DFID

Engineering Knowledge and Research Programme

Department for International Development, UK

Water demand management in areas of groundwater over-exploitation

Chennai Workshop: Saturday 20 November 2004

REPORT ON AFTERNOON WORKSHOP

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

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Contents

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1. Introduction

The research project on water demand management in areas of groundwater over-exploitation is being undertaken and funded as part of the UK Department of International Development (DFID)'s Knowledge and Research Programme.

The purpose of the research is 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)

Case studies have been undertaken in Chennai, India and Al Jafr, Jordan during 2004. The general findings and those which relate to the studies in India were presented and discussed during the Mornings Sessions of the Workshop held at IIT, Chennai on 20 November 2004.

This document reports the findings of the Afternoon Sessions of the Workshop

2. Objective of the Afternoon Workshop

The objective of the Afternoon Workshop was to test a number of water demand management measures that could be applicable to the Chennai Case Study area[1]. The means of achieving this was through rating and ranking exercises in which three groups with different perspectives (Technical, Economic and Community based) evaluated options and the possible impact of a selection of measures on the poor and vulnerable.

During the first afternoon Session, each group discussed eleven water demand management measures and then rated them against viability, ease of implementation and chance of success. Three measures were then selected for impact evaluation.

During the second Session, the three measures were examined by the three groups independently with respect to their likely impact on the poor and vulnerable members of the community in the Case Study area.

The conclusions of the Workshop will be used to support the development of a strategy for water demand management to be determined by the research team during early 2005.

[1] The study area comprises the area south of the Tamil Nadu – Andhra Pradesh boundary, the District of Tiruvallur covering the A-K aquifer and Chennai Metropolitan Area…

3. Composition of working groups

Three Working Groups were formed from the Workshop delegates. The groups were composed of members who felt themselves best suited to examine the water demand management measures from: (i) technical; (ii) economic; and (iii) social or community based perspectives.

A list of the participants is given in Appendix A.

Each group had a nominated Chairman, Rapporteur and Facilitator as follows:

	Chairperson	Rapporteur	Facilitator
Technical	Dr S.M.Ramasamy	Dr S.Chidambaram	John Petrie
Economic	Dr P Appasami	Kandaswamy Barathan	Tran Kim Thanh
Social	Mrs Shoba Iyer	Louis Menezes	Dr Elizabeth Mann

The Chairperson's role was to call the group together, give general direction to the group and ensure that it met time deadlines.
The Rapporteur role was to take notes and present any reports required when the three groups met together at the end of the two Sessions.
The Facilitator ran the action of the meeting, eliciting ideas and assisting participants as necessary in the discussion and in presenting their evaluations.

The numbers completing evaluation forms in each group were:

(i) Technical	Session I (16); Session II (11)
(ii) Economics	Session I (8); Session II (6)
(iii) Social	Session I (12); Session II (10)

4. Methodology

(i) Water demand management measures selected for evaluation

The research team has identified over twenty water demand management measures that could be applied to in the Chennai region. These have been classified under three broad categories:

- Technical measures (e.g. reduction in water losses, more efficient irrigation)
- Allocative, financial and market-based measures (e.g. allocations and quotas, changes in cropping pattern or land-use, water tariffs)
- Other socio-economic measures (e.g. community level management, water user groups, resettlement)

For workshop purposes, eleven of these measures were chosen, five relating principally to the domestic/municipal/industrial sector and six relating principally to the agricultural sector.

Measures chosen were:

	Domestic/Municipal/Industrial
DT1	Reduce Water Loss (leakage control)
DT2	Water Saving Devices
DT4	Use of "grey" Water
DA4	Water Tariff
DS1	Community Level Management
	Agriculture
AT1	Improve efficiency of surface irrigation
AT2	Introduce sprinkler/drip irrigation
AA1/2	Water quotas and allocations
AA3	Land use change and control
AA5	Change cropping pattern
AA7	Introduce water tariff

Descriptions of these measures are given in Appendix B.

(ii) Evaluation of water demand management measures

Evaluation of the measures was undertaken by each Group with each member of the Group scoring the measures against three indicators. These were the measure's "viability", "ease of implementation" and "chance of success". Records were made on an Evaluation Table (attached as Appendix C).

The scoring of each indicator was on the basis of the following rating: 0 (none); 1 (low); 2 (medium); (3) high, providing a total possible score of 9 for each measure. The results are given in Section 5.

(iii) Evaluation of the impact of selected measures on poor and vulnerable

During the break, the results of the three working Groups were compared. Three water demand management measures were selected for evaluation of the potential impact they would have on the livelihoods of the poor and vulnerable. The measures selected were:

	Domestic/Municipal/Industrial
DA4	Water Tariff
DS1	Community Level Management
	Agriculture
AA5	Change cropping pattern

The basis of the selection was as follows:

Two were selected from the Domestic/Municipal/Industrial category; DS1 which was the top ranked measure by the combined groups and DA4 which was the one which showed the greatest disparity between the groups.

One measure was selected from the Agricultural category. This was AA5 (Cropping pattern change) which was ranked third after AT1 and AT2 (i.e. measures which improve water use in irrigation systems). The impacts of AT1 and AT2 were considered to be reasonably well known already.

Each Group was then reminded of the nature of the poor and vulnerable in both rural and urban contexts, as outlined in the morning's presentation. Definitions of poverty and vulnerability were provided (Appendix D), to clarify for participants the sort of persons who were being considered in the impact evaluation.

The selected measures were examined by each of the Groups with each member of the Group indicating the likely impact of the implementation of the measures on poor and vulnerable sections of the community[2]. The Impact evaluation table is given below. (see also Appendix C).

Vulnerability Indicator	**Impact on poor & vulnerable**			
	Positive Impact	**Negative impact**	**No change**	**Does not apply**
1. Access to water				
2. Quality of water				
3. Affecting livelihood				
4. Affordability				
5. Sense of empowerment				
6. Health				

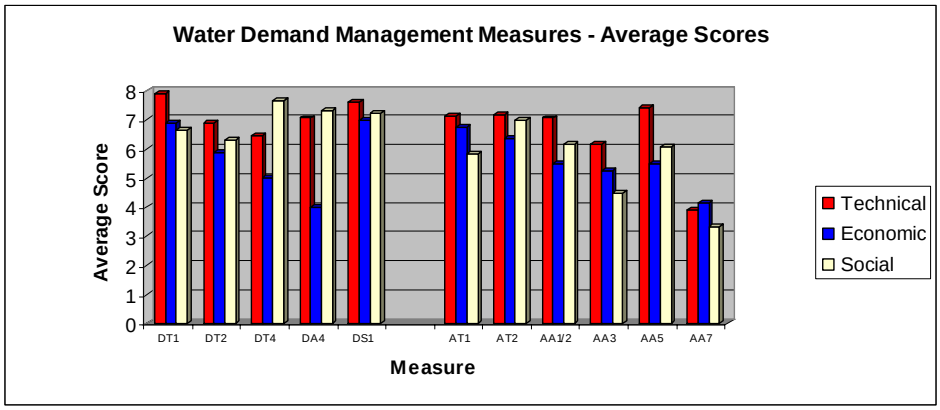
Group members were asked to indicate, by entering an X in cells in the Impact Evaluation Tables the impact of each of the three measures. Six poverty indicators: access to water; quality of water; livelihood affectedness; affordability; sense of empowerment; and health were rated separately for positive impacts, negative impacts, no change, and non-applicability. Results are given in Section 6.

5. Evaluation of water demand management measures - outcome

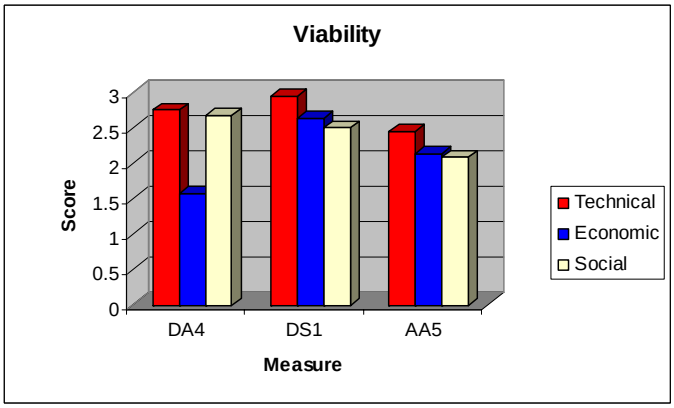
Working Group outputs on the evaluation of the five domestic and six agricultural demand measures were compared to see whether there were significant differences in perspective and views of the three Groups. The chart below show the comparisons for each of the eleven measures. The (i) viability; (ii) ease of implementation; and (iii) chance of success of introducing them were evaluated. Results for the three selected measures are given below. Further details are given in Appendix E.

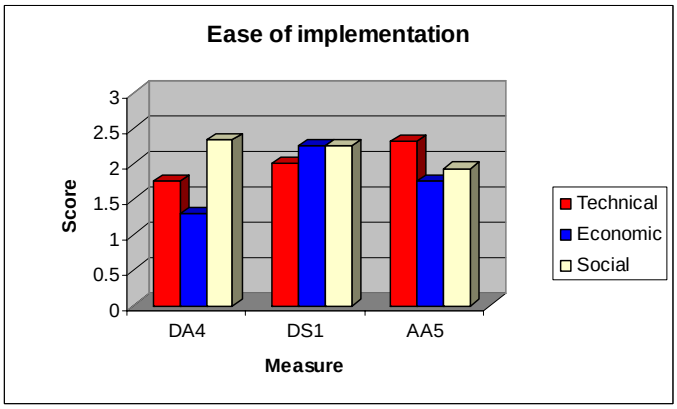
[2] The definition of poor and vulnerable is given in Appendix D

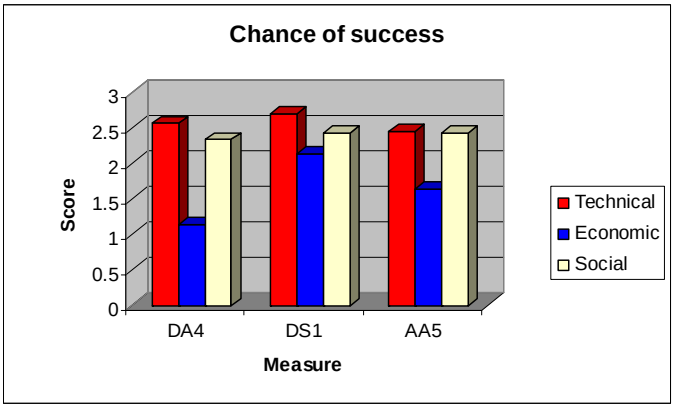
Evaluation of Water Demand Management Measures



Selected demand management measures analysis







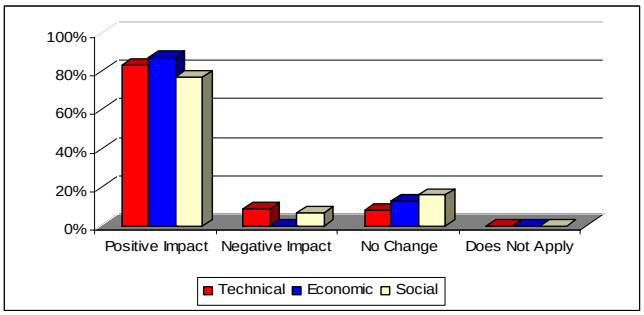
Most of the demand management measures were scored similarly by all three groups. The economic group scored DA4 (Domestic water tariffs) much lower than the other groups mainly due to their opinion that in a limited supply situation the imposition of tariffs: would not influence the demand; would be difficult to implement politically, and would have a low chance of success as a result of the other two factors.

All groups considered AA7 (Agricultural water tariffs) as the least likely to be effective. The Social group considered DT4 (Use of grey water), more than the other groups, likely to be the most effective.

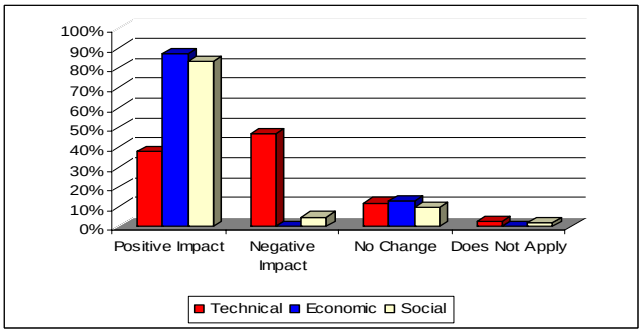
6. Impact of selected measures on poor and vulnerable – outcome

Working Group outputs were compared, to see how technical, economic and community perspectives coincided or differed. The following charts illustrate comparative views that the different Working Groups held with respect to the selected three water demand management options.

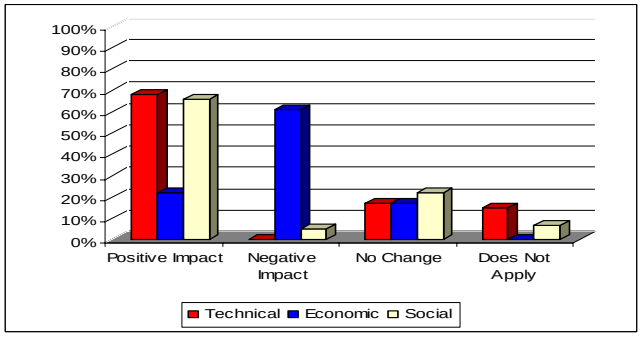
WDM Measure DA4: Domestic Water Tariffs



WDM Measure DS1: Community Level Management



WDM Measure AA5: Change Cropping Pattern



Interestingly, there is quite a high degree of consensus of opinion on many of the indicators, particularly for option DA4 (Domestic water tariff), with all groups showing a positive rating. Opinions diverged quite sharply for option DS1 (Community mobilisation) between the technical group as compared to the economic and social groups. For option AA5 (Cropping pattern change), the technical and social groups were more aligned in opinions, but the economic group differed.

More detailed charts showing where opinions differ most are included as Appendix F. Key differences in option DS1 focused on technical concerns that community management would have negative impacts on livelihoods, water quality and health. Reasons for this included concern that communities would delay distribution of water, leading to reduced access, higher costs and increased risks from infection from standing water.

The social and economic groups considered DS1 would have more positive than negative impact, given that many slum communities are already managing the demand for water promptly within the community (from the limited supplies of water) upon delivery by water tanker, and no-one allows it to sit for any length of time as every household needs to use it immediately. These groups did not consider that costs would be higher than the poor are currently required to pay.

6. Conclusions

The objectives of the Workshop were met. Some useful indicators of the differing points of view of the three Groups were obtained.

In the first Afternoon Session, where eleven water demand management measures were evaluated, there was generally a good deal of agreement between the groups in scoring the measures. The greatest difference was in DA4 (Domestic water tariff) which the Economists thought would not be effective in reducing demand. All groups rated AA7 (Agricultural water tariffs) as likely to be the least effective measure.

In the second Afternoon Session, the water demand management impact assessment exercises demonstrated that stakeholders may have widely differing views on how different water demand management measures would affect the poor and vulnerable.

The challenge to planners is how to integrate informed and useful opinion into an overall decision-making process on water demand management measures without alienating some sections of society.

By developing methodologies which draw upon public opinion and by acknowledging where differences of opinion lie and why they are different, planners in the water sector can become better informed and better equipped to develop practical and realistic water sector policies for circumstances of water scarcity.

The Study Team acknowledge, with thanks, the valuable contributions made by participants at the Workshop.

Appendix A. List of participants

1,	Mr S P Ambrose, IAS (Retd)	@
2.	Mrs Andal Damodaran Indian Council For Child Welfare	@
3.	Mr Ananda Rajan Doss SUSTAIN	X
4.	Mr M Anandakrishnan MIDS	
5.	Mr T K Arunachalam Advisor, Trade and Investment British High Commission	@
6.	Mr P L Annamalai Senior Hydrogeologist, Metro Water	XXX
7.	Mr R Bhuvana Consultant Social Studies	X
8.	Mr P Baskar Doss, I A S Secretary, Agriculture Department Govt of Tamil Nadu	
9.	Mr T Balasubramanain Asst Director (Geology) PWD	XXX
10.	Mr P Balasubramanian Consultant – Environment	XXX
11.	Mr R Chakrapani Regional Director Central Ground Water Board	@
12.	Dr S Chidambaram Reader, Dept of Geology, Annamalai University	XXX
13.	Mr G Dattadri Trustee, SUSTAIN	
14.	Mr M G Devasahayam, IAS (Retd) Trustee, SUSTAIN	XX

15.	Mr David Abbott Second secretary, Trade & Investment British High Commission	@
16.	G Dinesh Consultant, Environment	XXX
17.	Dr EASO John Consultant, Water	@
18.	Mr P G Ganapathy Regional Manager, Black & Veatch	XX
19.	Mr S Gnanasekaran Farmer	XXX
20.	Mr Gopinath General Manager, Hotel Regency	XX
21.	Mr K P Ganesan Vice President, Sakthi Sugars	
22.	Mrs C K Gariyali IAS Secretary, MA & WS Dept Govt of Tamil Nadu	
23.	Mr R Hariharan, Auditor	XXX
24.	Mr Ian Curtis Senior Advisor DFID – India	@
25.	Mr G Israel Secretary, JANODAYAM	X
26.	Mr Jeremy Goad Director, International Projects, Black & Veatch Consulting	@
27.	Mr Krishna Srinivasan Legal Consultant	
28.	Fr Kurien Thomas Director, ASHA NIVAS	X
29.	Mr T T Kodhandapani Farmer	XXX

30.	Mr Kandasamy Bharathan Economist	XX
31.	Mr L N Krishnan IAS Special Secretary, Finance Govt of Tamil Nadu	
32.	Mr Louis Menezes, IAS (Retd)	X
33.	Mrs Lakshmi, Reporter, The Hindu	@
34.	Mr C Munianathan General Manager, Metrowater	
35.	Mr D Madavamurthy Chief Engineer, Metrowater	
36.	Mr S V Narasimhan Managing Director, Chennai Petroleum Corporation	
37.	Mr P S Neelakantan General Manager, Madras Fertilizers Limited	
38.	Mr K V Nair Chairman – Sakthi Gripa Foundation	X
39.	Mr Natesan Farmer	XXX
40.	Dr Paul Appasamy Madras School of Economics	XX
41.	Mr N S Palaniappan IAS Secretary, PWD Govt of Tamil Nadu	
42.	Mr S Prakash Tamil Nadu Water Investment Company	XXX
43.	Mrs Dr Parvathi Rajagopal Retd, Director Institute of Paediatric & Child Health	@

44.	Mr N Ravinadra Kumar Mas Aqua Techniks (P) Ltd	XXX
45.	Mr S Ranganathan Engineering Director, Metrowater	@
46.	Mr S Ramakrishnan, IAS Prinicpal Secretary Food & Consumer Protection Govt of Tamil Nadu	
47.	Dr S M Ramasamy Director, Center for Water Resources	XXX
48.	Dr A M Swaminathan, IAS (Retd)	@
49.	Mrs Smita Nagaraj, IAS Special Secretary, MA&WS Dept Govt of Tamil Nadu	
50.	Mr V Sivakumar Chief Engineer, Metrowater	XXX
51.	Sr Shanti Don Bosco Social Service Society	X
52.	Mr S Srinivasan Consultant – Water	
53.	Mr R Seshasayee Managing Director, Ashok Leyland	
54.	Mrs Shoba Iyer Consumer Action Group	X
55.	Mr S Sendhil Kumar Asst Hydrogeologist, Metrowater	XXX
56.	Mr P Subramanian Asst Hydrogeologist, Metrowater	XXX
57.	Mr V Somasundaram Special Secretary, PWD Govt of Tamil Nadu	@

58.	Mr N Shyam Kumar Consultant – Water Transmission	XX
59.	Mr Stuart Innes Deputy High Commissioner Southern India, British High Commission	@
60.	Mr V Thangavelu IAS Managing Director Metrowater	
61.	Prof Vetrivel Dept of Mathematics, IIT, Chennai	@
62.	Mr A K Venkatasubramanian IAS (Retd)	@
63.	Sr Vimala Presentation Convent Community Development Projects	X
64.	Dr Vatsala Nair Senior Vice President Wilbur & Smith Consultancy	@
65.	Mr S Vijayakrishna Consultant – Water Royal Haskoning India (P) Ltd	X
	Participants in Group discussion – Social	
	Participants in Group Discussion – Economic	XX
	Participants in Group discussion – Technical	XXX
	Attended the Workshop	@

Water demand management in areas of groundwater over-exploitation

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1st Afternoon Session - Discussion Groups (Part I)

Appendix B

WATER DEMAND MANAGEMENT MEASURES –EVALUATION

DESCRIPTION OF WATER DEMAND MANAGEMENT MEASURES

DEMAND MANAGEMENT MEASURES – DOMESTIC/MUNICIPAL/INDUSTRIAL

DT1 Reduce water loss (leakage control)

Description of measure

The measure relates to leakage control to reduce water losses from the pipe system. It consists of (i) transmission loss; (ii) meter under-registration; (iii) leakage and illegal use. The measure is implemented through repairing leaks, pressure control, pipe replacement and rehabilitation. Leak detection is also required to locate sites of leakage.

DT2 Water Saving Devices

Description of measure

The measure would provide better plumbing at household level and introduce water saving devices to reduce water consumption. The measure includes high technology shower/taps, toilet flushing. Currently there are several types of (i) toilets with 6-10 litres flush comparing to "traditional one" of 15 litres; (ii) Faucets of 6 litres/minute compared to that of 20 litres/minute; (iii) washing machine using 60-70 litres/load compared to 100-120 litres/load. This has a potential for water savings, however, water saving faucets always require high pressure in a pipe. This may limit the scope of application.

DT4 Use of "grey water"

Description

Re-use of water that has already been used for domestic uses such as washing or cleaning for other purposes such as garden watering or outside use.

DA4 Domestic Water Tariff

Description

By charging a higher tariff to those who consume high amounts of water, this measure aims to reduce the amount of water consumed. A progressive or stepped water tariff provides a method of ensuring all consumers can afford a basic quantity of water (charged at a low tariff) but those who consume more have to pay for additional amounts at higher tariffs. Or by charging a different tariff to different types of users or different socio-economic groups, this measure aims

to reduce the amount of water consumed. Through this measure, water may be re-allocated among the users and/or induce a saving of water which may be used to serve new connections.

DS1 Community level management

Description

Where the supply of water is restricted or unreliable, the community manages demand through managing local distribution to make the most appropriate and best use of available water.

DEMAND MANAGEMENT MEASURES - AGRICULTURE

AT1 - Improve efficiency of Surface Irrigation System

Description

In many surface irrigation schemes the overall irrigation efficiency (consumptive use as a percentage of water supplied from the source) is low due to (i) poorly maintained earth canal systems; (ii) low operation efficiency; and (iii) low field application efficiency due to poor on-farm development. The losses to evaporation may be reduced by (i) lining the irrigation canal system, (ii) improving operation of system; and (iii) improving irrigated field to reduce on-farm losses.

AT2 Introduce Sprinkler and Drip Irrigation System

Description

The measure would encourage the use of sprinkler and drip irrigation systems so that evaporative losses are reduced. The development of sprinkler and drip irrigation has been considerable in India in recent years, mainly due to the pressing demand for water from other sectors.

AA1/2 - Water Quotas and Allocation

Description

When renewable resources are being over-exploited, defining inter-sectoral and intra-sectoral water allocations and quotas for the water consuming sectors (e.g. domestic, municipal, industrial and agricultural users) – the limits to abstraction - becomes a priority.

Sectoral allocations can then be applied. Once sectoral allocations and quotas for the water consuming sectors (e.g. domestic, municipal, industrial and agricultural users) have been defined, it may be necessary to define the quotas within any water using sector. For example quotas may be defined for different farming communities.

AA3 Change Land-use

Description

This measure will bring about a change in land use from agricultural to non-agricultural use, thereby eliminating the use of water for agriculture. This may be done by a number of methods: for example (a) land purchase; (b) re-zoning/re-classification; (c) well buy-out and transfer of water rights, and may release water for other uses.

AA5 Change Cropping Patterns
(a) through extension services; (b) through applying tax;

Description

This measure relates to a change of cropping pattern from high irrigation water requirement (normally paddy and sugarcane) to lower irrigation water requirement (less water consuming crops). Different supporting measures could be employed to bring about the changes, including services to classify land suitability and markets for new products. In the A-K basin, the main cropping patterns at present are paddy-paddy, paddy-paddy-paddy, and paddy-groundnut.

AA7 Introduce Water Tariffs

Description

The measure would have to be introduced at a regional or national level with the aim of reducing agricultural water consumption. There tariff options available are those: (a) based on volume pumped; (b) based on power supplied to pump; and (c) based on area irrigated. The impact of the measure is unpredictable. The choice of tariff levels requires considerable extra study (of technical, social and economic aspects) and piloting before its introduction.

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1st Afternoon Session - Discussion Groups (Part I)

WATER DEMAND MANAGEMENT MEASURES – EVALUATION

Appendix C

GROUP: Technical / Economic / Social ***[delete as applicable]***

EVALUATION TABLE

Score 0 (none); 1(low); 2(medium); 3 (high)

Ref.	Measure	Viability	Ease of implementation	Chance of success	Total score
	Domestic/Municipal/Industrial				
DT1	Reduce Water Loss (leakage control)				
DT2	Water Saving Devices				
DT4	Use of "grey" Water				
DA4	Water Tariff				
DS1	Community Level Management				
	Agriculture				
AT1	Improve efficiency of surface irrigation				
AT2	Introduce sprinkler/drip irrigation				
AA1/2	Water quotas and allocations				
AA3	Land use change and control				
AA5	Change cropping pattern				
AA7	Introduce water tariff				

2nd Afternoon Session - Discussion Groups (Part II)

WATER DEMAND MANAGEMENT MEASURES – IMPACT EVALUATION

GROUP: Technical / Economic / Social *[delete as applicable]*

Water Demand management measure: ……*[Selected from Part II]*

Score **X** in appropriate column

Vulnerability Indicator	**Impact on poor & vulnerable**			
	Positive Impact	**Negative impact**	**No change**	**Does not apply**
1. Access to water				
2. Quality of water				
3. Affecting livelihood				
4. Affordability				
5. Sense of empowerment				
6. Health				

Water Demand management measure: ……*[Selected from Part II]*

	Impact on poor & vulnerable			
	Positive Impact	**Negative impact**	**No change**	**Does not apply**
1. Access to water				
2. Quality of water				
3. Affecting livelihood				
4. Affordability				
5. Sense of empowerment				
6. Health				

Water Demand management measure: ……*[Selected from Part II]*

	Impact on poor & vulnerable			
	Positive Impact	**Negative impact**	**No change**	**Does not apply**
1. Access to water				
2. Quality of water				
3. Affecting livelihood				
4. Affordability				
5. Sense of empowerment				
6. Health				

Appendix D Vulnerability indicators & definitions of poverty and vulnerability

Vulnerability indicator	Indicator explanation
1. Access to water	Will this make the quantity of supply sufficient for the poor and vulnerable? Will it improve the frequency of supply? Does it mean the source of supply will become more or less accessible and easy to reach
2. Quality of water	Will the measure improve the quality of potable water or not?
3. Affecting livelihood	Will the water demand management measure change the current impact of water shortages on people's livelihoods
4. Affordability	Can people afford to pay for the water demand management measure? Will they be better able to pay connection charges, water bills etc?
5. Sense of empowerment	Will the water demand management measure enhance equity of water distribution to the poor and vulnerable or will it marginalise them even further? Can it be managed by effective community participation or not?
6. Health	Will this water demand management measure reduce the number and type of water related health problems or increase them?

MOST VULNERABLE TO WATER SHORTAGE

Agriculture:

- **Marginal farmers (approx. 4 acres or less)**
- **Landless Labour**

Urban dwellers:

- **Elderly**
- **Women-headed HHs, no adults**
- **Inner city low income groups**
- **Poorly served areas**
- **Non-formalised slum dwellers**
- **Daily wage earners**

POVERTY DEFINITION - SUSTAINABLE LIVELIHOOD APPROACH (SLA):

The SLA defines poverty in terms of an asset base. Do the basic needs of a household outstrip the resources available to meet those needs. Five key assets are identified. Those who are poorest have least amount of these assets:

- **HUMAN** assets (absence of working adult males in proportion to number in household)

Water impact: *too few adults mean no-one is available to wait for water deliveries*

- **FINANCIAL** assets (household income not more than Rs. 4,000 a month, mainly dependent on daily wage labour)

Water impact: *insufficient household funds to pay for direct water connections, water storage facilities, independent borewells, or bulk purchase of water*

- **SOCIO-POLITICAL** assets (low level knowledge and use of tools and technologies, no effective social or political influence)

Water impact: *no power to influence water service providers*

- **NATURAL** assets (no ownership of water resource)

Water impact: *heavily dependent on external water suppliers, location determines quantity and quality of water supply*

- **PHYSICAL** assets (owning no land or property, or less than 4 acres of land or very poor quality housing)

Water impact: *no space or right to install borewells, tankers cannot negotiate narrow lanes*

•VULNERABILITY DEFINITION:

Greater likelihood of experiencing harmful or negative impact as a consequence of water shortage

The poorest as defined above, are more vulnerable to the impacts of water scarcity than those with more assets.

Appendix E: Working Group evaluation of water demand management measures

List of water demand management measures evaluated by Working Groups

	Domestic/Municipal/Industrial
DT1	Reduce Water Loss (leakage control)
DT2	Water Saving Devices
DT4	Use of “grey” Water
DA4	Water Tariff
DS1	Community Level Management
	Agriculture
AT1	Improve efficiency of surface irrigation
AT2	Introduce sprinkler/drip irrigation
AA1/2	Water quotas and allocations
AA3	Land use change and control
AA5	Change cropping pattern
AA7	Introduce water tariff

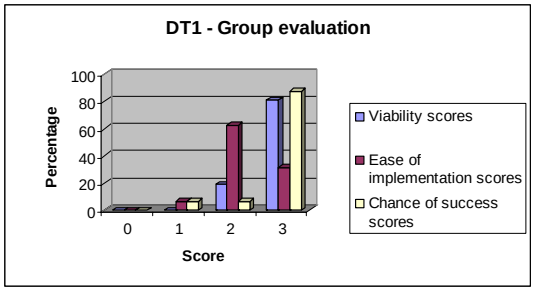
Appendix E: Working Group evaluation of water demand management measures

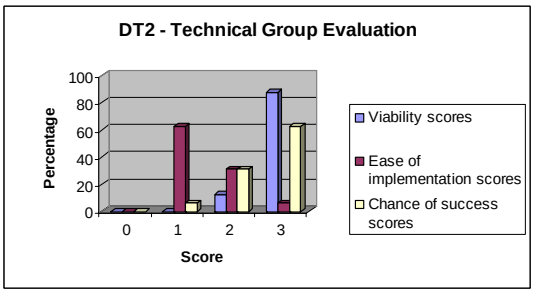
Introduction

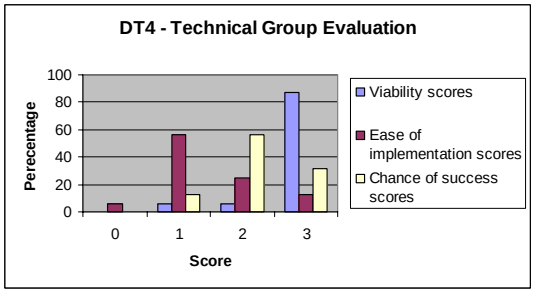
The scoring of each indicator was on the basis of the following rating: 0 (none); 1 (low); 2 (medium); (3) high. The total number of responses were standardised to percentages to allow comparison between groups with differing numbers of participants.

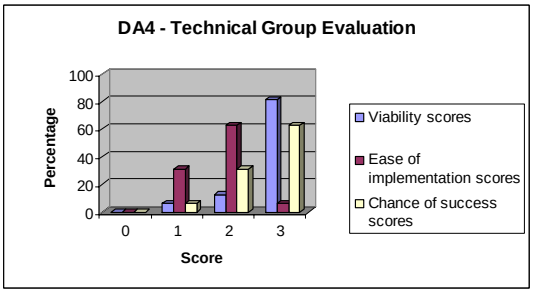
E1 Technical group results

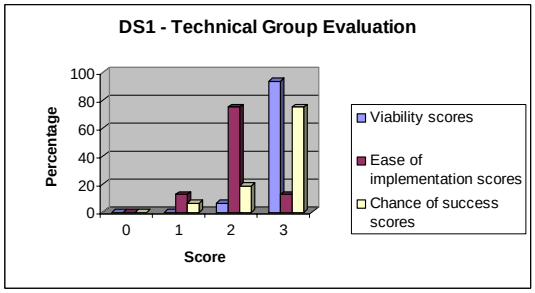
Domestic municipal and industrial demand management measures



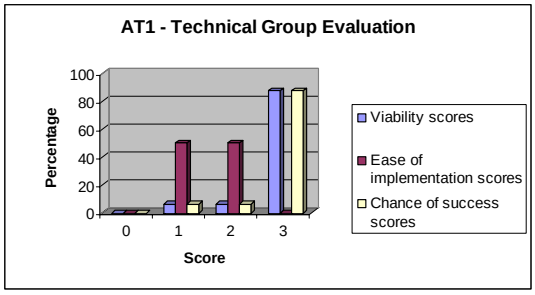


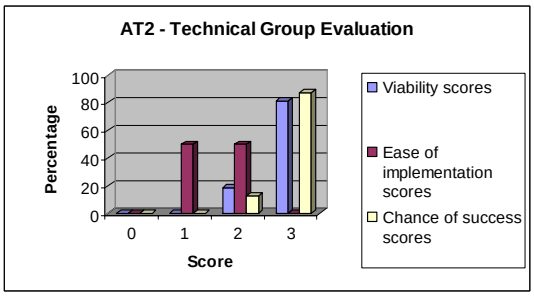


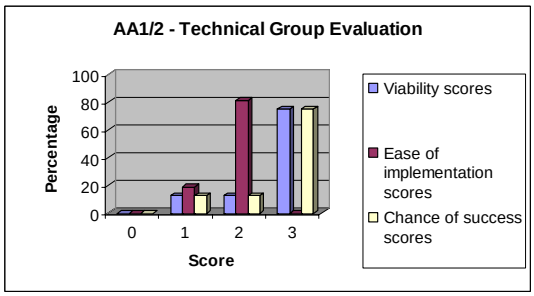


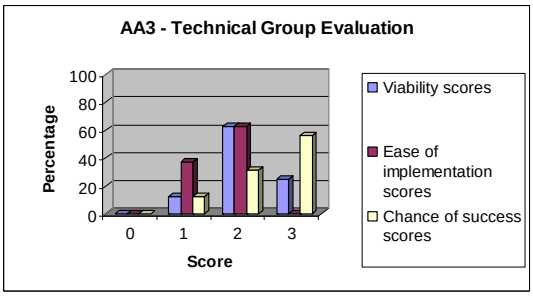


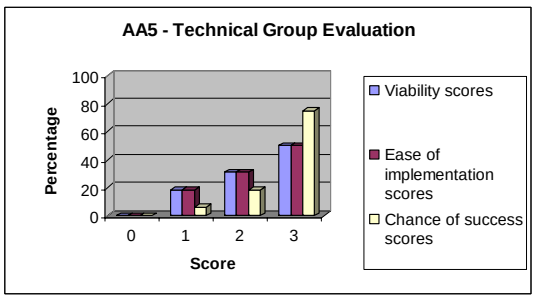
Agricultural demand management measures

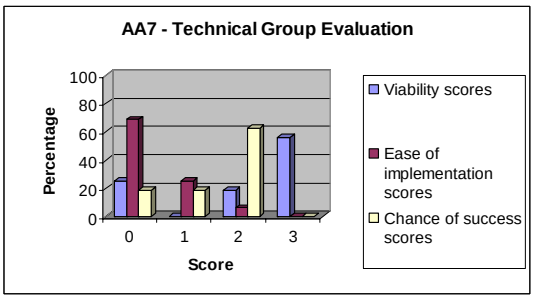






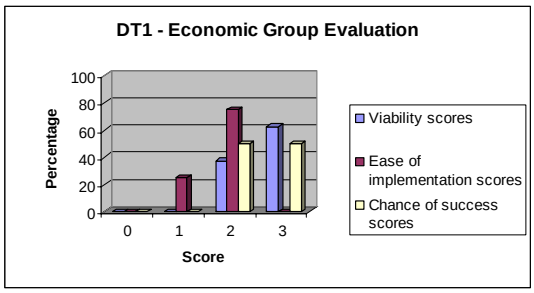


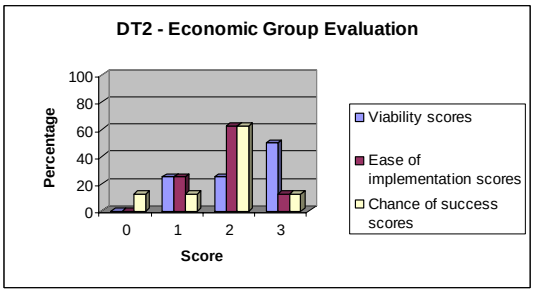


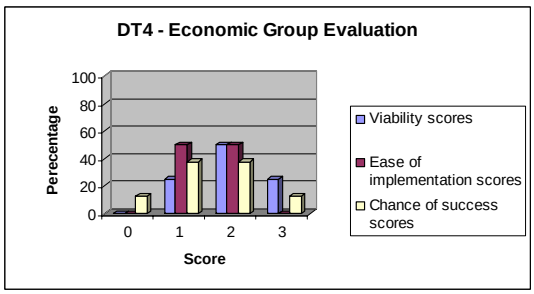


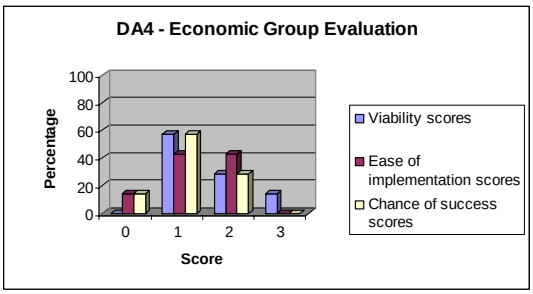
E2 Economic group results

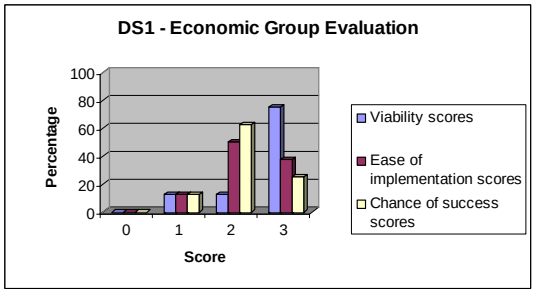
Domestic municipal and industrial demand management measures



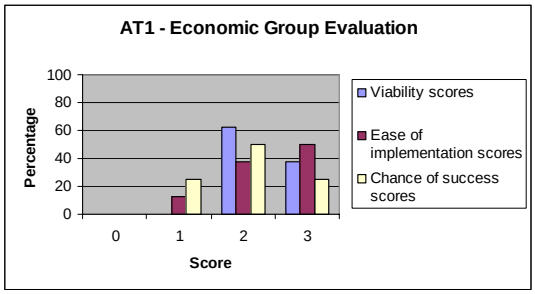


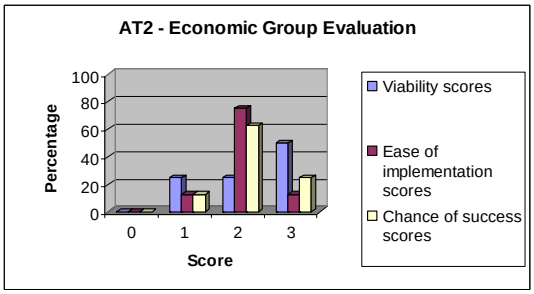


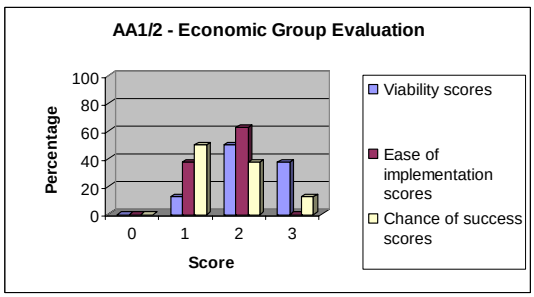


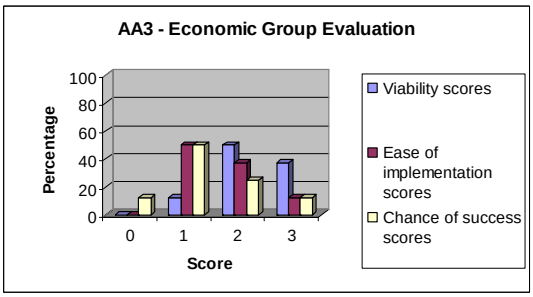


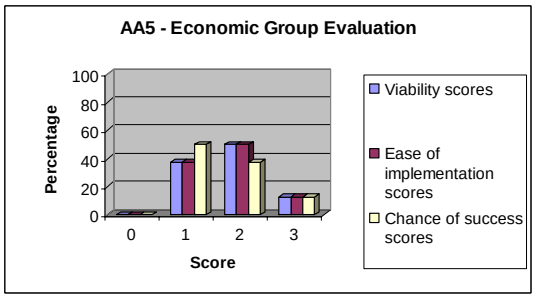
Agricultural demand management measures

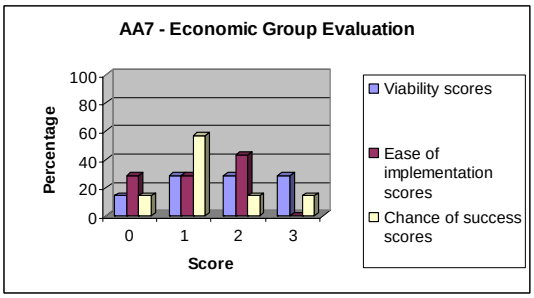






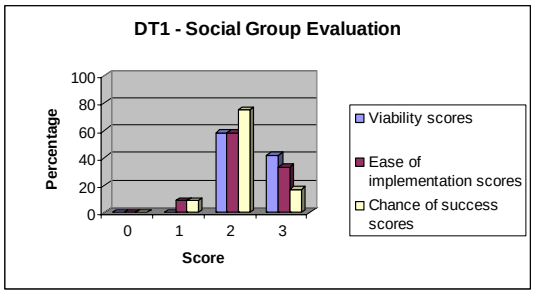


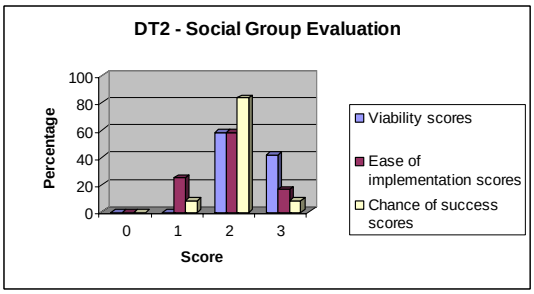


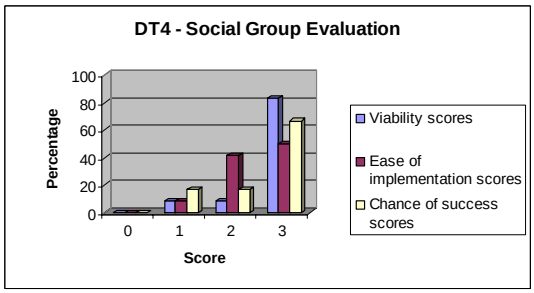


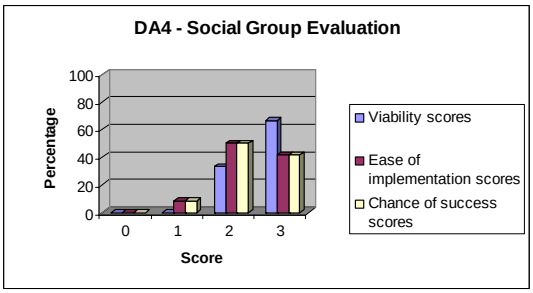
E3 Social group results

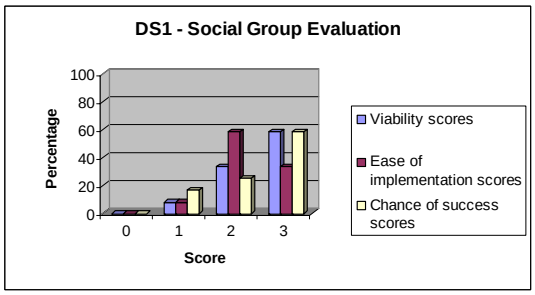
Domestic municipal and industrial demand management measures



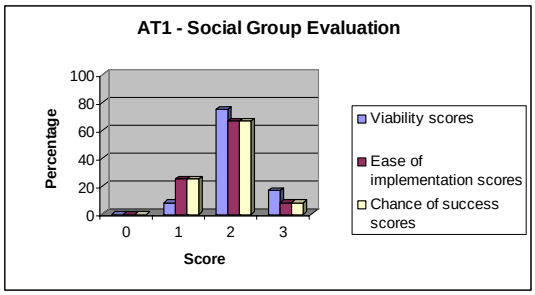


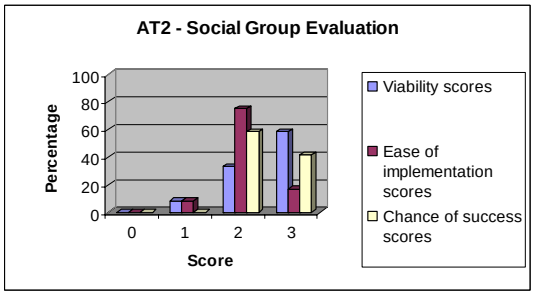


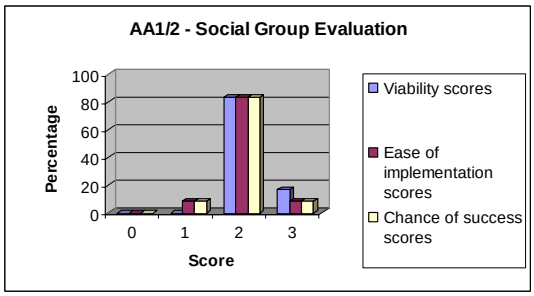


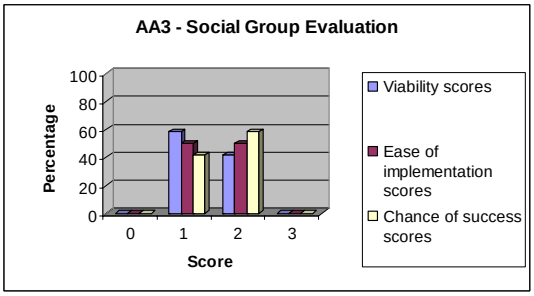


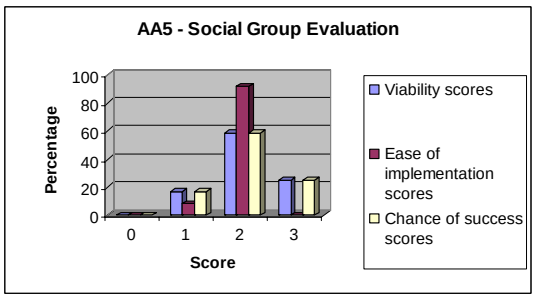
Agricultural demand management measures

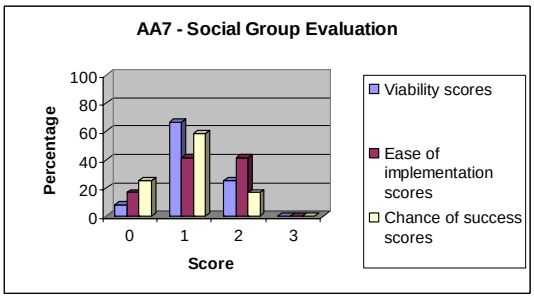








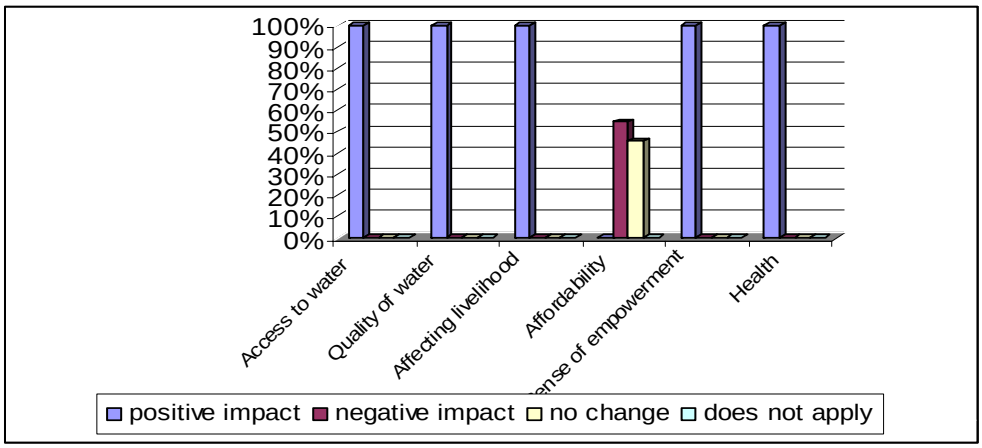




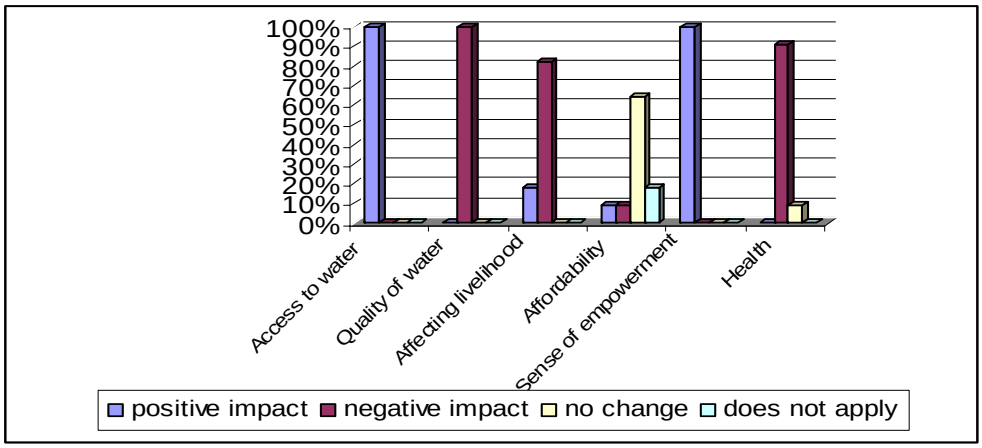
Appendix F. Working Group evaluation of impact of water demand management measures on the poor and vulnerable

F1: Technical Working Group Impact Assessment on the Poor & Vulnerable

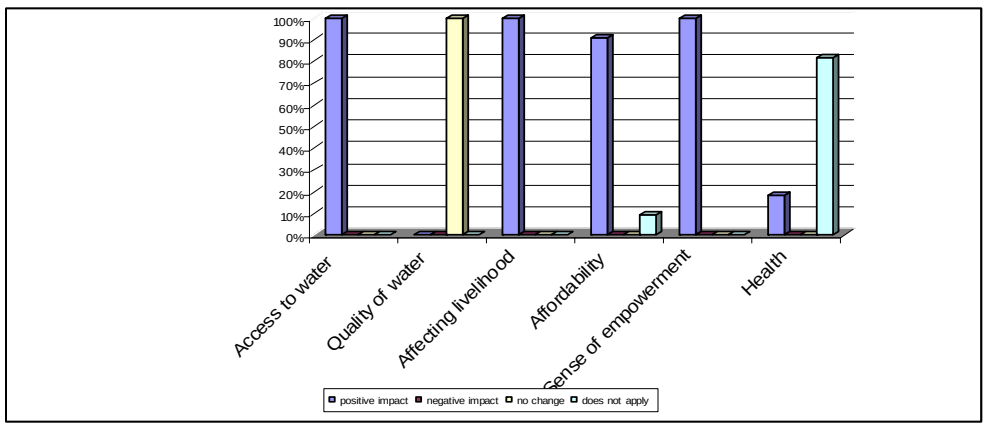
WDM DA4: Domestic Water Tariffs



WDM DS1: Community Level Management

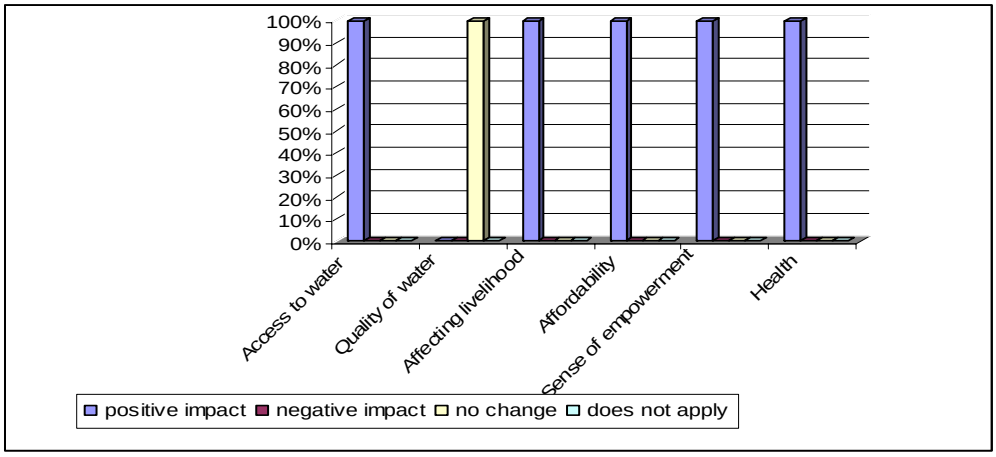


WDMAA5: Change Cropping Pattern

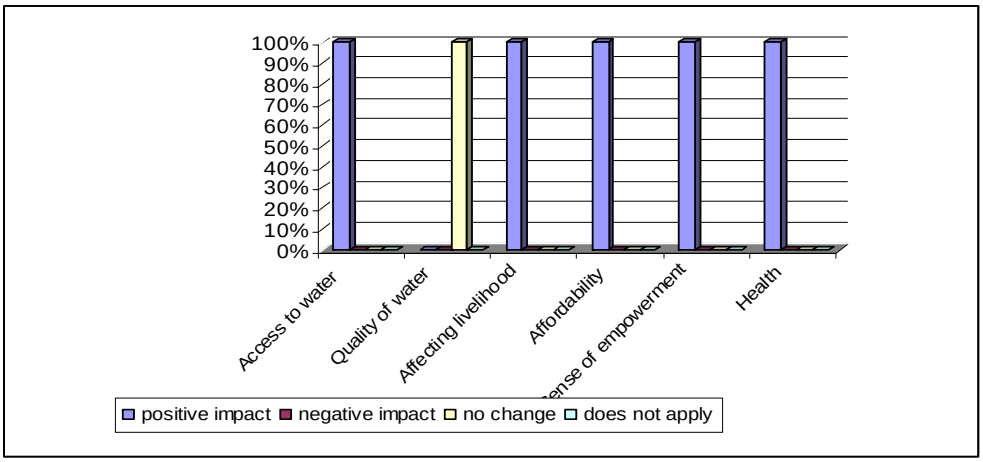


F2: Economic Working Group Impact Assessment on the Poor & Vulnerable

WDM DA4: Domestic Water Tariffs



WDM DS1: Community Level Management



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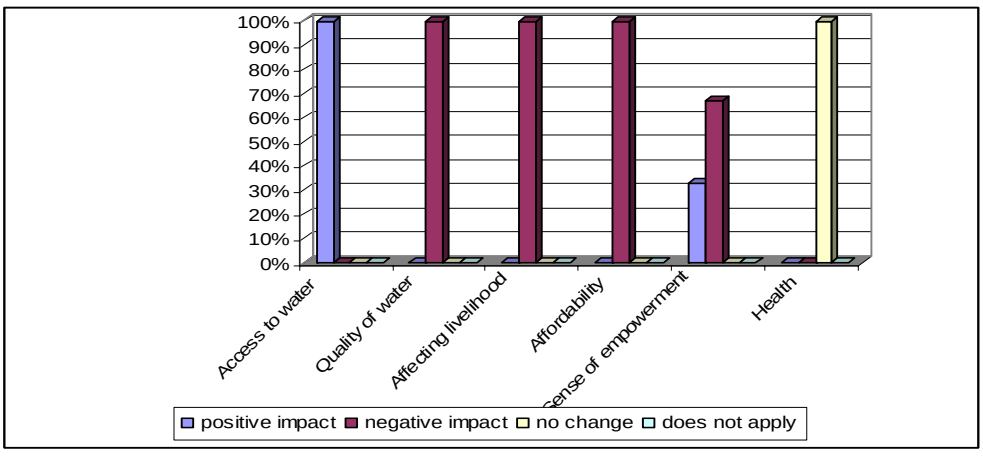
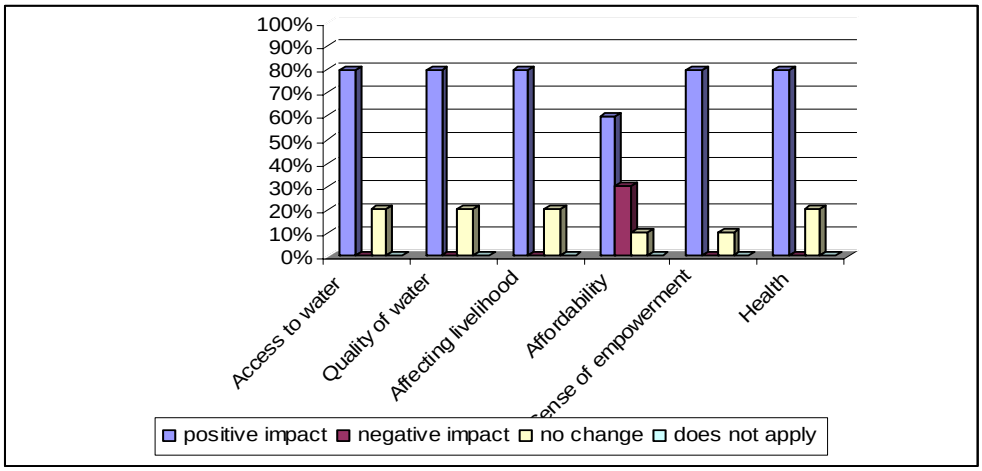
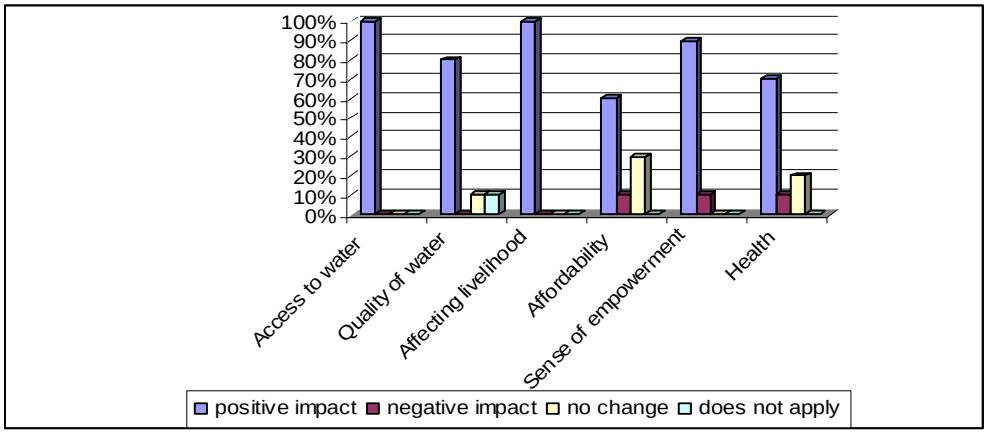


F3: Social Working Group Impact Assessment on the Poor & Vulnerable

WDM DA4: Domestic Water Tariffs



WDM DS1: Community Level Management



WDMAA5: Change Cropping Pattern