapalle revenue division, some agricultural laborers migrated to this urban area with a hope of getting an alternative lively hood.
- Some people migrated with other reasons lick children education, petty business like milk vending.
- To meet the civic emanities & services like shelter, water supply, drainage, health, education, and lively hood have become a major concerns of the municipality.

# WATER SUPPLY

- There is an acute drinking water problem prevailing in Madanapalle Town.
- There are no perennial sources in and around Madanapalle town with in the radius of 100 k.m.
- The main source of water supply is ground water only.

# RAIN FALL PARTICULARS

| Year | Normal Rain fall in mm | Activual in mm |
|---|---|---|
| 2000 | 848.00 | 751.00 |
| 2001 | 848.00 | 668.50 |
| 2002 | 848.00 | 651.20 |
| 2003 | 848.00 | 173.00 |
| 2004 | 848.00 | 411.40 |
| 1 to 10/2005 | 848.00 | 912.00 |

# REQUIRMENT OF WATER SUPPLY

| Sl. No | Year | Population | Water Requirement @ 140 LPCD | Supply MLD | | Deficit MLD | |
|---|---|---|---|---|---|---|---|
| | | | | Normal | Summer | Normal | Summer |
| 1 | 2001 Present | 99967 | 14.00 MLD | 10.00 | 4.29 | 4.00 | 9.71 |
| 2 | 2016 Propective | 146000 | 20.44 MLD | 6.28 | 6.28 | 5.84 | 14.16 |
| 3 | 2031 Ultimate | 199000 | 27.86 MLD | 8.55 | 8.55 | 7.96 | 19.31 |

# WATER SUPPLY SOURCE

| Sl. No | Source | Water Supply position during | |
|---|---|---|---|
| | | Normal Season | Summer Season |
| 1 | Vempalle head water works | 1.36 MLD | 0.45 MLD |
| 2 | hand pumps | 0.64 MLD | 0.55 MLD |
| 3 | Power Bores | 8.00 MLD | 3.29 MLD |
| | TOTAL | 10.00 MLD | 4.29 MLD |

# STATIC WATER LEVEL

- Ground water in the area occurs under water table and semi confined conditions.
- Weathered zone aquifer is dry and the fracture zone aquifer which occur up to 300 mts is being tapped by the bore wells.
- There are 249 bore wells in the area the depth of the bore wells were drilled up to 120 m to 320 m.
- **I. The yield available in Town area.**
- Previously water can be tapped from 180 feet to 1090 feet.
- Presently water can be tapped from 25 feet to 180 feet due to heavy rainfall occurred recently.
- **II. The yield available in Rural area.**
- Previously water can be tapped from 10 mts to 52 mts.
- Presently water can be tapped from 5 mts to 28 mts due to heavy rainfall occurred recently.

# STATUS OF BOREWELLS

| Source | Total Bore wells | Total borewells under testing of yeild | Functioning at present |
|---|---|---|---|
| Power Bores | 249 | 169 | 90 |
| Hand Pumps | 154 | 64 | 90 |
| TOTAL | 403 | 233 | 180 |

# PRESENT WATER SUPPLY

- 1. Water supply through the the head works and 7 Nos OHSR's : 4.40 MLD
- 2. Transportation of Water through the tankers : 0.54 MLD
- 3. Hand pumps : 0.54 MLD

**TOTAL : 5.48 MLD**

- Town area divided in to 3 zones and water supplied to 2 days once to the areas.

# PROPOSALS & COST

- .

## SHORT TERM

## LONG TERM

# SHORT TERM

- 14 Nos Irrigation tanks to be converted in to percolation tanks to maintain ground water recharging.
  - **Est. Cost Rs. 15 Lakhs**

- Providing Ingection wells for 14 percolation tanks.
  - **Est. Cost Rs. 70 Laksh.**

- Individual rain water Harvesting structure.
- Community Harvesting structure - Checksdams -5 Nos, along the Bahudha River. Mugguralla Vanka and Allivanka to maintain ground water recharging.
  - **Est.cost Rs. 10 Lakhs**.

# LONG TERM

- Augmentation of water supply to the Madanapalle Town with HNSS Canal as source by constructing SS Tank, filter beads treatment plant and to the existing distribution with an
  - **Est. cost Rs.138.00 Cros**
- Government of Andhra Pradesh have given administrative sanction - DIR is under progres by P.H. Engineering Department.
- O.D.S to Compressive town for rain water.
  - **Est. Cost. Rs. 5 Cros**
- Providing regional water supplies policy by combining the 4 to 5 Municipal Urban Areas.
- Providing 24/7 water supply to the town with metering.

# CONCLUSION

- More customer satisfaction.
- Increased public health.
- Improve Revenue by way of sanction of HSC’s and tariff
- Development of urban areas,.
- Social Development.
- Environmental improvement. Due to regional water supply palicy.
- Reduced capital cost  on each urban area.
- Reduced the O & M cost on each urban area.


THANKS

# MADANAPALLI MUNICIPAL TOWN

## STATUS REPORT ON WATER – MEASURES TO TACKLE -1

### 1) OBJECTIVE :

To bring out a comprehensive report on the present severe shortage of water and to suggest workable and result centered solutions concerning Madanapalle urban area.

### 2) INTRODUCTION OF MADANAPALLI :

Madanapalle Town is located between East longitude $78^0$ 29'20" – $78^0$ 31' 00" and latitude $13^0$ 24'00" - $13^0$ 32'32" falling in survey of India top sheet 57 K/6 and 57 K/10.

Madanapalle was built in 1618 AD by Sri. Ahobila Naidu. It was constituted as Municipality with effect from 1-4-1961. Town covers an area of 14.20 Sq Kms comprising 3 Revenue villages namely, Kammapalle, Bandamida Kammapalle, Madanapalle urban area and 3 Hamlets of Ponnetipalem village, Sugalithanda, Nakkala Dinne. Madanapalle is one of the Revenue Divisional Head quarters, in Chittoor District. This town is only the urban Center for a vast region covering about 175 villages, depending for marketing their Agriculture produces and sale and purchase of consumer needs. The Municipality is having 17 Revenue wards divided into 35 election wards with 32 notified poor settlements and 10 non notified poor settlements. The population of town is 1,07,449 as per the 2001 censes. And the present population is around 1.15 lakh.

Madanapalli Municipality falls in Chittoor District, which is one of the four drought prone districts of Rayalaseema region. This area assumes importance as it is in the tourist map of the country due to the presence of Horsely Hills, which is designated as the Governors summer resort.

### 3) TOPOGRAPHY :

The area is having undulatery topography with general slope towards East. The area is located at an altitude of around 670m above mean sea level. The Municipality is surrounded by Basinikonda Hillock with the peak Basinikonda

at 861m above mean sea level in the East. Madanakonda reserve forest with the peak Madana Konda at 954m above mean sea level in the South, Mallaiah konda 1010m above MSL in for South west and a rocky extension of reserved forest with peak at 1083m above MSL in for west.

**a) Climate :**

The climate of the area is hot and Semi- Arid for most part of the year especially in the month of May with mean maximum temperature of 40.2$^0$C, a mean minimum of 24.4$^0$C and mean of 30.2$^0$C, while December being the coldest month. The area receives an average rainfall of 650mm. The rainfall is less during the early months of every year and it is generally more during June and December. From the study of water balance computation. It is observed that the area has water deficit during most part of the year. It is revealed that the climate of the area is Semi – Arid type.

**b) Drainage :**

The drainge pattern of the area is in sub- dentritic in nature. The streams originating from these hills flow towards the municipal area. Confluencing near Ankisettipalle and flow towards East as Bahuda river.

**c) Soils :**

The predominant soils in the area are red soils and little alluvium in the stream course.

**d) Geomorphology :**

The land forms identified in the study area are Pediplain shallow (PPS), Residual hills Pediment zone and pediment inselberg complex (PIC).

**e) Geology :**

The area is underlain by granites of Archean age, which are intruded by doleryte dykes of trending NE-SW direction. Granites are weathered and the weathered zone extends up to a depth of 19mts. They are also intruded by quartz veins which are fractured. The fractured zones occurs up to a depth of 60mts. The important rock types are granite, Biotite granite gneiss, Hornblende granite gneiss etc. The country rock is intruded by quartz, Dolerite and

Gabbero. At places Pegmatites and quartze – feldespathic veins were also observed.

Alluvium and tallus are the sub recent to recent formations present along the Bahuda river course and also along the Mugguralla Vanka and Allivanka. The general thickness varies from 10m to 15m below ground level.

**f) Hydrogeology :**

Ground water in the area occurs under water table and semi confined conditions. Weathered zone aquifer is dry and the fracture zone aquifer which occur up to 300mts is being tapped by the bore wells. There are 249 bore wells in the area. The depth of the bore wells were drilled up to 120m to 320m. The yields of bore wells varies as follows.

1) Allivanka area - Water can be tapped form 600fts to 700 fts
2) SBI Colony area- Water can be tapped form 270 fts to 710 fts
3) Vempalle Head water works - Water can be tapped form 180fts to 700 fts
4) Rami Reddy Lay out - Water can be tapped form 90 fts to 600 fts
5) Mugguralla Vanka - Water can be tapped form 180 fts to 700 fts
6) D. S.P. Bangla area - Water can be tapped form 350 fts to 700 fts
7) Pedda Thopu - Water can be tapped form 250fts to 400 fts
8) P & T Colony area - Water can be tapped form 450fts to 750 fts
9) Indira Nagar - Water can be tapped form 440fts to 600 fts
10) Gottigani Cheruvu - Water can be tapped form 350 fts to 1000 fts
11) Reddeppa Naidu Colony - Water can be tapped form 450fts to 600 fts

## 4) WATER STATUS

The Municipality supplies water from about 249 power pumps, 154 Hand pumps and from, infiltration galleries. Due to increase in population, decline in rainfall and over exploitation of available water sources fall in water level becomes inevitable and ends up in the failure of bore wells during summer seasons. There is an acute drinking water problem prevailing in Madanapalle town. There are no perennial water sources in and around Mandapalle town within a radius of 100 kms. The main source of water supply is ground water only. Ground water level is beyond 850ft. depth, at present, due to acute short of rain fall for the last 6 years. There are 154 Hand pumps out of which 90 Hand

pumps only are working. Out of 249 Power bore wells only 67 Power bore wells are functioning to cater to the drinking water needs of urban people.

For the past 6 years there is continued deficiency in the normal rainfall. It results in the vast depletion of the ground water table and it is affecting the drinking water situation in urban areas. As on today 64 Hand pumps and 182 Power bore wells are completely dried up.

The Municipality is not in a position to supply water through pipelines completely to the entire population. Water supply is being supplied through pipeline covering a population of about 15,000 only as against population of 1,07,449.

The Municipality is transporting water through tankers. The drinking water supply is solely depending on transportation of water through tankers only. To meet the water needs of people of the Madanapalle, the Municipality has provided transportation of drinking water from 35 habitations with tie up arrangements made with private irrigation bore wells located in surrounding villages.

## 5) PRESENT POSITION OF WATER AVAILABILITY:

For a Population of more than 1.15 lakh, the daily demand and anticipated consumption is 22 lakh gallons but water supplied is only 11.50 lakh gallons, leaving a glaring deficit of 10.50 lakh gallons.

**Requirement of water Supply**

| Sl. No | Year | Population | Water Requirement @ 140 LPCD | Supply MLD | | Deficit MLD | |
|---|---|---|---|---|---|---|---|
| | | | | Normal | Summer | Normal | Summer |
| 1 | 2001 Present | 1,07,449 | 14.00 MLD | 10.00 | 4.29 | 4.00 | 9.71 |
| 2 | 2016 Prospective | 1,46,000 | 20.44 MLD | 14.60 | 6.28 | 5.84 | 14.16 |
| 3 | 2031 Ultimate | 1,99,000 | 27.68 MLD | 19.90 | 8.55 | 7.96 | 19.31 |

**Water Supply Source**

| Sl. No | Source | Water supply position during | |
|---|---|---|---|
| | | Normal Season | Summer season |
| 1 | Vempalle Head water works | 1.36 MLD | 0.45 MLD |
| 2 | Hand pumps | 0.64 MLD | 0.55 MLD |
| 3 | Power Bores | 8.00 MLD | 3.29 MLD |
| | **Total** | **10.00 MLD** | **4.29 MLD** |

**Present water supply**

1. Water supply through the the head works and 7 Nos OHSR's : 4.40 MLD
2. Transportation of Water through the tankers : 0.54 MLD
3. Hand pumps : 0.54 MLD

**TOTAL : 5.48 MLD**

Town area divided in to 3 zones and water supplied to 2 days once to the areas.

**Status of Bore wells**

| Source | Total Bore wells | Total borewells under testing of yeild | Functioning at present |
|---|---|---|---|
| Power Bores | 249 | 169 | 90 |
| Hand Pumps | 154 | 64 | 90 |
| TOTAL | 403 | 233 | 180 |

**6) REASONS FOR SHORTAGE OF WATER :**

**Reasons for the present severity in water supply:**

- The town had no well thought out future plans prepared in the past.
- Rainfall which was found sufficient in the past to the then population, is found to be abnormally less to the present day population.
- There are no assured water resources in the form of permanent flowing river.
- Only source is ground water.
- Ground water availability is decreased due to excessive exploitation. As a result the Ground water table has sunk to much deeper levels.
- Area is falling under rain shadow region
- Irrigation cum percolation tanks namely
  - Gottigani Cheruvu,

- Komativani Cheruvu, are encroached upon and they have no inflow of water due to short of rainfall and encroachments in catchment area.

- ❖ 16 tanks surrounding Madanapalle town are totally neglected and are in a least useful stage. They are not receiving any appreciable in – flow levels.
- ❖ A couple of the above tanks were breached in the year 1996 and remain unattended.
- ❖ The River Bahuda, that passes through the town remains dried for the past 7 years, with maximum area being encroached upon.
- ❖ There are no proper water harvesting structures on the river Bahuda. The water that comes in, flows down to Bahuda project which is located 20km away. Similar is the case with Mugguralla vanka, another stream that joining Bahuda River.
- ❖ One of the very important reason is excessive migration of people to Madanapalle town from surrounding rural habitations for a wide range of reasons.
- ❖ High depletion in area covered by greenery.
- ❖ Excessive emission of hazardous exhausts by using of adulterated fuels.
- ❖ Non availability of storage systems.

## 7) HOW THE GOVT. IS TACKING THE WATER PROBLEM

98% of water needs is supposed to be met by the Municipality (Civic Body). The remaining 2 % is met by individuals, having their own in house water Bore wells.

Due to failure of Municipal water sources, the Municipality is purchasing water from surrounding private Agriculture Bore wells located about 6–8 Kms away. The purchased water is supplied through hired tankers. Even then, it is unable to supply adequate water to the population. It is note worthy that Madanapalle Municipality is

- ❖ Spending a huge amount of Rs. 1,20,000/- a day on water.
- ❖ Unable to meet the total requirement of 22 lakh gallons
- ❖ Able to supply the water once in 3to 4 days only
- ❖ Unable to supply water to meet needs satisfactorily.

- Sinking further Bore Wells and fixing Hand pumps and Motors for a few wells is done to make available additional quantity.

Due to inadequacy in availability of water, majority of population is purchasing water from private suppliers.

## 8) THE PROBLEMS ENCOUNTERED BY GOVT. & PEOPLE IN TACKING WATER PROBLEM.

**Govt. / Municipality experiencing the following problems**

- Availability of water even from private Bore wells is on decline
- Proper accessibility to water sources is not satisfactory.
- Time duration to fill a tanker is increasing due to lessened flow from the source.
- Unscheduled power supply breakdowns.
- Irregularity in availability of hired tankers due to repairs and maintenance of vehicles.
- Resistance from surrounding villagers for drilling or tapping of water by the Municipality.

**PROBLEMS FACED BY PEOPLE :**

- Difficulty in getting assured and regular supply of water
- Exorbitant cost charged by private suppliers.
- Irregular timings, resulting in dislocation of daily work schedules.
- Scuffles among people while sharing free supply of water by Municipality.
- People are forced to purchase a pitcher of Drinking water at a cost of Rs. 1.00 & 1.50ps.
- Due to impurity of water supply, Public are facing a variety of Health problems.
- Even if one is prepared to spend money, one is forced to undergo lot of inconvenience.

## 9) SUGGESTIONS / MEASURES TO TACKLE THE WATER PROBLEM:

Considering all the available data, information and facts on ground, the following suggestions / solutions are considered worth implementation.

- Construction of water harvesting structures around the base of surrounding hillocks like Basinikoda, Madana Konda, Kappa Konda, Anapa Gutta and Mallaiah Konda etc.,
- Converting the surrounding 16 irrigation tanks as percolation tanks.
- Individual rain water harvesting structures.
- Desiltation and construction of injection Bore wells in near by tanks and in local streams.
- Measures to prevent evoporation of water.
- Plantation to cause increase in green coverage.
- Construction of summer storage tank
- Arranging water from HANDRI – NEEVA canal.
- Long term plans to augment water supply.
- Construction of soak pits
- Installation of filtration unit.
- Proper and regular repairs, replacement and maintenance of water pipe lines.
- Enforcing to avoid deep bore wells.
- Regional water supply.

## 10) CONCLUSION :

Proper planning, coordination and implementation of the suggested measure by all Depts. Concerned having clearly defined time schedule and with adequate funds at disposal, will go along way in providing sustainable water supply systems, that could with stand adverse conditions.

- Madanapalli town is experiencing unprecedented shortage of water due to a variety of reasons.
- While the daily demand is for 22.00 Lakh gallons of water, only 10.5 lakh gallons are supplied.
- Available municipal water supply sources are unable to supply water as expected.
- Private water sources are undependable, irregular and exorbitant.

- ❖ Levels of awareness and concern in public about proper and optimum utilisation of available water is found lacking.

Under the above explained scenario, it is advisable to take up the suggested measures/ solutions in phased manner to result in making water availability on a progressive and sustainable manner, keeping in view the future needs and growth of town population.

***Prepared by***

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# MADANAPALLE MUNICIPAL TOWN

## STATUS REPORT ON WATER & MEASURES TO TACKLE - 2

Madanapalle town of Chittoor District, Andhra Pradesh is located between East longitude $78^0$ 29' 20" – $78^0$, 31'00" and Latitude $13^0$, 24'00" - $13^0$, 32'32" falling in Survey of India topo-sheet 57 K/6 and 57/K10.

**HISTORY OF THE MADANAPALLE**.

1. The existence of Madanapalle as per available history dates back to 1618 AD and is said to have been built by one Mr. Ahobila Naidu. It was constituted as Municipality with effect from 01-04-1961. It has a salubrious climate located at an altitude of 2116 feet above mean sea level. It is well known as "Poor Man's Ooty".

2. Madanapalle has a record of consistence growth and development.

3. It was under the rule of various dynasties of Mogal and Hindu Kings.

4. The world famous spiritual leader Jiddu Krishna Murthy was born at this place where his ancestral home is preserved as a monument.

5. The theosophical society had its deep rootes and links with this town.

6. There is a Beast Theosophical college, considered to be the oldest in Rayalaseema Area that was established by Anibesant.

7. The place had the distinction by a visit of Ravindranath Tagore where our National Anthem was translated into English version, the original copy of the translation is presently, kept for visitors in B.T. College, Madanapalle.

8. Madanapalle town is the Revenue divisional Head quarters and Madanapalle Revenue Division is the largest Revenue Division in our country.

9. The Horsely Hills, a summar resort, at an altitude of 3500 feet is a place for all visitors. It is the official resort for the Government of Andhra Pradesh.

10. There is an internationally reputed School by name Rishi Valley that was a brain Child of the Late Jiddu Krishna Murthy. Many students throughout the length and breath of our country and the world seek admission here.

11. Because of the highly supportive climate of this place, a well known T.B. Hospital was established at Sanitorium which is just at the outskirts of the town. It is known as Arogyavaram well recognised.

## SOCIO ECONOMIC STATUS

1. Madanapalle town is the only urban center covering 175 villages and majority people are depending for sale and purchase of all their needs.

2. By and large the main activity is Agriculture.

3. This place is famous for large production of commercial crops like Tomato's, Sericulture and Groundnut.

4. Since three decades this place has been witnessing a high growth of Industrial and commercial activities and as a result industries such as Clean-Foods, Spinning Mill, Silk, hand looms and Power looms are established here.

5. This place is harmonious and is generally free from religious, social and Political unrest.

6. Due to a number of encouraging and supportive conditions this town continues to receive large number of migrants from for and near.

7. It is also known as Pensioners Paradise.

8. It has all the Characteristics of a cosmopolitan city.

9. It is centre for Educational, Health, Commercial and Entertainment facilities.

10. It attracts considerable floating population, and is located close to Bangalore City.

**PRESENT STATUS OF WATER**

1. After prolonged severe drought spell for about a decade, Madanapalle and adjacent areas have received sufficient rain recently. As a result of which, the availability of water has considerably improved much to the delight and relief of citizen's and officials.

2. The severe shortage of water in the immediate past could be attributed to the following regions.
   a. Continuous failure of monsoons.
   b. Over exploitation of ground water due to drying up of open and sub-surface water resources.
   c. For a decade, due to the population increase, the town has been confronting large-scale encroachments on the riverbeds of Bahuda, Kuravanka causing obstruction to natural flow and decrease in depth of ground water. The photographs here are sufficient to prove the damage done to the riverbeds.
   d. Conversion of Gottiganicheruvu as house sites has resulted in a major set back for ground water.
   e. Encroachment of Chennamma Cheruvu and converting it as cultivable dry lands.
   f. Though the water available how is much better, there is still a lot to be done for proper and regular supply of quality water like construction of treatment plant, repair and maintenance of pipe systems and construction of over head tanks and installation water meters etc.
   g. To tide over and avert future water crises, there is an urgent need.
      i. To take up summer storage works.
      ii. To convert 16 irrigations tanks as percolation tanks.

iii. To supply water from Hundri Neeva Canal.
iv. To implement inter connected water harvesting scheme.
v. Discouraging the Bore wells.

**The existing water level after recent torrential raining is**

- Previously it was 1090 feet. There is remarkable improvement in the water table in the town.
- In respect of water quality there is alarming content of fluoride in the areas mentioned. There is every need to remove the fluoride to avoid its effects and establish water salinity plants.
- Due to the lack of proper maintenance of tanks around Madanapalle, there were devastating of floods in the town due to the large-scale breaches where there was huge loss of life and property. The encroachments along the river beds obstructed the natural flow of water and the houses were inundated.
- **The yield available in Town area.**
  - Previously water can be tapped from 180 feet to 1090 feet.
  - Presently water can be tapped from 25 feet to 180 feet due to heavy rainfall occurred recently.
- **The yield available in Rural area.**
  - Previously water can be tapped from 10 mts to 52 mts.
  - Presently water can be tapped from 5 mts to 28 mts due to heavy rainfall occurred recently.

**Bahuda** : Water Level: 2008.20 feet
Capacity: 265.20 feet

**How to tackle the water problem**

The rivers Bahuda and Thettuvanka flow west to eastern direction through Madanapalle Town. There used to be large quantities of ground water. In sand beds in and adjacent to the rivers and several barried valleys. Because of over exploitation of ground water shallow ground water in the riverbeds is almost fully exhausted. Entry of untreated sewage into these rivers has led to extensive pollution of surface and ground water bodies. If proper effects are made to conserve rainwater and using it for recharging ground water. It helps boost up

ground water resources. As against ground water occurring at a few feet below the ground level. It occurs several hundred feet below the ground level. This situation can be corrected by conserving every drops of ground water, rain water harvesting and rain water recharging.

**How the Government is tackling** :

The Government of Andhra Pradesh carefully examined and sanction of permanent argumentation of water supply scheme to Madanapalle Town with H.N.S.S. as a source by constructing SS tank, Filter beds with treatment plant and supply to the existing distribution system. The cost of the project is around 138 crores. The investigation of the scheme is under progress for the preparation of DIR by the public Health Engineering Department.

Another proposal was prepared and submitted to the District Collector by the Panchayat Raj (RWS) Department to convert all the 16 irrigation tanks into percolation tanks by way of closing the sluices to improve the ground water table to the existing bore wells.

**E.P.C.A.S ( Environmental Promotion & Consumer Awareness Society) :**

1. EPCAS is headed by Dr. S. Siddiraju a qualified and Experienced Hydro-Geologist with a lot of concern for Environment and Natural resources and Public issues.

2. EPCAS is a dully-registered association that was established in 1998.

3. EPCAS has been conducting a number of need specific programmes through peoples participation covering the following.

    a) Awareness building on environment and students role.
    b) Awareness camps on Ground water conservation rainwater harvesting, surface water conservation structures, desiltation of tanks. The traditional harvesting of water was almost forgotten. For. Eg. The harvesting techniques adopted by the kings in Chandragiri fort where the water was used for drinking and the excess water was diverted to the fields. Basing on this

technique, I have prepared an inter connected water harvesting plan for an individual house and the society as well. If this plan is materialized, there will be no shortage of drinking water and the harvested water will be well preserved. In particular I have a proposal to inter connect 16 tanks around Madanapalle to reduce the shortage of water in the town.

c) Awareness camps on natural resource management and farmer's role.

d) Awareness camps in WALTA Act

e) Awareness camps an community participation in management of Forest resources.

f) Submitted an analysis report on the quality and ingredients of bottle, and packet water to CM, PM and President.

g) Conducted a number of Youth Empowerment programmes.

**PROPOSED EPCAS ACTIONS**

1 Building pressure and conducting advocacy programmes/camps to introduce uniform regional policies by considering existing various sources in respect of each region.

2 Holding sustained discussion with elected representatives for expediting proposed water related measures.

3 Building awareness and concern in all the officials and citizens to convert existing irrigation sources as percolation tanks.

4 Awareness building on the need and usefulness of strengthening structures for conservation of water.

5 Advocacy camps to encourage individuals and community to go far rain water harvesting structures.

6 Installation of water meters as a part of regional policy, for rationale use.

7 Organizing awareness camps, public rallies and meetings to educate and to feel responsibility for proper management of water targeting students, women, farmers.

**PAST ACTIVITIES AS AN INDIVIDUAL**

1. I am a Hydro-Geologist by profession with considerable field and subject related experience of 15 years.

2. I have carried out a number of field surveys with regard to geological and hydro-geological issues of concern in this area. I have done field surveys and connects activities for local municipality, Panchayat Raj, (Rural Water Works) and other service agencies (CAPART)

3. I have to my credit of being a successful hydro-geologist and have identified 350 (this year drought condition) of potential water points.

4. I have been working as a Lecturer and Head of the Department of Geology in Besant Theosophical College for the past 10 years.

5. I have prepared and submitted a number of Hydro-Geological reports to various Government Departments and Agencies highlighting the problems, needs and solutions for example like, Handri Neeva Sujala Sravanthi.

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