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Appendix 5, 6,7 and 8 Supporting Appendices

PREPARED FOR

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Asian Development Bank

Supporting Appendices

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Appendix 5 Selection Matrix for the Sub Basins

A. Objectives of the pilot sub basins

1. The NAPCC TA will undertake studies in three selected pilot sub-basins to develop strategic frameworks for addressing existing issues and likely scenarios of climate change. Framework planning would be applied to identify key issues, including surface, groundwater as well as the related water sectors including environment. The plans would set out broad strategies and programs to meet the needs of increased robustness and resilience of water systems against climate uncertainty, increasing water demand and environmental requirements. The pilot basins have been selected based on the type and likely degree of sensitivity to climate change. The basin selection should incorporate three major areas of concern: (i) alterations of winter snow-pack dynamics from climate change, (ii) basins or sub-basins where groundwater is major water source with issues and (iii) coastal areas where sea level rise will have impacts on surface and groundwater, together with increased flood risk.

2. The studies will be based around 'focal states' within the selected sub basins. Where sub-basins cover a number of states, other states will be incorporated as 'associate states'; to be consulted and studied to a lesser degree to support the main stream studies for the focal states. The selection of the three pilot sub basins are described below.

B. Snow Fed Basins

Alterations to snow pack dynamics causing downstream impacts

Issues: Temperature changes are likely to cause changes in the hydrologic flow regimes due to reduction of dry season flows in the North Indian Plains from reduced snow and glacier melt and increased runoffs during the monsoon.

- Focal state will be the impact area in plain immediately below the mountains
- States in lower reaches of snow fed rivers can be considered as Associate States
- To access data and planning for the mountains the mountain part should be in India
- 21 possible sub basins have been identified from this a short list of 5 basins and 4 states(Punjab, Uttar Pradesh and Assam) have been identified.

Table 1 Short listing of Snow Fed Basins

#	Basin/Sub Basin	Locations of snow and glacier water sources	Description of Impacts Areas in India (P-plain, M-mountain,)	Appropriateness for study	Sub Basin Short list	Candidate Focal State
A	INDUS					
1	Indus	China, Jammu & Kashmir	Jammu & Kashmir (M)	No plain impact area	No	
2	Chenab	Himachal	Himachal (M) and Jammu & Kashmir (M)	No plain impact area	No	
3	Beas	Himachal	Himachal (M), Punjab (P)	Plain area in Punjab	Yes	Punjab
4	Satluj	China, Himachal	Himachal (M), Punjab (P), Haryana (P)	Irrigation, Flood, GW	Yes	Punjab Haryana
5	Ravi	Himachal	Himachal, Punjab (P)	Plain impact area very small	No	
6	Shyok	China, Jammu & Kashmir	Jammu & Kashmir (M)	No plain impact area	No	
7	Zhob	Jammu & Kashmir	Jammu & Kashmir (M)	No plain impact area	No	
B	GANGA					
8	Yamuna up to Delhi	Uttaranchal,	Haryana (P), Uttar	Irrigation, Flood	Yes	Uttar

#	Basin/Sub Basin	Locations of snow and glacier water sources	Description of Impacts Areas in India (P-plain, M-mountain,)	Appropriateness for study	Sub Basin Short list	Candidate Focal State
		Himachal	Pradesh (P), Rajasthan (P), Delhi (P)			Pradesh
9	Ganga (Haridwar to Kanpur)	Uttaranchal	Uttar Pradesh (P), Bihar (P), West Bengal (P)	Irrigation, Flood	Yes	Uttar Pradesh
10	Sarda	Uttaranchal, Nepal	Uttar Pradesh	Snow/glaciers lie partially in Nepal	No	
11	Ghaghara	Nepal		Snow/glaciers lie outside India	No	
12	Gandak	Nepal		Snow/glaciers lie outside India	No	
13	Kosi	Nepal		Snow/glaciers lie outside India	No	
14	Ramganga	Uttaranchal	Uttaranchal Uttar Pradesh	Plain impact area very small	No	
15	Ajay, Banas, Betwa, Chambal, Gomti, Kasai, Mayurakhi, Ken, Rupnarayan, Sind, Sone			Non-glaciated sub-basins		
C	BRAHMAPUTRA					
16	Brahmaputra	China, Bhutan, Arunachal Pradesh	Arunachal Pradesh(M), Assam(P)	Appropriate-possibly consider upper part above Tezpur	Yes	Assam
17	Teesta	Sikkim, China, Bhutan, Nepal	Sikkim (M), West Bengal (P)	Plain impact area very small	No	
18	Manas	Bhutan	Assam (P)	Plain impact area very small	No	
19	Kameng	Arunachal Pradesh	Arunachal Pradesh (M), Assam (P)	Plain impact area very small	No	
20	Subansiri	Arunachal Pradesh	Arunachal Pradesh (M), Assam (P)	Plain impact area very small	No	
21	Dibang	Arunachal Pradesh	Arunachal Pradesh (M), Assam (P)	Plain impact area very small	No	
D	Rest of the sub-basins are non-glaciated					

C. Ground Water Basins

Where groundwater is a major water source with significant over exploitation issues

Issues: Over exploitation of groundwater is one of the most serious water issues in India

- Climate change will affect the recharge of already depleted groundwater systems
- Increased variability of surface water resources will put increased pressure on groundwater
- Properly managed and sustainable groundwater can provide a important buffer to rainfall irregularities and deficiencies in the surface water systems.

Selection: Sub basins will selected based on the levels of over abstraction based on groundwater data compiled by the Central Groundwater Board

1. Assessment of Groundwater by Basin

3. A broad assessment of groundwater by basin is presented in Table 2 below. Of the nineteen basins six have been identified as being critical. The information by basin is too broad so it is proposed to prepare an assessment based on states.

Table 2 Groundwater by Basin

#	Basin	No. of Blocks	No of Over Exploited(OE) & Critical blocks	% of OE and critical blocks	Indicative assessment
1	Indus	398	160	40	Critical
2	GANGA	2245	248	11	
2.1	Brahmaputra	350		0	
2.2	Barak	83		0	
3	GODAVARI	606	109	18	
4	KRISHNA	635	145	23	
5	CAUVERY	241	106	44	Critical
6	PENNAR	205	85	42	Critical
7	EFR between Mahanadi and Pennar	332	21	6	
8	EFR between Pennar and Kanyakumari	369	162	44	Critical
9	MAHANADI	287		0	
10	BAITARNIand Brahmani	168		0	
11	SUBARNAREKHA	104		0	
12	SABARMATI	70	27	39	
13	MAHI	94	22	23	
14	Luni	208	105	51	Critical
15	NARMADA	168	7	4	
16	TAPI	111	7	6	
17	WFR from Tapi to Tadri	151	1	0.7	
18	WFR from Tadri to Kanyakumari	280	37	14	
19	Areas of inland drainage	37	27	74	Critical

2. Assessment of Groundwater by State

4. Information on the status of groundwater is collected by the Central Ground Water Board by State. Key data on ground water from the Central groundwater board is presented in Table 3 below. A simple ranking of groundwater issues has been applied to support the sub-basin selection process as below.

- The stage of groundwater development
- The percentage of over exploited and critical blocks
- The annual draft (groundwater extraction)
- The number of areas notified
-

5. Based on an average of the four ranking methods an overall ranking of the basins has been presented in Table 3. From the ranking six states are selected for short listing .

Table 3 Summary of Groundwater by State

S. No.	Name	Area km2	Rainfall maximum (mm)	Nr Districts	Nr Blocks	Annual Replenishable Ground water (BCM)	Net Annual Groundwater Availability BCM	Annua1 Ground water Draft (BCM)	Stage of Ground water development (%)	Over exploited Blocks (Nr)	Critical Blocks (Nr)	Semi Critical (nr)	Areas notified for reg of GW (Nr)	% Overexploited and critical blocks	Ranking					Assessment
															Rank Stage of Development	Rank%OE and Critical	Rank Annual Draft	Rank Areas Notified	Average rank	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Punjab	50,632	780	17	138	24	21	31	145	103	5	4	6	78.3	2	3	2	4	*2.8*	short list
2	Rajasthan	1,483	712	32	236	12	10	13	125	140	50	14	12	80.5	3	2	7	1	*3.3*	short list
3	Haryana	53,484	1523	13	78	9	9	9	109	55	11	5	8	84.6	4	1	12	2	*4.8*	short list
4	Tamil Nadu	44,212	615	32	384	23	21	18	85	142	33	57	0	45.6	5	5	3	10	*5.8*	short list
5	Uttar Pradesh	342,239	504	32	236	76	70	49	70	37	13	88	1	21.2	7	9	1	7	*6.0*	short list
6	Madhya Pradesh	130,058	995	30	384	37	35	17	48	24	5	19	7	7.6	10	11	4	3	*7.0*	short list
7	Delhi	3,702	1999	2	12	0	0	0	170	7	0	0	3	58.3	1	4	19	5	*7.3*	
8	Gujarat	38,863	3073	14	154	16	15	11	76	31	12	69	1	27.9	6	7	9	7	*7.3*	
9	AndraPradesh	275,069	1113	23	1125	37	33	15	45	219	77	175	3	26.3	13	8	6	5	*8.0*	
10	Karnataka	307,713	1433	35	231	16	15	11	70	65	3	14	0	29.4	8	6	11	10	*8.8*	
11	Maharashtra	191,791	1779	27	175	33	31	15	48	7	1	23	0	4.6	11	13	5	10	*9.8*	
12	West Bengal	196,024	1243	25	184	30	27	12	42	0	1	37	1	0.5	14	14	8	7	*10.8*	
13	Uttrakhand	10,492	1927	4	17	2	2	1	66	2	0	3	0	11.8	9	10	17	10	*11.5*	
14	Kerala	155,707	1502	30	314	7	6	3	47	5	15	30	0	6.4	12	12	15	10	*12.3*	
15	Bihar	308,000	917	48	459	29	27	11	39	0	0	0	0	-	15	15	10	10	*12.5*	
16	Assam	88,752	2074	18	341	27	25	5	22	0	0	0	0	-	18	15	13	10	*14.0*	
17	Orissa	74,438	2262	23	219	23	21	4	18	0	0	0	0	-	21	15	14	10	*15.0*	
18	Chattisgarh	222,236	998	14	123	15	14	3	20	0	0	8	0	-	20	15	16	10	*15.3*	
19	Jharkhand	55,673	1340	12	69	6	5	1	21	0	0	0	0	-	19	15	18	10	*15.5*	
20	Himachal Pradesh	22,327	1927	9	34	0	0	0	30	0	0	0	0	-	16	15	22	10	*15.8*	
21	Goa	22,429	2050	7	32	0	0	0	27	0	0	0	0	-	17	15	23	10	*16.3*	
22	Jammu/Kashmir	7,096	3494	4	8	3	2	0	14	0	0	0	0	-	23	15	20	10	*17.0*	
23	Tripura	16,579	1927	8	52	2	2	0	9	0	0	0	0	-	24	15	21	10	*17.5*	
24	Sikkim	83,743	3000	13	59	0	0	0	16	0	0	0	0	-	22	15	24	10	*17.8*	
25	Nagaland	21,081	1927	8	22	0	0	0	3	0	0	0	0	-	25	15	25	10	*18.8*	
26	Manipur	240,928	1279	70		0	0	0	1	0	0	0	0		27	15	26	10	*19.5*	
27	Meghalaya	94,163	1231			1	1	0	0	0	0	0	0		28	15	27	10	*20.0*	
28	Mizoram	79,714	917	18		0	0	0	1	0	0	0	0		26	15	29	10	*20.0*	

D. Coastal Areas.

Issues: Sea level rise will have impacts on surface and groundwater, together with increased flood risk

- Climate change will increase sea levels, frequency of storms, heights of storm
- Fragile water balances in low lying coastal areas will be affected, impacts will likely be most in areas of intensive agriculture dependant of fresh water for potable water and irrigation.
- Increased sea water levels including surge will increase the risk of flooding.
- Increased coastal erosion

Selection: It is proposed to select coastal areas with a likely combination of risks including groundwater and surface water, salinity intrusion, flooding, impacts on agricultural systems. These impacts will most likely to have most impact on the river delta areas. The study will focus on current issues and the likely impacts from changes in climate on the delicate balance of surface and groundwater and the sea.

1. Approach

6. There is limited quantitive information to assess the relative impacts on different part of the coastline, therefore a more general and descriptive methodology has been used.

7. India's coastline is densely populated - with an average population density of 455 persons per km2 as opposed to the national average of 324. Adverse effects are likely to be worsening of existing coastal zone problems such as erosion, flooding, and the submergence and deterioration of coastal ecosystems. A one-meter sea level rise could displace about 7.1 million people, and result in the loss of 5674 sq. km of land, damage coastal infrastructure and result in the salinisation of fertile agricultural soils. Studies by TERI 1996 about 0.41% of India's total coastal area and 4.6% of the coastal population (7.1 million people) could be directly affected. The most vulnerable areas are the Kutch region of Gujarat, Mumbai and South Kerala, deltas of rivers Ganga (West Bengal), Cauvery (Tamilnadu), Krishna and Godawari (Andhra Pradesh) and Mahanadi (Orissa). The islands of Lakshadweep Archipelago would be totally lost.

8. India has an 8000 km-long coastline with two cyclone seasons, during the southwest and northeast monsoons. Cyclones have been observed to be more frequent in the Bay of Bengal than the Arabian Sea. Consequently the states of West Bengal, Orissa, Andhra Pradesh, and Tamil Nadu along the Bay of Bengal are the most affected by cyclones and surges compared to Kerala, Karnataka, Goa and Maharashtra along the Arabian Sea. Storm surges along the west coast are minimal in the south and gradually increase and peak in Gujarat. There have been several severe tropical cyclones which have caused extensive damage along the Gujarat coast; surge in this part of the West coast are amplified by the high tidal range in the funnel shaped gulfs of Khambhat and Kachch in Gujarat. Modelling work for the Gujarat coast carried out in 1984[1] and 2000[2] indicated possible storm surge levels of between 2.5m to 4.0m which correlated well with actual recorded surge levels of the Veraval (1982),Diu(1996) and Kandlha (1998) cyclones.

9. The effects of sea level rise go beyond the gradual inundation of coastal land areas to include the intrusion of saline water into freshwater rivers and aquifers and the intensification of impacts from cyclones and storm surges. As sea levels rise, saline water will intrude directly into rivers and streams, advancing not only as a function of the water level but also according to changes in river discharge that may result from climate change. Sea level rise also puts upward pressure on the saline freshwater interface in groundwater aquifers. Similarly, sea level rise raises the base on which storm surges build, making storm waves higher and carrying them farther inland.

10. The projections by the National Institute of Oceanography (NIO), under the Council of Scientific and Industrial Research (CSIR), Government of India on the impacts of climate change on sea level, to assess the degree to which mean sea level and the occurrence of extreme events may change, showed an increased occurrence of cyclones in the Bay of Bengal, particularly in the post-monsoon period, along with increased maximum wind speeds associated with cyclones and a greater

number of high surges under climate change (DEFRA/GoI, 2005b). In addition, the strength of tropical cyclones, which represent a threat to the eastern coast of India and to Bangladesh, could increase. The risk to these areas will be aggravated by the rising sea level (WBGU, 2006). Sea level rise has been observed to increase by 0.4–2 mm/year along the Gulf of Kutch and the coast of West Bengal. However, relative decrease along the Karnataka coast has also been observed[1]

11. . India's initial National Communication to the United Nations Framework Convention (UNFCCC) on Climate Change projects that Luni, the west flowing rivers of Kutchh and Saurashtra occupying about one fourth of the area of Gujarat and 60 % of Rajasthan are likely to experience acute physical water scarcity. The river basins of Mahi, Pennar, Sabarmati and Tapi are also likely to experience constant water scarcities and shortages (GoI, 2004b).

2. Coastal Basins

A total of nineteen coastal basins have been identified and are summarised in Table 4

Table 4 Broad Assessment of Climate Vulnerabilities in Coastal Basins

S. No.	River Basins with Coastal Interface	States	Description	Salinity Intrusion	Flood and Other Issues	Other Points	CC Vulnerability Assessment
	WEST FLOWING RIVERS						
1	West Flowing Rivers of Kuchcha and saurashtra including Luni	Gujarat		Intensive problems of intrusion	Highest tidal surges of all west coast states	Extreme dry season water shortages.	Critical
2	Mahi	Gujarat	Small estuary area			Extreme dry season shortages	Local Issues
3	Tapi	Gujarat	Small estuary area			Extreme dry season shortages	Local Issues
4	West Flowing Rivers Tapi to Tadri	Gujarat(S), Maharashtra, Goa, Karnataka(N)	Strong freshwater flows Localised coastal erosion especially in South Kerala	Minor localised. Some parts of Mumbai metro area have problems due to over extraction.	Minimal impacts of surges		Issues
5	West Flowing Rivers Tadri to Kanyakumari	Kerala, Tamil Nadu(S)					Issues
	EAST FLOWING RIVERS						
6	Ganga Delta	West Bengal	Hugli River Sundarbans	Mixed quality shallow aquifers overlying fresh aquifers.		High Population Densities	Critical-trans boundary and complex
7	Subernarekha	Orissa		In general salt water aquifers separated by clay layer-some mixing in parts-low salinity issues			Local issues
8	Brahmani-Baitarni	Orissa					Local issues
9	Mahanadi	Orissa	Mahanadi Delta-Major Delta		Vulnerable to flood and cyclones	High population densities	Critical
10	East Flowing Rivers between Mahanadi and	Orissa Andrah Pradesh	Only minor rivers				Local Issues

[1] Climate Change and India: Impacts, Policy Responses and a Framework for EU-India Cooperation

S. No.	River Basins with Coastal Interface	States	Description	Salinity Intrusion	Flood and Other Issues	Other Points	CC Vulnerability Assessment
	Godavari						
11	Godaveri	Andrah Pradesh	Godaveri Delta Major Delta	No extensive problem of saline intrusion along coastal area Except some local incidents.		Coastal plain and deltas have extensive cropping and irrigation Krishna and Godaveri delta have high population densities	Critical but no salinity issues
12	East Flowing Rivers between Godavari and Krishna	Andrah Pradesh					Local issues
13	Krishna	Andrah Pradesh	Krishna Delta-Major Delta		Salinity not seen as an issue		Critical
14	East Flowing Rivers between Krishna and Pennar	Andrah Pradesh	Coastal Plani-Minor rivers				Local issues
15	Pennar	Andrah Pradesh					
16	East Flowing Rivers between Pennar and Cauvery	Tamil Nadu Pondicherry Andrah Pradesh(S)		Salinity intrusion N of Chennai and Pondicherry due to extraction for potable water			
17	Cauvery	Tamil Nadu	Cauvery Delta- major delta	Tracts of saline groundwater with limited fresh water	Sea water floods leading to salinity problems	Limited dry season flow Intensive agriculture	Critical
18	East Flowing Rivers South of Cauvery	Tamil Nadu	Vaipar river is minor river				Issues
19	Drainage areas of Andman, Nicobar and Lakshadweep islands	Andaman Nicobar Lakshadweep	Localised issues			Vulnerable to sea water rise-especially Lakshadweep islands	Issues

E. Selection

1. Social and Economic Aspects

12. Lower income and higher population densities are estimated to be more vulnerable to climate impacts. A summary of key social aspects for selected states is shown in **Table** 5 below.

Table 5 Socio Economic Aspects

	Per capita income as percent of the India average	Poverty Index % of the population	Population Density as % of India Average	Gross Irrigated (million ha)	% of landholdings <10ha	Irrigated with ground water (% of gross area)	Power consumption for irrigation (gigawat /km3)	High water demanding water industries
Andhra Pradesh	92	16	84	5	92	39	1131	Low
Gujarat	114	17	83	4	89	63	1160	High
Haryana	129	14	146	5	77	29	696	High
Karnataka	84	25	84	3	89	34	1024	High
Kerala	114	15	82	0.4	93	28	128	Low

Madhya Pradesh	54	38	60	6	84	64	388	Low
Maharashtra	125	31	96	4	93	50	804	High
Punjab	124	8	147	8	73	40	276	Low
Rajasthan	66	22	50	7	60	60	520	Low
Tamil Nadu	105	23	146	2	93	52	610	High
Uttar Pradesh	46	33	102	18	97	52	513	High
All India	**100**	**28**	**100**	**55**	**13**	**48**	**524**	

2. Selection of Snow Melt

13. Four possible snow melt basins have been identified Beas, Satluj, Yamuna, Ganga and Brahmaputra, there is no definitive data to rank impact from the loss of snow melt. An indicative matrix for selection is shown in **Table** 6 below.

Table 6 Selection of Snow Melt Basins

	Sub Basin	State	Reasons for selection	Reasons against selection	Other	Selection
1	Beas	Punjab		Smaller than Satluj.		Not proposed
2	Satluj	Punjab	Ongoing scoping studies and linkages with Himachal Pradesh by ADB for upper Satluj. Water availabilities/ demands in Punjab reasonably straight forward High population densities Critical groundwater issues in Punjab	High per capita income and low poverty index in Punjab		The linkage with the ADB scoping study with Upper Satluj will be very useful Proposed as Pilot Sub Basin for Snow melt.
3	Yamuna	Uttar Pradesh or Haryana	Critical GW issues in Uttar Pradesh Low per capita income and high poverty index in UP	No project linkages with Uttarakhand Yamuna forms the border with Uttar Pradesh and Haryana which makes for more complicated water assessment and management.	WB supported Uttar Pradesh Water Sector Project	Possible back up.
4	Ganga	Uttar Pradesh	Critical GW issues in Uttar Pradesh Low per capita income and high poverty index in UP Ganga is key water river for North India		WB supported Uttar Pradesh Water Sector Project	Possible back up.
5	Brahamaputra	Assam	Low per capita and high poverty index in Assam.	Complicated and maybe difficulties of sourcing data.		

3. Groundwater

14. A review of the six short listed states and the selection of the focal state for groundwater is summarised in **Table** 7 below. From the table Madhya Pradesh is proposed as the focal state. Uttar Pradesh would be an associate state.

Table 7 Short List of Groundwater States

Nr	State	Notes	Selection Decision
1	Punjab	Proposed for the snow melt category	Groundwater studies in Punjab will be incorporated under the snow melt category
2	Rajasthan	Very specific issues: • Significant volumes from interstate transfers • A desert area with very specific hydro and hydro-geological conditions. • Ongoing studies by World Bank	Rajasthan is a very specific situation and requires specific planning. Not considered as a representative state
3	Haryana	Neighbouring state to Punjab reduced benefit of studying two neighbouring states	
4	Tamil Nadu	Already proposed under the coastal category	Groundwater studies in Tamil Nadu -Cauvery Delta will be incorporated under the coastal category
5	Uttar Pradesh	Located in same NE zone as Punjab Under study by World Bank	
6	Madhya Pradesh	Critical groundwater conditions in parts of the state including the BundelKhand Region of the Betwa River sub-Basin and the Mawar sub-basin. MP has the lowest per capita income and highest poverty index of the six groundwater states	Madhya Pradesh proposed as the focal state for groundwater. The Betwa River basin was originally proposed as the study area but this was changed to Chambal basin based on discussions with the state..

4. Coastal

15. The east coast is prone to cyclones and is generally recognized as being more vulnerable than the west coast. The exception on the west coast is Gujarat where very high tidal range storm surges are a serious problems. On the east coast the river mouth delta areas are low lying areas of higher production and higher population density. The area around Ganga estuary is very vulnerable but impact area is partially in Bangladesh and assessment and data collection will be difficult.

16. The Delta areas Mahanadi, Godaveri and Krishna are all vulnerable to storm and sea water rise; however salinity intrusion is not of major issues in these three deltas. Salinity intrusion as well as flooding and surges are major issues for Gujarat and Tamil Nadu Cauvery Delta. The World Bank is proposing an integrated basin development plan for the Mahanadi basin which may result in some duplication.

17. The Andman, Nicobar and Lakshadweep islands are clearly vulnerable. The issues are very specific to each area and there would be less replicability to other areas. Logistics are also an issue,

18. **Gujarat**: There are major issues of salinity intrusion, along the Saurashtra and Kuchchh coasts, sea water has already intruded at several parts and the coasts are in general highly vulnerable to sea water intrusion. The Government of Gujarat has set up a high level committee to examine the issue and accordingly GWRDC. The general trend along the coast is a movement of the salinity contours about 8 to 20 kms inland, the movement is variable with some parts with fresh water right up to the coast. The government is initiating some remediation measures. With the longest coastline in India - 1,600 km – and a diversity of agro-ecological zones and hydro-geological patterns, Gujarat is prone to many disasters. Some of the most devastating disasters that have struck the state in the last few decades, include floods. The intensity and frequency of hazards in Gujarat shows that the state is facing four major types of extreme events (hazards) which can be seen as 'disasters'. These include, (i) physical or 'natural' disasters such as, earthquakes, and (ii) those increasingly linked to climate variability such as drought, floods, cyclones and severe coastal storms. In addition, sea level rise, caused by both climate change (global warming) and local factors has significant, but little researched, implications for coastal livelihoods and the marine environment. They indicate that the frequency and probability of disasters has increased sharply in this period intensifying the risks and potential costs of disaster impacts in the state. Gujarat with a high development of industry has one of the highest per capita income levels in India.

19. **Tamil Nadu Cauvery Delta**: The predicted impacts of climate change such as sea-level rise, and increasing intensity and frequency of cyclones and storms are likely to severely impact this already vulnerable region. All coping measures undertaken to date have been ad hoc and structural with largely no effect. Non-land based, long-term disaster preparedness and risk reduction strategies and early warning systems have not been part of any policy planning framework so far.[2] . The Cauvery delta's 1,800 year-old irrigation system is a complex network of rivers, canals and drainage systems. Large parts of the delta lies below sea-level or is water-logged and marshy. Already the Cauvery delta, on the whole, suffers from saltwater intrusion up to five kilometres inland, as well as severe drainage problems. Due to its flat terrain, the region is prone to flooding from drainage canals and seawater, in particular during the October to December monsoon months when most of the monsoon rain falls within a few days, often combined with cyclones and high wind storms. This is also a district where 90% of the population consists of small and marginal farmers with a very high concentration of landless agricultural labourers. Furthermore, the coastal region of Tamil Nadu is very densely populated (528 people/km_2, almost double the state average of 372 people/km_2), which only suggests that seawater rise may result in a good number displaced from their original habitats losing their land and livelihoods. Within Tamil Nadu the rapid industrialization along the coastal region, and coastal cities and towns are vulnerable to the impacts of climate change.

20. **Two candidate areas** for the coastal pilot area have been identified-Gujarat and the Cauvery Delta in Tamil Nadu.

21. The Cauvery Delta which is the preferred sub basin; involves a mix of surface, groundwater and sea issues. Agricultural productivity is very high in the delta and climate change will potentially have significant impacts on agricultural productivity adding to the already existing problems in the delta. The Cauvery delta forms a good focus area with clearly defined boundaries. The selection of the Cauvery Delta also provides a good geographical spread with the other two pilot projects (Punjab and Madhya Pradesh)

22. In Gujarat the problem is complex and there are affects along the whole 1600km coast and it is not so easy to select a focal area. In Gujarat there are major issues of better defining the coast and marine conditions including surges; Gujarat is one of the pilot areas for the MoEF Coastal

[2] ISET Climate Adaptation in Asia: Knowledge Gaps and Research Issues in South Asia based on information from Janakarajan (2007) Challenges and Prospects for Adaptation: Climate Change and Disaster Risk Reduction in Coastal

Management Project which will be addressing some of the coastal issues Groundwater salinity is an issue, however for the S_NWM groundwater state is already selected as Madhya Pradesh.

F. Summary

23. The summary of the selection is presented in the **Table** 8 below. Possible back up or substitutes are proposed.

Table 8 Summary of Selected and Back Up States and Basins

	Focal State	Sub Basin	Associate States
SNOW MELT			
Selected State	Punjab	Satluj	Himachal Pradesh
Back up options	Uttar Pradesh	Ganga	
	Uttar Pradesh	Yamuna	
	Assam	Brahmaputra	
GROUNDWATER			
Selected State	Madhya Pradesh	Betwa	Uttar Pradesh
Back up Option	Uttar Pradesh		
	Rajasthan		
COASTAL			
Selected State	Tamil Nadu	Cauvery Delta	Pudicherry
Back up Options	Gujarat		
	Orissa	Mahanadi Delta	
	West Bengal	Ganga	
	Andrah Pradesh	Krishna Godaveri	

.

APPENDIX 6 MEETINGS AND CONSULTATIONS

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TABLES

II. SUMMARY OF MEETINGS AND CONSULTATIONS

A. Summary of Meetings

The TA has included a wide spectrum of meetings and consultations at all levels; the outputs of the meetings and consultations have provided key information and significant direction for the strategic frameworks plans. A summary of all the meetings is shown in Table 1 below.

A participatory rural appraisal was carried out in the three sub basins. The (PRA) was designed to obtain key information from farmers and other stakeholders on current issues, impacts on climate change and information on the way forward. The results of the PRA are described in the appendix of each sub basin; the questionnaires are described in section V.

B. Meetings/consultations August 2010

1. Opening Discussions with CWC 09 August 13th Augst

Mr A K Kharya Director Climate Change
Dr Samarasekara ADB
Mr Adrian Young Team Leader NAPCC Consultancy
Meetings were held with CWC to plan the consultancy assignment including the selection of the sub basins.

C. Meetings/consultations September 2010

1. Meetings with CWC and MoWR to plan the consultancy (27 to 30 September)

Mr A K Kharya Director Climate Change
Mr Haque Commissioner Climate Change
Dr Samarasekara Senior Climate Change Specialist ADB
Mr Adrian Young Team Leader NAPCC Consultancy
Mr Indrha Raj Deputy Team Leader

Meetings were held with CWC to plan the consultancy assignment including the selection of the sub basins. During the discussions it was agreed to prepare a more analytical selection matrix for the sub basins

D. Meetings/consultations October 2010

1. Meetings with CWC and MoWR to agree selection Matrix for the Sub Basin

Mr A K Kharya Director Climate Change
Mr Haque Commissioner Climate Change
Dr Samarasekara Senior Climate Change Specialist ADB INRM Office
Mr Adrian Young Team Leader NAPCC Consultancy
Mr Indrha Raj Deputy Team Leader
Agreements were made re the selection of the sub basins-these were notfiified to MoWR and the states concerned. The states confirmed their agreements to participate in the programme.

2. Initial Visits to the Pilot Sub Basin States

Dr Samarasekara Senior Climate Change Specialist ADB INRM Office
Mr Adrian Young Team Leader NAPCC Consultancy
Mr Indrha Raj Deputy Team Leader
Secretary Water Resources (Punjab, Madhya Pradesh and Tamil Nadu)

Visits were made to the three States with selected pilot sub basins (Punjab 18th October, Madhya Pradesh 19 October, Tamil Nadu 20th October) In principal agreements were reached for each of the three states to participate in the TA study.

Table 1 Summary of Meetings and Consultations

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
August 2010	Inception	All	Central	Delhi	Meeting CWC to discuss project approaches and methodologies		Staff CWC	ADB climate specialist consultant Team leader	Opening meeting of project	B.1
September 2010	Inception	All	Centre	Dehli	Meetings to discuss selection of sub basins		Staff CWC/MoWR	ADB /2 consultant	Selection of sub basins	C.1
18 October 2010	Inception	All	State	Chandigarh	Selection of sub Basin and methodologies	Mr. Arun Goyal Principal Secretary	Officrers of various departments	ADB Climate specialist 2 consultants	Introdution, selection of sub basin,methodologies	D.2
October 19,2010	Inception	All,Basin-selection	State	Bhopal	Selection of subbasin andmethodologies and Approch	Mr.R.S.Julania,Principal Secretary	Officers of various departments	ADB Climate specialist 2 consultants	Introdution, selection of KSHIPRA sub basin for study,methodologies	D.2
October 20,2010	Inception	All	State	Chennai	Cuavery	Mr.S.Rmasundaram, Principal Secretary	Officrers of various departments	ADB Climate specialist 2 consultants	Introdution, selection of sub basin,methodologies	D.2
November 15 2010	Inception	All	Centre	Delhi	Inception Workshop	A K Kharya	About 40 participants from centre and state	ADB and consultants	Discussion of inception report	E.1
November 16-20,2010	Sudy of Subbasin	All	State	Chandigarh and Punjab field visits	(i) Introduction Meeting(16th) (ii) Field visit and Meeting (17th & 18th,Nov.) (iii) Irrigation Department officers meeting (19th,Nov.) (iv) Director of Agericulture (19th,Nov.) (v) Punjab State Council for Science and Technology (19th,Nov.)		district level officers and farmers	5 consultant and ADB officer	Study of sub basin profile, meetings with stakehoders, and departmental officers at district and state level	E.2
November 22to 26 2010	Study of sub basin	All	State	Chennai and field visits to Cauvery Delta	(i)Engineer in Chief WRD,PWD (22,Nov.) (II) Climate Change and Adaptation Research Anna University (22,Nov.) (iii) IIT Madras (22,Nov.) (iv) Field visit Cauvery Delta farmers fisherman and disrict officers at various			7 consultant and ADB officer	Study of sub basin profile, meetings with stakehoders, and departmental officers at district and state level	E.3

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
					location(23,24, Nov.) (v) Tamil Nadu water supply and Sanitation Board Chinnai (25 Nov.) (vi) State Agriculture Department (25th Nov) (vii) Department of Environment Chennai (26th Nov.) (viii) Director, Ground Water WRD,Chennai (26th Nov.) (ix) Wrap up meeting Engineer in Chief and various officers (26th Nov)					
28thNovember to 1st December,2010	Inception	All	State	Bhopal, ,Indore, Ujjain	(I) Mr.M.M.Upadhya,Principal Secretary Agriculture and Coopration Depatrment (29th Nov.) (ii) Mr.Alok Srivastava Principal Secretary Housing and Environment (29th Nov.) (iii) Mrs.Rashmi Arun Shami,Director Horticulture and Mission Director State Horticulture Mission (29th Nov.) (iv) Meeting with Manish Singh Additional Sceretary Water Resources Department and other staff in the Water Resources and Agriculture (29th Nov.) (v) Meeting with officers ffrom various departments like water resources and Agriculture (30th Nov.) (vi) Meetings with Disstrict Commissioner Ujjain and District level officer (1st December)				Study of sub basin profile, meetings with stakehoders, and departmental officers at district and state level	E.4
21st December,2010	data collection	data collection and collaboration IMD/CWC	State	Delhi	Meeting ith IMD for rainfall data and Collaboration of ADB,CWC	Dr Ajit Tyagi DH IMD			Rainfall Data collection for trend analysis	

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
Monday, January 3, 2011	Interim	Subbasin	Central	CWC	Introductory meeting with Mr Kharya	Mr AK Kharya	Mr Raj,		Discussed key issues around CWC including the restrcuring proposal of CWC	G.1
Tuesday January 4, 2011	Interim	Subbasin	State	Punjab	Punjab visits 4-6, January	Mr Thaksi Director WR and Environment		3 ADB consultant	Disucussion on the water sector problems	G.2
Wednesday January 5 2011	Interim	Subbasin	State	Punjab	Punjab Participatory Rural Appraisal visits 4-6, January		Field staff of WRD,	5 ADB consultants	PRA exercise was carried out	Appendix 2A, Section V
January 6 2011	Interim	Subbasin	State	Punjab	Punjab visits 4-6, January	Mr Thaksi Director WR and Environment			Discussion on Instittutional issues	G.2
January 6 2011	Interim	Subbasin	State	Punjab	Punjab visits 4-6, January	Mr YB Kaushik	Mr Vijayakumar		Discussion on CGWB and its view on ground water problems	G.3
Januray 10, 2011	Interim	Subbasin	State	WRO, TN	TN visits 10-11, January	Mr S Kumaresan. Ingineer-in-Chief	SE of WRD		Discussion on Instittutional issues	G.4
7th February 2011	Interim	Subbasin	State	Punjab	TN Participatory Appraisal RA visit 7-11th Feburary		Field staff of WRD,	5 ADB consultants	PRA exercise was carried out	Appendix 4A, Section V
18, February 2011	Interim	Subbasin	State	Indore	MP Participatory Rural Appraisal Field Visit 17-22, February	Mr Ajit Kumar, EE	AEE of WRD		PRA exercise was carried out in Deewas	H.1 and Appendix 3A
19, February 2011	Interim	Subbasin	State	Bhopal	Introductory meeting with Mr NK Singh of SWaRA	Mr NK Singh, Special Officer, SWaRa	Various department staff		Disucussion on functions of various departments	H.1
20, February 2011	Interim	Subbasin	State	Bhopal	Introductory meeting with Mr NK Singh of SWaRA	Mr NK Singh, Special Officer, SWaRa	Various department staff		Disucussion on Institutional issues	H.1
24, February 2011	Interim	Subbasin	State	Indore	Visit to Dewas	Mr SS Gharwar, EE Indore	Various state and district departments and farmers	5 ADB consultants	Regional consultataion with farmers and district officials on draft interim report	H1.a
25 February 2011	Interim	Subbasin	State	Bhopal	Wrap-up with PS, WRD	Mr Radhey Shyam Julania, Principal Secretary, WRD	Various state and district departments and farmers	5 ADB consultants	Wrap up meeting with the PS (WRD) and discussion on Water related problems	H.2

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
28, February 2011	Interim	Subbasin	State	Chandigarh	State Level consultataion	Mr Vajralingam, PS WRO	Various district departments and farmers	4 ADB consultants	Preliminary discussion and apprasal of Planned regional consultataion at Ludhiana	I.1
1st March 2011	Interim	Subbasin	State	Chandigarh	State Level consultataion	Mr Thaksi Director WR and Environment	Various state and district departments and farmers	4 ADB consultants	Regional consultataion with farmers and district officials on draft interim report	I.1
7th March 2011	Interim	Subbasin	State	Tamil Nadu	State Level consultataion	Mr S Kumaresan. Ingineer-in-Chief	Various departments in Tamilnadu	4 ADB consultants	Regional consultataion with state officials	I.2
8th March 2011	Interim	Subbasin	State	Tamil Nadu	State Level consultataion	Mr S Kumaresan. Ingineer-in-Chief	Various departments in Tamilnadu	4 ADB consultants	Regional consultataion with farmers and district officials on draft interim report	I.2
15th March 2011	Interm	Subbasin	Central	Delhi	Interim Workshop	Mr Bjaj, Chairman, CWC	Various state and central departments representatives	7 ADB consultants	Presentataion of Interim report on India Water Systems and 3 sub-basin frameworks	I.3
26th April 2011	Final	Subbasin	State	Punjab	Discussion with PAU	Mr	Discussion with various faculty memebrs of PAU	5 ADB consultants	Discussion on climate resilent adpataion research /activities of PAU	J.1, .J2
27th April 2011	Final	Subbasin	State	Punjab	Field Visit to Moga project site	Mr Krishan Vattam	Discussion with presidents and members of Agricultural cooperative society	5 ADB consultants	Discussion with members and president of Village cooperative society. Discussed on the obejecives, process and outcome of PAU and Columbia university reserach project on resource conservation	J3, J4

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
									technilogies	
28th April 2011	Final	Subbasin	State	Punjab	Meeting	Mr Yajuvindr Singh,	Various state department representatives	5 ADB consultants	Discussion on sub basin strategeic farmework and seeking feedback on draft interim report	J5
28th April 2011	Final	Subbasin	State	Punjab	Wrap-up meeting with PS, WRD	Mr Vajralingam, PS WRO	Various state department representatives	5 ADB consultants	Apprasial of ADB team visit to PAU and feedback from field visit	J6
29th April 2011	Final	Subbasin	State	Punjab	Meeting officials of National Institute of Hydrology, Roorkhee	Dr RD Singh, Director, NIH	Discussion with various faculty memebrs of NIH	5 ADB consultants	Discussion on various activities of NIH and sharing of NAPCC interm report findings	J7
29th April 2011	Final	Subbasin	State	Punjab	Meeting with faculty of department of Hydrology, Roorkhee	Dr Himanshu Joshi	Discussion with various faculty memebrs of DH	5 ADB consultants	Discussion on various activities of DH and sharing of NAPCC interm report findings	J8
29th April 2011	Final	Subbasin	State	Punjab	Meeting with faculty of department of Civil Engineering.IIT Roorkhee	Dr AK Jain	Discussion with various faculty memebrs of Department of Civil Engineering	5 ADB consultants	Discussion on various activities of Department of Civil Engineering and sharing of NAPCC interm report findings	J9
4th May 2011	Final	All	Central	Delhi	Meeting with MoEF	Dr S Satapathy, Scientist E, GOI	None	5 ADB consultants	Discussion on the status of various state's action plan for climate change and feedback on Interim report on sub basin startegic framework	K.1
5th May 2011	Final	All	Central	Delhi	Meeting with MoEF	Dr Subodh. K Sharma. Advisor, MoEF	None	5 ADB consultants	Discussion on development linkages with the SAPCC and current response of the state government to	K2

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
									implement the operational plan	
5th May 2011	Final	All	Central	Delhi	Meeting with CWC	Mr ME Haque, Member, CWC	Various officials	4 ADB consultants	An overview by the TA team of work done and the options proposed for each subbasin including discussion on the need for regulation and the ways and means by which WUE issue being addressed	K3
5th May 2011	Final	All	Central	Delhi	Meeting with Director, DoUD	Ms Nivedita, Director, DoUD	None	4 ADB consultants	An overview by the TA team of work done and the options proposed for each subbasin including discussion and on specific schemes of DoUD addressing towards climate change	K4
5th May 2011	Final	All	Central	Delhi	Meeting with Department of Agricultureand Cooperation,GOI	Dr Subrata Nath	Mr Rath	4 ADB consultants	Discussion on climate change impact on food security and sustainable agriculture and DoA s proposed adapatation measures	K5
5th May 2011	Final	All	Central	Delhi	Meeting with Minor Irrigation wing of MoWR, GOI	Mr Vijayakumar, CE	None	4 ADB consultants	Discussion on the involvement of CWC at every stage and on inter river systems and irrigation options	K6
6th May 2011	Final	Subbasin	State	Lucknow	Meeting with Geological Survey of India	Dr. Arun Chaturvedi	Dr SP Shukla and Dr LS Jain	3 ADB consultant	To get an insight into the work areas of GIS and	G7

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
									finalise OR proposal for possible collaboration	
6th May 2011	Final	Subbasin	State	Lucknow	Meeting with Regional Director of CGWB	Mr. Biswas, RD, CGWB	Dr. Sanjay Marwaha	3 ADB consultant	To get an insight into the work areas of CGWB and to discuss on the scope for Ground water modeling in Punjab and also drainage works	K8
13th June, 2011	Final	Subbasin	State	Tirichiruapalli, Tamil Nadu	State Level Workshop	Er Balasubramanian Chief Engineer, WRO	85 Participants	6 ADB consultants	One day workshop to present and discuss draft final report	L1
16th March 2011	Final	Subbasin	State	Indore, MP	State Level Workshop	Mr SS Gharwar, EE Indore	104 Participants	6 ADB consultants	One day workshop to present and discuss draft final report	L3
21 June 2011	Final	Subbasin	State	Chandigargh	State Level Workshop	Mr Thaksi Director WR and Environment	125 participatants	5 consultant ADB project officer	One day workshop to present and discuss draft final report	L5
22 June 2011	Final	Subbasin	State	Chandigargh	Meeting PS Science and Technology			5 consultant, ADB project officer	Discussion on DFR and how strategic plan links to the Dept Science and Technology and linkages. PS presented a summary of river clean up programme which is addressing clean up of 46 out 141 urban centres. Clean up programme very successful and	L6

Date	Stage	Topic	Level	Place	Meeting	Chair	Other Participants	ADB	Summary	Write up refere-ence
									linkage with proposed project would be very useful	
27 June 2011	Final	All India	Cenral	Delhi	Central Final Workshop	Central Water Commission	90 participants		Final workshop attended by central government and representatives from the states. Guest speakers included the Minister of State,	L7

E. Meetings/consultations November 2010

1. Minutes of the Inception Workshop

Date: 15th November, 2010
Venue: Seminar Hall, CSMRS, New Delhi

The Inception Workshop on the ADB funded "Support to the National Water Mission under the National Action Plan for Climate Change" was held on 15th November 2010 at CSMRS, New Delhi. The list of Members and Invitees who have attended the workshop is given in the Annexure – I.

The meeting was opened by Mr. Kenichi of ADB, who welcomed the members and other participants. In his opening remarks, he outlined the role of ADB on the S_NWM TA and in other initiatives in the country.

- Mr. R.C. Jha, Member (RM), CWC, outlined the role of CWC and MoWR in the S_NWM TA. He also informed that due to ongoing parliament session and other official engagements some of the invitees had been unable to attend the workshop.
- Mr. S.C. Dhiman, Chairman, Central Ground Water Board described various groundwater problems that India is currently facing, and the issues associated with the increasing demands associated with urban and rural development. He also highlighted the different hydrological conditions developing across the country with increased rainfall intensity a feature in many areas. Further, he informed that the results of the ADB S_NWM TA might raise awareness of climate change in the context of Indian continent.
- Mr. R.D. Singh, Director, National Institute of Hydrology, informed that models which will be used for climate change analysis, should consider the various changes in runoff and resource availability resulting from the constriction of dams and reservoir and other water resources developments.
- The project director, Mr. A.K. Kharya, Director, Climate Change, Central Water Commission presented the different objectives of the S_NWM TA and the role of National Water Mission on climate change. He also thanked to ADB for assisting through the TA.
- Dr. Vidhisha Samarasekara (Climate Change Specialist, ADB) outlined some of the other TA programs funded by ADB in the Asian subcontinent.
- The ADB team leader, Mr. Adrian Young, presented an overview of the methodology to be adopted in the TA.
- Different national and international experts presented on a number of themes relevant to the TA.
- Applications of Climate Change Projections to Support Decision Making for Water Resources Planning: Prof. A.K. Gossain, IIT Delhi; Dr. Robin Wardlaw, Dr. Bernd Eggen (ADB Consultants). Prof. Gossain outlined some of the work undertaken with the SWAT model for the National communication on Climate Change, and its role in the S_NWM TA. Dr Wardlaw described some of the uncertainties associated with climate projections, and how to deal with these in the planning and adaptation process. Dr Eggen presented the current status of climate modelling and climate change projections internationally.
- Mr. Anuj Kanwal, Director, CWC, presented on the need to increase water use efficiency particularly in the irrigation sector. This is a key strategy of the NWM.
- Prof. P.P. Majumdar, IISc Bangalore, made a presentation on climate change impacts in Orissa and Punjab. He described a statistical downscaling technique that shows particular promise.
- Mr Manesh Singh (IAS) of Madhaya Pradesh WRD gave a description of some of the issues in the Chambal basin and the focus that they would like to see from the ADB TA. There is significant over-exploitation of groundwater in many areas. The Shipra basin has been identified as the focus for the TA, where in at least ten blocks groundwater is significantly over-exploited.
- Mr T. Baintamil and M. Backthavathsalam of the Tamil Nadu PWD WRO gave a description of the issues in the Cauvery Delta. Issues include salinity intrusion, poor drainage in the coastal strip, water scarcity and over-exploitation of groundwater that exacerbates saline intrusion. They identified a need for greater storage and utilization of flood water that at present passes to the sea, for greater groundwater recharge, and means of arresting saline intrusion.

- Following the technical presentations, an all India perspective was delivered by the TA Deputy Team Leader, Mr Inder Raj.
- A summary and wrap up discussion was led by the by the TA Team Leader. Availability of data and data collection was discussed at some length and Team leader informed that consultants are visiting different basins identified by the MOWR to get information for further study. There was also discussion on water use efficiency and the role of hydrological models.

A vote of thanks was given by Mr. A.K. Kharya, CWC.

2. Visit Punjab November 16 to 19th

a. November 16th 2010 Punjab Chandigarh Water Resources Department Introductory Meeting

Mr SS Ladhas J D Env
Kawaayt JAAL
A. K Gupta Director CWC Punjab
H.S Newan MD PWRMDC
K.S Takshi Director WROD
Harinder Singh Chief Engineer Water Resources
Bernd Eggen Climate Change Specialist
A.K Kharya Director CWC
Adrian Young Team Leader ADB S_NWM Consultants
Robin Wardlaw Hydrologist ADB S_NWM Consultants
N K Dhir Superinteding Engineer Water Supply and Sanitation
B. S Sandolim SE Farezpur Canal Circle
Amajir Sir Duller Chief Engineer Canals
Ashish Singh XEN Canals
Ashaur Agemul XEN Floods
Japemohar Man XEN WR

The objectives of the study were explained by the Team Leader Adrian Young. The meeting objectives were to obtain information and understanding of issues and ongoing programmes and initiatives. It was explained that nearly all the irrigation area uses flood irrigation, allocations are made strictly using the Warabandi system -a rotational system with allocations to each field based on a 7 day cycle.

Groundwater is a major water source and is seriously overexploited. The GW assessment report for 2004 is available and the 2008 assessment will be available in the next month or so. The Hydrology II project is increasing the number of groundwater monitoring points

Rainfall is very erratic, rainfall monitoring is being upgraded by the hydrology 1 project and has 5 years data with the expanded network.

It was explained that the Sutlej in Punjab had many problems including salinity, soil problems, pesticide and internal and externally caused floods-although flooding was not such a major issue due to the retention at the Bhakra dam. Water allocations varied and were 3.5 cusecs per 1000 acre at the secondary heads and 3.05cuseces/1000 acres at the outlets. There are an estimated 12 lakh (1.2 million) tubewells in the state.

There are issues of water logging -the locations are shifting a recent NIH workshop at Punjab University Issues and Management explored many of the issues. A water logging assessment was prepared in 2008.

b. 17th and 18th November 2010 Punjab Field Visits to the Sirhind Canal Systems

Adrian Young Team Leader ADB S_NWM Consultants
Joyashree Roy Social Community Consultant ADB S_NWM
Indra Raj ADB 17 November

Robin Wardlaw ADB 17 November
Bernd Eggen ADB 17 November

The visits included visits to parts of the main canal, secondareis as well as some offtakes. Meetings were held with Irrigation officials and farmers. The irrigation systems are very old with the Sirhind System built in 1850 and the Ropper barrage completed in 1885. The canal operates continuously with closures for maintenance if required during the lean season March and October; closures are constrained by the need to provide water for domestic and industrial use. Potable water for Chandigargh is almost entirely supplied from .....system. ... The main crops are rice and wheat; there is also some sugar marketing of sugar can be a problem. Farmers like rice due to stability of the price throught . Surface water is charged at Rs 75/acre/crop and tubewells at Rs50/hp/month. Recently it was agreed to waive the surface water fee due to the difficulties facing farmers. The groundwater fee is not enforced. Yields are of the order of 30kw/acre for rice and 20kw/acre for wheat. The tubewell extractions are very much limited by the power availability typically 4-5 hours per day. The low allocations of surface water and limited groundwater is not sufficient.

Visits were made to the saline areas of the Sirhind canal system which is suffering from water logging. The water logging has been a mix of causes but include the supply.canal to Rajahstan. In the lower areas some tubewells are abstracting from the surface freshwater lense in other areas tubewells are not possible due to poor quality groundwater. Cotton is a longer crop April to November and is a substitute for rice in some areas. Areas of orchard mainly orange were seen which are reported to have better returns than rice but the long growth period prior to harvesting (about 5 years) make it only suitable to richer farmers.

Cleaning of the canals in the lower areas is a more major problem-the canal water contains silt (from the canal banks) unlike the head areas which have sediment free water. Cleaning of weed growth is an issue with cleaning costs by NREGA as 30man days per 100' canal (with a flow of 500-1000 cusecs. Smaller canals Q= 10 to 50 cusecs require 20 mandays. The irrigation department Deep Tubewell Department is constructing deep tubewells in the kendi area. The deep tubewells are beyound the capacity of the farmers to finance -they are 150-450metres deep costing 0.3 to 1 crore and can supply 100acres.

The irrigation department is developing lining as funds become available and has currently lined about 50% of the canal system under the CADA area and Water Management Programme.

The Government has recently introduced a ruling that rice must not be planted prior to 20th of June-as a measure to help conserve the groundwater..

c. November 19th Punjab Chandigarh Water Resources Department Follow up Meeting

Harinder Singh Chief Engineer Water Resources
Dimesh Tewali Scientist C
PKL Litoria Scientist SE
Kanwargt Singh Joint Engineer Agric
Pritipal Singh Senior Engineer PSCSB
A. K Gupta Director CWC
H S Niswan
Adrian Young Team Leader ADB S_NWM Consultants
Joyashree Roy Social Community Consultant ADB S_NWM
Vinod Chaudery C.E Dag
Ravind Dhal DDEP
KS Takshi Director WRD
Jagnobban S Mann XEN WR
S.K Saluyo XEN CAD
Ashish Middle XEN Canals

A wrap up meeting was held at the WRDO office meeting room. Mr Takshi mentioned the connectivity of the neighbouring aquifers including the foothills which should be examined. The HPII project is carrying out some pilot artificial recharge project. the department is carrying out recharge trials into the

river beds using infiltration wells, the pollution control board due possible pollution issues. The department is implementing a 700 crore canal lining project. The target is to line 60% of the farmer water courses with brick lining -the funding is 10% from farmers, 40% punjab state and 50% central government. The background of agricultural development in Punjab dated to the 1960's with the Governments plan to meet food security; since then the area of crop has increased 12 times and yield increased three times.

A groundwater regulation bill was proposed but rejected by the state Government The subsoil preservation act now prohibits transplanting rice before 10 June is however is reported to be gradually adopted. There is reported to be no WUA with all the allocations made strictly on predefined rotations-farmers with larger holdings would irrigate part of the their holding every week but crops would receive water after 2 to 3 weeks. This was reported to be working well and was very efficient. The different departments agreed to send to the ADB team notes and information on the different ongoing programs and initiatives.

Other points raised include flooding has positive and negative impacts, the need for artificial recharge is a paramount there are issues of water quality of the recharge water which is drain or river water and carries pesticides and high nitrate values. Agricultural yields remain low compared with other states The agriculture representative mentioned the need for seasonal flood forecasting. The application of gypsum is important in saline areas The department has promoted laser levelling and varous programmes to introduce mulching.. The key is reported to be substitution of the padi crop however nothing appears to give the same financial returns with secure pricing. 80% of the farmers are now have ing to use submersible pumps as centrifugal pumps are no longer viable due to the drop in GW.

Dams have been built in the Kendi area and may be affecting the recharge. Suggestions were made to support timely irrigations through better electricity supply and timely surface water irrigation. There are 120000km of water courses in Punjab all water systems-of which 45,000km already lined, 12000 in hand and 30,000 planned for the near future-total 87000 cost is Rs15000/ha -7500/ha central govt. The requirement is probably RS25000 to 30000.

The State remote sensing department is carrying out assessments of the yield and acreage of wheat and rice since 1990. The also hold GIS data including land use, geomorphology, lithology and geology a cropping system analysis, drainage and irrigation canal layouts, transport boundaries and revenue villages. They also hold cropping data, rainfall stations, tubewell locations. They are working in detail in the urban areas developing LPA maps at 1:10,000 scale

d. 19th November Meeting with the Director of Agriculture

19th November Meeting with the Director of Agriculture

Dr B. S Sidhu Director Agriculture Punjab 01722601567
Harinder Singh Chief Engineer Water Resources

Adrian Young Team Leader ADB Consultants

The Dept holds long term records of cropping including some satellite imagery. It was explained the farmers are facing increasing water problems-typically tubewells last three years and replacements are very and increasingly expensive. The Punjab is effectively doing contract farming for the Govt of India-there is very minimal rice consumption in Punjab.. The key is to move away from rice but at the moment there is no alternative. The increasing rice production from Bihar and other states in NE where water availability is much higher are likely to affect the rice market in the not too distant future.

Dept Agriculture is investigation alternatives to rice- including pulses. Pigeon pea is of interest and can achieve 5 tons per ha but the growth is presently 180 days so interferes with the wheat crops there is a need to develop a shorter duration variety. The Department has promoted the use of laser levelling by providing support grants of 30% for laser levellers. This has now taken off and there is now a good private sector programme of laser levelling. There are major issues of salinity in the west part of Punjab. Orchards are growing up but the capital requirements to establish new orchards is limiting the take up. There are investors providing cold storage. A major problem in Punjab is 7% of the farmers own 30% of the land-these farmers are content to grow rice and wheat which are low risk and good

returns. The SRI system of cultivating rice had been tried but in Punjab labour costs are too high and the use of mechanised farming is important, there is no financial incentive for farmers to save water

e. 19th November Meeting with the Director of Dr Neelima Jerath Executive Director Punjab State Council for Science and Technology

The Department are about to initiate the State Action Plans for Climate Change and are looking for good consultants and support. The ADB study would be extremely useful as the SAPCC will likely focus on water and agriculture. The Department has a good web site punenvis.nic.in including state of the environment reports which include aspects of water and agriculture, New ideas were required to enable farmers to meet the impacts of climate change which would have major impacts on the farmers.

f. Community Consultations Sutlej

Sutlej River Basin

In November 18, 2010 when we met Bhupinder Singh in Burjmahma village showed us how he has started his experiment of orchard (horticulture) in 19 acres of his total large landholding of 110 acre. Rest are still in paddy and wheat. Orchard is very less water intensive and he is trying drip and sprinkler irrigation but feels initial five years no return can be expected so he has started in small land to see how the yield improves over time. His opinion is without some government support it will be difficult initiate for many farmers as initial years will mean capital investment without return. Gurchand Singh with 45 acres still grows paddy. An elderly farmer has to say that these were cotton growing areas traditionally. With growing labour problem cotton which is labour intensive is becoming difficult to practice although it is suitable given the dry soil condition. Paddy although is getting challenged due to increasing scarcity of water and tubewells at deeper acquifer are bored in to get water, still is less labour intensive. Shami Singla, local SDO added that in these areas 20% is canal irrigation water but 40% is from ground water and feels that integrated water management is a real challenge. In Wazid-Kekalan Village before 1984 cotton, ground nut and corn were grown but due to canal system flowing through that village ground table has come up and now they are growing paddy. They once experimented with biofuel but was not continued after not much success and support received compared to paddy. Sugarcane, they do not want to grow as it does not yield fixed income flow. November hailstorm of 2010 caused almost 30% damage to their crops farmers in Cudsonda reported .

In our meeting of November 19, 2010 Mr Harinder Singh Chief Engineer of Irrigation department feels sprinkler irrigation technology deployment should happen at national scale like a movement under NREGA. T.S Taxi, Director of WRD while doubts farmers' willingness to move out of cash crop cultivation and also feel as paddy in Punjab was introduced by national policy in late sixties is national government now ready to take the responsibility of compensating Punjab farmers for not growing paddy? So it is a larger question of political will as well. Farmers however, assure the survey team independently that if they are given an alternative option to paddy cultivation which does not at least reduce their income stream and does not make it uncertain they ready to practice it.

In Bathinda district on January 2, 2011 when we visited Balaharvinjhu village in Guniyana Canal Rest House Jagtar Singh Brar who introduced himself as progressive farmer is of the opinion that Political will can change many maladies in Punjab. He himself is secretary of Bathinda Horticulture association and is member of Fruit and Vegetable Production Committee PAU Ludhiana, Indian potato association, Distrtict Govt. Committee of ATMA, National Horticulture Mission (BTI) and owns a fruit and potato farm. He is of opinion that by legislation paddy cultivation be regulated in many districts of Punjab and water saving crops/ fishery be encouraged along with training, technology deployment and market support price. He even feels that national scale land zoning by crop is needed and appropriate legislation be implemented. New technology development for cultivation is needed. They are of opinion that agriculture should be more organised activity like industry. This area being affected by fluoride, arsenic and brackish water has major health problem. They moved away from gram cultivation to paddy initially in 1983 and in large scale from 1997 for better income. Earlier gram cultivation brought on many migratory birds but now they are rarely seen. Here ground water is saline so only source of irrigation is canal water which is used for drinking purpose as well. Progressive farmer is of view that water users association be strengthened to lobby for water supply and management as well. Small framer Bhuta Singh was unable to understand and was agitated if survey team was to stop paddy cultivation or to find a solution for their livelihood and ultimately income security.

In Harigarh Canal Rest House in Sangrur Sarpanch Rajendra Singh along with other members present on January 3, 2011 previously, i.e. 20 years back, the area was rich in cotton, sugarcane and corn. Nowadays, BT cotton seeds are available. However, the quality of the seeds in terms of production and growth are suspect. American Ballworm came with BT cotton. The worm damaged Kapas and since then the farmers started cultivating BT cotton. Malkeet Singh, Darshan Singh, Nahal Singh and rest all present felt that price of agricultural inputs have gone up so profit has been declining and next generation is not willing to come in agriculture. Many lands are being given in contract farming. In Sangrur, flood is an issue particularly in the low lying areas. Drainage is also an issue in the low lying areas. They have high debt burden. Gurmail Singh, SDO, irrigation department has to say that indebtedness is not always for agricultural purpose but for non productive loans as well and farmers are too much dependent on governmental support. Community and collective actions are relatively less.

In Ludhiana as opposed to Bathinda ground water is good. 75% of water demand is met through boreholes (hand pump and electric pumps). Many individual households have own RO filters and the ground water is treated before drinking. Farmers had to say that SRI variety has given mixed result for them as transplantation need is labour intensive and labour supply is a problem. Gurnam Singh (3.5 acres) , Balur Singh (8 acres), Prem Singh (15 acres , all voiced that problem is not one of short duration of electricity supply but of erratic timing which sometimes do not coincide with farmer's requirement.

3. 22nd to 27th November Visits and Consultations to the Cauvery Delta Tamil Nadu

Mr Adrian Young team leader, Mr Indra Raj,
Dr SK Sharma,
Dr Robin Wardlaw,
Dr Garrett Kilroy,
Dr Joyashree Roy
Dr Bernd Eggen
Mr Nayak Dy Director NIH
Mr Thangamani Superintending Engineer CWC
Mr T. Baintamilselvan SE PWD Trichy
Mr M.Bakthavathsalam Executive Engineer PWD Maliaduthurai

Key Persons Met

Mr S. Jeyaraman the Engineer in Chief of Water Resources PWD Tamilnadu
Mr S. Kumarsen CE Plan Formulation
Mr P. Sivasankaran CE Institute of Water Studies
Mr P. Marriappan Joint CE
Mr K.Shevarajan Joint Director Ground Water and other officers .
Mr Arumugaperumal Director, and Mr L. Rangamannan Senior Hydro-geologist and Dr S.Vinoba Hydro-geologist. Tamilnadu Water Supply and Sanitation Board (TNWSSB)
Department of Environment on 26th November. Mr T.S. Srinivasamurthy Director

The team held discussion on 21st with Mr Thangamani Superintending Engineer CWC to work out the detail tour programme of the visit and other logistics. Team started with a meeting on 22nd Nov with Mr S. Jeyaraman the Engineer in Chief of Water Resources PWD Tamilnadu and other officers: (I) Mr S. Kumarsen CE Plan Formulation (II) Mr P. Sivasankaran CE Institute of Water Studies (III) Mr P. Marriappan Joint CE (IV) Mr K.Shevarajan Joint Director Ground Water and other officers .Mr Thangamani SE CWC and Mr Nayak Dy Director NIH also participated in the meeting.

Mr Adrian Young explained the work done so far by ADB consultants on the Technical Assistance – Support to National Action Plan on Climate Change, and further course of action to be taken to carry out various studies. The Engineer in Chief appreciated the works being done by ADB team and expressed full cooperation and support of the state government to ADB for the studies. He expressed that water shortages at Grand Anicut due to low supply from Mettur dam is already creating lot of problems to the delta farmers and climate change problems may further aggravate the situation. It was decided that Chief Engineer Irrigation Cauvery Delta Trichy will plan the inspection of the team to the

delta areas. Engineer in Chief also agreed to arrange meetings of the team with various state government departments like Agriculture, drinking water, Environment etc in Chennai after the team competes its tour to the delta areas. Team also visited office of Chief Engineer and Director Ground Water PWD at Taramani, where the requirement of ground water data for the delta region was discussed.

Team visited Centre for Climate Change & Adaptation Research Anna University, Chennai. Dr. A. Ramachandran explained the studies being carried out by the Centre and extended full support to the ADB efforts and expressed that a close tie up between ADB and Anna University for the various studies related to adaptation research is very important. He expressed the urgent need to have cadastral maps of big scale 1 to 2000 or 5000 which require good investments and efforts for micro level studies for adaptation. He also explained that lack of high power computers is a major bottleneck for downscaling of various climate change modelling at sub-regional level. Dr.N.K. Ambujam Director Centre for Water resources Anna University and others also participated in the meeting.
Team also visited Indian Institute of Technology (IIT) Madras and discussed various works being carried out by the IIT on Climate change and adaptation.

On 23rd November Team carried out field visits to the Cauvery Delta areas. Mr T. Baintamilselvan SE PWD Trichy and Mr M.Bakthavathsalam Executive Engineer PWD Maliaduthurai and other PWD officers accompanied the team during the various visits. And provided technical details, logistic support to the team and also arranged meeting with the farmers, Fishermans, and other people in the Cauvery delta.

Planting of Samba paddy is in full swing in the delta. Widespread rains have been received in the area which has created encouraging situation for paddy plantation. However in some area it has caused severe flood situation also causing hardship to the farmers. During the discussion with farmers the spread of salinity ingress and drainage congestion were expressed as the severe problem in the area. Other problems cited are untimely and irregular rainfall particularly SW summer rainfall, insufficient water releases form Metter reservoir, and shortage of labour for farm activities. Most farmers have been demanding repair of existing outfall regulators and construction of new regulators. At the outfall of drainage channels to the sea. These regulators are kept opened during flood to pass the flood flows to the sea and kept closed for backflow and spread of sea water into the fields. The regulators also provide heading of water for flow of water to the fields.

Due to salinity ingress and accumulation of water vast stretch of land have become barren. The saline water intrusion is quite visible up to 5 to 6 kms stretch of land near sea coast. Team held discussion with farmers and state government officers to assess the trends and reasons for the spread of salinity ingress. Most farmers believed that the problem is gradually increasing. Many believed that tsunami in 2004 has caused major disturbance in the topography of sea coast and unpredictable behaviour of waves action. However, no definite trends are known except gradual spread of saline water. The future prediction about sea level rise has created apprehensions in the mind of local people and they are curious to know the exact nature of the coming problem.

The Saline water has also created shortage of drinking water in the area. The fresh water is being carried to the area by long distance pipes from outside delta area. The water in the local area wells is not sufficient to provide sufficient water to the population.

The problems due to salinity are largely mitigated in the area where there is water body like pond.The pond is filled up by the rain water and this water is used for irrigation, drinking etc; and the this water checks ingress of sea water in the vicinity of the pond. The ground water in the vicinity is also of good quality.

Efforts have been made to take up prawn culture in the saline water areas near the coast. However such enterprises have mostly failed due to opposition of farmers who feel that proper sea water drainage is not possible due to prawn ponds as these ponds blocks the flow of water. Moreover, these prawn farms were taken up by entrepreneurs from outside the area which is not welcomed by the local farmers. Some of the local farmers who have taken up prawn farming with proper management of the prawn ponds like water management, good seeds, nourishment, disease control, proper aeration of water etc have fetched good financial returns from such farming. It is noticed that if the local farmers

are supported to take up scientific prawn farming with proper drainage management, prawn farming could be a big boon to the delta region.

Settings up of power plants near the coast in the saline water have also been considered by several companies. This requires large vessel, coal jetty etc, for proper operations of coal movement which is mostly brought from Indonesia. However, local farmers have not welcomed the setting up of power plants citing the environment concerns as the main problem.

On 25th November team visited the Tamilnadu Water Supply and Sanitation Board (TNWSSB) in Chennai and met Mr Arumugaperumal Director, and Mr L. Rangamannan Senior Hydro-geologist and Dr S.Vinoba Hydro-geologist. Domestic water supply in the Cauvery delta is through ground water wells but these are grossly inadequate for the entire area. The bulk water supply is through long distance pipelines from the collection/infiltration wells which are high yielding wells in the Koladam River bed which is in the north of Cauvery delta. Water is carried through long distance gravity pipes and in some places water is pumped up for higher elevation. Subsurface dams downstream of these wells further improve the yield of the wells. Team visited TNWSSB Data Centre which has GIS facilities and they have carried out block wise subsurface water profile and geological profile of the area. Officer of the Board agreed to supply the GIS maps of Cauvery Delta area to the ADB study team as per requirement.
Team visited Office of the State Agriculture Department in the state Secretariat. Mr N. Ponnuswamy Additional Director Agriculture and his team of officers explained that agriculture near the coast line is shrinking due to saline water intrusion in the paddy fields. Earlier farmers were growing three crops a year up to near the coastline which has now reduced to only one crop in a year. Pulses and oilseeds have also been taken up in dry season after persuasion by the Agriculture Department. Agriculture Department officers supplied various crops statistics of the delta region giving block wise details of the sowing operations, crop yields, farms inputs and other details.

They also informed by the research work being done by Dr Ms Geethalakshmy in the Tamilnadu Agriculture University Coimbatore on 'Climarice' project about affect of climate change on the rice production etc.

Team visited office of Department of Environment on 26th November. Mr T.S. Srinivasamurthy Director informed about the work being done on state Action Plan on Climate Change and State Water Mission. He explained about various working groups already constituted for working out the State Action Plan. He also informed about the joint project of German Technical Cooperation with the states of Tamilnadu, West Bengal, Madhya Pradesh and Rajsthan on the climate change adaptation by Deutsche Gesllschaft Fur Technische Zusammenarbeit (gtz). He also explained about the procedure for environment clearance of various projects by MOEF under Coastal Regulation Zone. He also explained the coastal vulnerability study by DHI Denmark. Other work on projected sea level rise is being carried out by Institute of Coastal and Marine Management Chennai. Shore line changes study are being carried out by Institute of Ocean Management, Anna University with PWD. About adaptation of agriculture MS Swaminathan foundation Taramani Chennai is carrying research on salt tolerant varieties of rice cultivation. A World Bank aided project namely Emergency Tsunami Reconstruction Project is underway for creation of shelter belts and ecosystem rehabilitation by Tamilnadu government.

Team held wrap up discussion with Engineer in Chief and other PWD officers on the afternoon of 26th November. Mr Adrian Young appreciated help and logistic support and technical details provided by government of Tamilnadu officers to the ADB team. He informed that based on the data and inputs provided by the PWD and other offices, ADB will try to work out simulation studies for the Cauvery Delta area for the existing situation and future climate change scenarios. Director Ground Water informed that as per their study clay land formation in the delta is the main reason of salinity of ground water and it may not be connected with the over extraction of ground water for irrigation. Salinity line is due to geological reasons. Team explained that this would be considered while studying the ground water situation. Director Ground Water supplied the Annual Reports on Sea Water Intrusion in the three districts of Cauvery Delta for the year 2009. He also supplied the Metadata availability of the ground water monitoring wells and rainfall stations which can be made available to the ADB team on soft copy. Chief Engineer Plan Formulation gave the details of various studies carried out by him on drainage improvement and checking salinity ingress in the delta. He promised to supply the details of these studies to ADB team for further study. He also gave details of efficiency improvements of the

water systems in Tamilnadu and Cauvery delta by use of improved irrigation methods. He also explained about scheme of flood water diversion from Cauvery delta to outside basin for improving the overall water efficiency of the system. The details of these studies will be made available as inputs to the National Water Missions. Meeting ended with thanks the chair and ADB team.

a. Community Consultations Cauvery Delta

Thirmullaivasal[3]: (less than 3 km from coast line)

This village exist for more than 400 years and people have been engaged in open sea marine fishing with traditional and intergenerational skill. This was Tsunami affected on 26 Dec 2005 with 15 feet high water standing for an hour and killing 90 human lives.

Panchayat President Mr. R. Arul Sivaramavel is very active leader in addressing community problems: need for piped drinking water supply, resolving community conflict over access to drinking water from public stand posts, bar-mouth closure problem relevant for fishermen. He expressed the need for setting up of drinking water supply system as first priority. How Tsunami has changed ecosystem by affecting the ground water quality at the depth of 6-8ft has been voiced by each one present both men and women.

Women, both young and elderly, engaged in drying of fish and marketing are willing to get house connection for drinking water and are willing to pay to save on time. Kutty Aunty, Malliga, Alamelu (widow) , Kalliamma, Raja laxmi, Aravalli, Upamal, Sundari, Nallama, Illachi, Anjali, Jayanti Nahavalli, Patrojan amma and many others all rushed to put in their name in writing with survey team with the anticipation that this might be helpful for them for getting loan on reasonable interest rate (local money lenders charge sometimes 10% per day) to facilitate their marketing business. They all were complaining and showing their health impacts in the absence of any scientific protective action for hands, feet while segregating landed fish. Innovative solution for marketing was suggested by Malliga as representative of few of them as they feel mobile cold storage van can provide all women going to market with centralized cold storage facility and can fetch better price in the market.

Fishermen Chinnadurai, Rajamoorthy, Majeed, Sengutuvan and all other present there felt that sea mouth closure is the biggest challenge in for them as they cannot take the boat to the sea. In addition, it affects the back water flow to sea, which is the major source of fish flow from sea to river. The inland fishers depend on this flow. Mud crab and prawn production is also facing a challenge. This is known to Arul Sivaramavel as well as to PWD and WRO officials like Er. M. Bhaktavathsalam who accompanied in all field visits. The fishermen want investment on a new jetty and barmouth opening activity.

Youths in their twenties M. Rajivagandhi, V Mulinathan, K Mahaindraan, N Dinesh, R Raju all with at least school education want to be in fishing business due to return it fetches given their traditional skill . However, they feel in no fishing months they are keen on taking up any training but special interest is on fishing effort related training. Women wanted marketing related training. Fish processing, preservation, packaging and marketing so fishing community can control the market. Panchayat President wanted technical training in managing drinking water supply facility .

Village Voimedu[4] (10-12 km from coast line)

It is at the tail end of river course. 70% are agriculturists and 30% fishing community. Panchayat President R Vedaratinan was proactive to show how river water gets lifted but no ground water is used for irrigation due to salinity. Coastal flooding is problem for 300 acres of land due to lack of drainage. This was supported by all present (17 members present) there like R Thaunanadevar, R Balamurugan and others. Primary source of drinking water is Kollidam river based storage and distribution pipelines by Tamil Nadu water Board and secondary sources are saline ground water at 8 ft depth. K Thyagarajan is of opinion that sometimes they use saline water due to lack of adequate alternative option but resultant health problem is unknown for them. They never heard of desalinisation possibility too. A Kalimuthhu , a veteran of age 65 feels that temperature in may–june are higher than in the past. Causing multiple health impact on humans and livestock. Erratic rainfall especially rain in February at the harvest time is causing loss upto 50-70%. M Guori a Fisherman feel like all others present there that tail end regulator which is currently not functioning but structure exist,

[3] We visited this village twice. Once in November 2010 and during detailed PRA survey in February 2011 and was attended by 42 individuals and of whom 10 were women in a thatched roof space on the coast.

[4] PRA (9.2.11) was attended by 17 individuals near pump house open air under a tree

reconstruction of it will solve water problem better. Both agricultural and fishing community wanted this.

Thondiagadu[5] (3-10 km from coast line)
Double occupation is natural in this village for almost all households: agriculture and fishing. Samba is single crop grown given the water availability. Pulse and black gram they can grow but water scarcity and soil quality do not allow. Being at tailend V Thiayagarajan, P Balasundar with all 11 members present feel tail end regulator which used to exist n the past but is now not functioning needs to be repaired as it can help in storage of water and distribution in time of need and will help in managing backflow of sea water as well. They walked with us to show the tail end regulator which is at -1.8 meter sea level.

F. Meetings Consultation December

1. Visits to Madhya Pradesh 29th November to 2nd December

A series of meetings and consultations to Madhya Pradesh were carried out 29th November to 2nd December

a. Summary of Meetings in Bhopal

The following meetings were held with various high level administrators of the department of WRD, Agriculture, Environment, Horticulture and Public Health Engineering Department (PHED).

Meeting with Engineer-in-Chief PHED Bhopal, at Satpura House, Bhopal :	Shri G.S. Damor -- In Chair
Meeting at CWC with Chief Engineer : CWC & Regional Director, CGWB	Shri. Mishra and Sh Parvinder Singh, Sr. Hydrogeologist were present
Meeting at Department of Agriculture and Cooperation, Bhopal Agriculture & Cooperation :	Shri M.A. Upadhye Principal Secretary
Meeting with Commission –cum Director, Horticulture	: Dr M Deepa, Collector, Ujjain, --In Chair
Meeting with Principal Secretary :	Principal Secretary (Environment)- In chair
Meeting with Principal Secretary at WRD Bhopal :	Shri. Manish Singh in Chair

The meetings were coordinated by Shri. R.P. Gupta, Deputy Director (Hydrometeorology) and Shri. N.K. Singh. The gist of discussion of above meetings are given below:

b. Meeting with Engineering Chief at Satpura House, Bhopal. A list of participant to this meeting in placed at attached Annex I

At outset Ms. Vidisha Samarshekhara, ADB Chief gave background of TA project to meet needs for sustained development & management of water resource system for Climate Change adaptation. She told that ADB study team is here to held consultation at various levels to understand the need and priorities of water sector in the state as well as to explore opportunity for longer-team framework on water related issues.

Mr. Adrian, the Team Leader gave all- India perspective of TA project as well as a brief of 3 pilot sub-basins identified in the States of Punjab, Tamil Nadu and Madhya Pradesh in view of their vulnerability to likely changes in climate variables. It was explained that simulation hydrologic models based an exiting situation and on account of climate change implications shall be worked out for purposes of adaptation & mitigation work. The team thus, it was said, looks towards the state government input on the on-going & future initiatives in water resources & related programmes.

[5] PRA (9.2.11) was attended by 11 individuals near pump house and tail end shutter point under a tree

The Engineering -in-Chief enquired the basis of selection of Chambal basin. To this Ms. Vidisha explained that this was proposed to ADB team by Principal Secretary, WRD when she visited Bhopal during October 2010.
The visiting team enquired into the on-going drinking water supply programme under implementation by PHED. The Engineering –in- Chief gave detailed account of Drinking Water Supply schemes & issues connected with it. The brief of which is as follows:

- This about 90% rural water supply schemes in the state are ground water based.
- The urban water supplies are sourced by surface water.
- Due to dependency of state on ground water, the levels are declining in most parts.
- Also this Malwa region is practicing irrigated-agriculture through general water use leading further depletion in the levels.
- The PHED has now long-term plan to supply Narmada river water to Gram Panchyats and Urban area.
- Multi-village and multi district schemes are planned for all 21 districts of Malwa region.
- DPR for drinking water supply schemes for NABARD & WB funding are under preparation.
- These is some shift from ground water use to surface water based schemes in order to reduce dependency and check the depleting ground water.
- PHED is in the process of launching campaign for community participation work in the development & use of water.
- PHED also implements multi village schemes in water quality problems districts.
- Schemes also include education & awareness of farmer and WUAS to the scientific use of water.
- Scheme of water quality monitoring and surveillance programme is in vogue in water quality affected districts.
- PHED is monitoring ground water levels from key observation wells in various districts.
- Water recharge work such as construction of Check Dams as water conservation measures have been under taken.

c. Meeting at CWC officer with CE/Regional Director of CGWB.

Team leader of ADB study team enquired into the action of CWC in the state. The CE, CWC informed that CWC is devoted to work of project monitoring and project appraisal work in all basins. It guides state government in the preparation of project proposals & DPRs. The CE also told that the organization has regional officer at Bhopal and Sub-Divisional office at Indore.

Mr. Mishra & Mr. Parvender Singh Sr. Hydrogeologists of CGWB represented Regional Director of CGWB in the meeting. On an enquiry from Mr. Gerrat, ADB consultant, Hydrologist Mr. Mishra, CGWB explained that CGWB is maintaining a network of 800 open wells and 250 piezometers wells as ground water monitoring observation wells. The CGWB gave its year book containing time series data on ground water levels and ground water quality for its observation stations located in M.P. It also published booklets on ground water situation in Indore, Dewas and Ujjain districts to visiting team for its use in climate change studies.

d. Meeting at Department of Agriculture & Cooperation.

The team leader ADB, Mr. Adrian, circulated a sheet summary of the background of TA project and explained the team study work plan to Principal Secretary (Agriculture). It was stated that study shall be taken up at two levels i.e .at all India level and at sub-basin level. It this regard it was told that highly vulnerable basin areas have been identified including one in Chambal sub-basin of M.P. It was given to understand that climate change in general but focus shall be on water and agriculture which are interlinked subjects. In this regard ADB team is visiting field area in Indore, Ujjain, Dewas to understand issues on the ground for preparation of strategic framework needed for climate change adaptation.

The Principal Secretary gave has views about the region and explained that the study area is a high land area from where there is rivers out flow in all directions and to other states. He said that area bears climate extremes and the temperature rises to high on 45ºC and shared the information that State has set up BISA institute in 550 acres of land in Jabalpur (MP) dedicated to climate change and to develop hybrid varieties of Maize and Wheat. It was told that BISA shall be operational in few

months. Secretary observed that role of agriculture and water mission should be clearly understood. He also mentioned that issue of depletion of water resource is an old issue. He was categorical to say that linkage between agricultures & water should have been more effective for which interaction at planning level was must. The Secretary suggested that ADB mush include a time line for its output and keep provisions for concurrent evaluations. He also desired that ADB should give a look to DFD draft plan prepared by it for state of M.P.

e. Meeting with Commissioner/ Director Horticulture.

Ms. Vidisha and Mr. Adrain explained about 3-basin areas identified to develop location specific climate adaptation plan. A sheet-summary of ADB study programme in the state was circulated. It was told that intended study by ADB shall build on existing studies and on-going plans and outputs. The study it was told shall also look into matter of water use efficiency in irrigation system.

Commission Horticulture mentioned that state is implementing Horticulture Mission Programme of GOI using drip and sprinkler system as water saving devices. She said that scheme which started in 2006 is open to all farmers. Currently the benefit of 50% subsidy is being extended to SC/ST farmer and 70% to general category farmers. It was informed that there is high demand for horticulture crops including cotton and sugar crops. Farmers use Jain Irrigation System and are quick in the adaptation of techniques and methods. Farmers on their own interest visit adjoining state of Maharashtra to gain learning experience of working with sprinkler cum drip irrigation system equipments. Farmer buy equipment from companies related with state dept of Horticulture such companies also provide maintenance to equipments. It was informed that a Process Framer Development Centre (PFDC), a government organization devote itself to teaching & training farmers on aspects of preparation of project proposals on drip & sprinkle irrigation system. In view of the stated development efforts are made to see to what extent the switch over from current paddy cultivation to horticulture crop growing has begin to occur. Commissioner said that visiting team shall have opportunity to see for themselves the horticulture work in Dewas.

f. Meeting with Principal Secretary (Environment)

The team Leader ADB initiated discussion and explained background of TA project & its engagement in development of strategic framework to meet needs of water resource system in the context of climate change scenarios, He mentioned that after consultation at state level the Chambal basin has been identified as study basin. It was mentioned that team a here for in-depth consultation & field visit leading to preparation of mid team report & holding of workshops with a view to discussing output framework adaptation programme. It was mentioned that workshop shall be organized at Bhopal on February 2010.

- That the State in setting up a centre for climate change.
- Desired that it would be appropriate if ADB shares its report prior to workshop on which the state could give its view & observations.
- That ADB should also suggest some good location for development 10MW capacity Hydro-projects.
- That there is need for clear water policy & view points on climate change.

The discussions were also centered around following issues:-

- The existence of *"Paye Jal Abhiyan"* and its relevance as water regulatory measures.
- Whether adaptation of best practices of artificial recharge to ground water are going to solve problems of declining levels of ground water & whether at some stage government of MP shall put stop to ground water over extractions.
- And further how long the ground water reserves would last in the state & whether recharging has real impact.

Secretary derived that ADB team should give holistic look to development of surface and ground water resources and come out with out-put framework for planning integrated programme.

g. Meeting with Principal Secretary (WRD)

The days conclusive meeting was held with Shri Mainsh singh Principal Secretary (WRD)in chair. Meeting was held at office of state Hydrology Data Bank.
Ms. Vidisha & team leader Mr. Adrian gave account of various level meeting held with state government departments in the forenoon of 29-11-2010.

Secretary (WRD) reviewed the whole program of the visit of ADB team to Dewas-Indore areas and advised state officials to accompany the team to Dewas, Indore & Ujjain area to show excessive use of ground water.

Conclusively it was mentioned that the visiting team while carrying out scoping study of issues concerning water & climate change should also look into aspects of long term prospective planning with a new dimension of increasing water use efficiency.

Meeting ended with vote of thanks to Chair

h. Field visit and Meetings Held with officials of state Govt. of M.P. On 30th November, 2010

A summary of discussion & points that emerged is given below:

- **Field visit to DM Farm in Village Arnniya:** A field visit was organized by Horticulture Dept.of State to Arniya DM farm where drip irrigation system for horticulture crops(Vegetable & fruits) are practiced as micro irrigation method of water use. The drip system is linked to two Bore wells of 66 m (200ft) depth & size 6" and a pump of 5 HP capacity.

  The farm is owned by Shri. Kanta Bhai Jain an entrepreneur framer. Naryan Singh Manger at farm explained the micro-irrigation method of irrigation for vegetable & fruit crops. It was gathered this vegetables of the order of 65 ton/ha were being produced. Chilly, tomatoes & green grams were grown. The mango & papaya orchard had a separate drip irrigation system linked to another bore hole of 100 m depth. The drip irrigation farm covering 5 ha area for growing vegetable was picturesque.

- **Field visit to Village Mahukhera in Dewas District MP** The state govt. officials conducted the visiting ADB team to Mahukhera village where drinking water scheme operated and maintained by village inhabitants was examined. The scheme was commissioned in 2007 at cost of Rs. 23.6 lakh where 2 borehole of 150 & 120 meter depth & a large diameter dug well are source of village drinking water supply. The source are located at about 1 km distance from the village and water from bore wells is pumped to a overhead tank of 70,000 liters capacity. The borehole of 10 HP capacity pump are operated for about 2 hrs/day to fill overhead tank located on a high ground in the village. The operating cost of scheme was told to be Rs. 1.5 lakh/year and collection raised from users of households was told as 1.95 lakh/ year. The water supply is designed for population of 4700 inhabitants and it serves a population of 2739.
- Shri. Aniruddh Pawar, President of Village Watershed Committee told about the watershed management measure being practiced over 8000 ha catchment area. The check dam & other water conservation measure were told to have raised water level in the area.
- The participation effort of village is exemplary which is also being viewed as model for neighborhood villages. The villagers suggested that a lake in this area needs to be revived and improved for which government efforts would go a long way in improving water supply needs of village inhabitants.

- **A presentation on integrated water supply project for Village and tour of Dewas and Shagapur District of M.P.** Shri. Rojesh Joshi Executive Engineer, PHED organized a presentation by state Govt. on the scheme proposal of water supply based on Narmada river water.

  A feasibility report for water supply for 1513 village and 27 towns of Dewas, Ujjain and Shajapur for a cost of Rs. 2988 lakh was presented. The scheme proposes intake well near

Nemawar village of district Dewas. The water shall be pumped to water storage tank at Dhantalab from where water is to be distributed under gravity to villages & towns. The scheme is said to cover a population of 42,69,579 in 1513 village and a population of 25,71,807 in 27 towns. The water supply has provision fora treatment plant.

In this proposal it was made out, that a barrage at village Shipra on Shipra river draws 6MLD of water for Dewas town.

- **Meeting at office of CE Irrigation, Indore:** As per programme the State Govt. organized a meeting in the afternoon of 30th November, 2010 at Indore. The CE, Narmada- Tapi Basin and senior officer of the State dept. of Agriculture, Horticulture, Board, Town planning, Groundwater and Irrigation working in the area were present. A list of participants to the meeting at Annex-II.

  Ms. Vidisha, ADB, explained purpose of visit of ADB consultants team. A note was circulated to participants to appraise the concept of TA project. She enquired in to the issues, plans and problems of State in Chambal basin in general & specific issues & programme in Shipra basin connected with scene of water & agriculture and possible impacts of climate change variable.

  The topic was discussed thread wise was and following points were emerged from discussions for their solution.
  - That out of 3 lakh sq.km area in Shipra basin only 7000 sq.km has assured irrigation based on surface water source & reaming through ground water based supplies.
  - Balram Talab Irrigation system (Pond based) should be encouraged.
  - Zinc (Zn) deficiency in soil needs to be improved.
  - Preparation of a report of Strategic framework plan prepared by state for the area was brought to the notice of ADB consultant. The report was prepared under Global Water Partnership.
  - The Shipra fed by Khan river totally carry sewerage of cities.
  - Horticulture is being emerged a priority using micro-irrigation system.
  - Village bunds as well as farm ponds should be renovated and constructed into percolation ponds to cause recharge to ground water.
  - The upper catchment of Shipra river was reported to be deforested. Participants were unanimous in this view to resort to watershed treatment & management measure including preservation of forest, water ponds, planting of trees and trapping of silt from eroded areas.

i. Record Notes on Field visit & Meetings held on 01.12.2010

On 1st December 2010, the ADB Consultant team undertook field visit to Ujjain and Dewas districts. Meet5ing with District Collector, Ujjain and the officers of Department of Agriculture, Horticulture, Housing Board, Ground Water & Irrigation was held.

The team held meeting at Residence–cum–office of Ms. Deepa the District Collector of Ujjain, where she had invited some senior officers working in the district on water & Agriculture projects.
The team members explained the purpose of visit. The study work connected with operationalisation of National Water Mission objective in context with climate change was appraised. It was told that one of the study work area of ADB mission is located in Chambal basin and the Shipra sub basin been identified for giving detailed look to projects & prgramme of water & agriculture. The Collector appreciated the initiative and programme of ADB and indicated her concern about depleting surface and ground water resources in the area. She highlighted the “Jal Sambvad” what has been giving on in the area for some time. She advised Additional Collector Sh Ranvir Singh to continue the discussions and provided all the necessary data & assistance as needed in the furtherance of ADB Mission activity in the region.

A separate meeting was held at Sheetal rest House where large number of State Govt. officials from Drinking water supply deptt., PHED, Ground water, Irrigation were present. After detailed discussions following issues emerged:

- That the Khan tributary to Shipra river carried effluent waste water.

- About 254 villages are still uncovered by drinking water supply.
- There are large number of irrigation tanks & ponds in rural area of Ujjain & Dewas districts.
- Decline in ground water levels of the order of 0.80 m / year was informed to have been observed by State ground water department in Ujjain area.

j. Field Visit to Gram Panchayat Harnewadi & Village Chidewet area

In Harnewadi Panchayat, 78 ponds are constructed by farmers for irrigation purposes. It was told that the top soil is black cotton soil which is underlained by yellow clay layer which provides structures for collection and storage of rain water. Sh Inder Singh of the village Panchayat gave details of pond irrigation in the area.

In Chidewet village 13 talabs (ponds) were reported in east end. Sh Nikram Singh Patel an entrepreneur gave in exhaustive account of the support of pond movement which has replaced the further digging of bore wells in the area. All farmers have one pond in their farm for irrigation. The water is pumped from pond & distributed to fields through pipes. It was told that excavation for construction of ponds is done mechanically.

The field discussions with farmers village Panchayat leaders brought out following aspects:

- The ponds movement and their construction and use for irrigation has raised ground water levels in Dewas area.
- Each farmer spare 1 *bigha* land for construction of farm pond.
- Water harvesting & conservation is the prime activity for increasing sustained agriculture and livelihood in the region.
- The construction of large number of ponds has reduced depending on costly borehole drilling for ground water extraction.

ANNEX – I

Familiarization field visit of ADB's consultants to Chambal Basin

Meeting held in the office of the Engineer-in-Chief, PHED on 29.11.2010 at 10.30 A.M.

List of participants attended the meeting

S.No.	Name & Designation of Participant	Signature
1.	Shri R.K. SWAIN, PS, PHED.	
2.	Shri G.S. DAMOR, E-IN-C, PHED	
3.	ADRIAN YOUNG ADB Consultant	
4.	INDRA RAJ ADB Consultant Ph 9810540680	
5.	Dr S.K. SHARMA ADB Consultant Mob 9910574983	
6.	Prof. JOYASHREE ROY 9836007382	
7.	Dr. Garrett Kilroy	
8.	Dr. Vidhusha Samarasekara	
9.	N.K. Kashyap CE Gwr.	
10.	C.S. SANKULE CE Gwalior	
11.	K.K. Payasi CE. Bpl. Zone.	
12.	N.P. MALVIA, S.E. PHED REWA	
13.	K.K. Songaria. SE. PHED Ujjain	
14.	V.S. Sojatia SE PHED Gwalior	
15.	S.K. HALDAR DIRECTOR, CWC	

16.	Ashok Jain SE PHE Shahdol	
17.	Sanjay Kumar S.E. PH.E Narmada Puram	
18.	V.K. Tiwari E.E PHE Sidhi	
19.	Er S.K. Andhuren S.E PHED Jbr	
20.	Salikendra Shrivastava Director (HIM) WRD	
21.	M.K. Shrivastav S.E. PHED	
22.	P. C. Jain EE. Narmada Project	
23.	S.K. SATAV SE % BN & PHED	
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Sub:- Familiarization field visit of ADB's consultants to Chambal Basin.

After a detailed analysis of all the related Basin/ States using relevant data and senior level discussion with concerned States, kshipra Sub Basin of Chambal Basin for ground water has been selected for details studies for addressing above specific issues.

In this connection the consultant would be visiting the state for further discussion with the officials as well as to familiarize with the study areas as per the programme given below:-

Monday	29/11/2010 10.30 am	Discussion with officers including data center meeting. Meeting with Agriculture Environmental and Public Health Engineering Department officers.
Tuesday	30/11/2010 12.00 am	Arrival at Indore and meeting with District Officers.
Wednesday	1/11/2010 08.35 pm	Field visit at Indore fly to Delhi

May like to request the Public Health Engineering department to give the time for discussion with ADB's consultants on 29.11.10.

Principal Secretary (WRD)

PS (PWE)

Project Director
World Bank Projects

26.11.10.
Principal Secretary
Govt. of M.P
Water Resources Department

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k. Community Consultations in Kshipra

Sarpanch Indrajit Singh Tawra during December 1, 2010 visit in Tonk at Dewas told us how community level effort to hold rain water in farm pond has been later scaled up by government effort. Farmers informed that leadership of Umakant Rao, the then collector of Dewas, currently director Rajib Gandhi Jal Board took leadersip to popularise farm ponds as Balaram talab with government subsidy in villages of MP. Balaram Talab, khet talab, Reva sagar represent various sizes of farm ponds under various schemes which have been scaled up statewide. Vikram Singh Patel is now master trainer and helps farmers to dig farm ponds. Om Prakash Patel with 3 hectare landholding in Cherawad village on 18 January 2011 showed the survey team how one day's of unusual cold spell and frost destroyed 90% Papaya which he tried out this year as an experiment under horticulture department's demonstration farm project. His experience says farm ponds are very good for rainwater harvesting, substitute for ground water extraction and water recharge of ground water aquifer. He prefers drip irrigation better than sprinkler irrigation technology. Additional dam on Tillar River and excavation and rejuvination of Shasakya (government) Talab (Pond) can address water management issue much better in the village as for small farmers Khet (farm) talab (pond) cannot be feasible. The support in favour of rejuvenation through excavation and desiltation of shasakiya talab could be realised upon visit to Silarkheri Talab of 3 km area with gravity flow lined canals. Later such proposal was tested at focused group discussion at Ujjain and farmers present support unanimously and even suggested Jana-udyog (peoples' participatory action) to implement this proposal. Example of Dhar was cited where farmers used their own tractors and put in labour in desiltation. Dewas has 52 such ponds.

Om Prakash is aware of greenhouse technology, net house technology for weather resistant agriculture practices but feels more awareness building needs to be done. Preeti Purohit of CARD (Centre for Advanced Research and Development), a local NGO showed accompanied by government department and villagers how Kshipra Punarbharikaran (rejuvenation) project is functioning.

Water availability has been revolutionised in Ramkheri gaon (village) through balaram talab. Shyam Chowdhury of village Piwday as very progressive and knowledgeable farmer narrated how tanks and their cascading effect has rejuvenated the farming practices in the village. The efforts started at community level. But he is desirous of new eco tourism /new business opprtunities out of these community actions as a second level action to increase farmer's income and rural level activities.
In Ujjain during meeting on 25 february, 2011 Yogendra Kaushik a progressive farmer took leadership and invested in ground water recharge through a tubewellusing gravelle method and successfully experimented with oil seed (kusum) cultivation. Rajendra Singh Solanki of Barkheri village said how he took leadership in experimenting with pisciculture in his talab. Jalsangbad (water dialogue) is for community participation in MP in water related matters at village level is very popular and formally recorded we got to know from Dr Geeta in district collector's office.

Examples of innovative actions by community and later/simultaneous scaling up through government support for local actions are diverse and interesting in MP. In 30.11. 2010 we met B.Com honurs graduate Narayan Sindhevo with training in drip irrigation and with family level traditional knowledge now is manager of an absentee landlord. All his experiments so far on drip irrigation with mulching for tomato, chilli, mango, grams have yielded expected return and is labour saving too. Mohukhera village in Dewas is famous for it's community's initiative and experiment with Panipanchayat for drinking water distribution and management with monetary contribution for water consumers. Females in the village had to say that earlier people from other villages were unwilling to get their daughters married in the village due to hard work they had to do to get drinking water for the family. Now they have piped water supply points within their premises which has enhanced quality of life of the females. Mr Surya Chowdhury, Panipanchayat president proudly announced participation on payment by 475 households and how elected body tries to maintain transparency in management. Laxmi Beragi tests water samples with her 5 anganwari members with support from village panchayat. Ramprasad Suriya voiced a demand on behalf of the community for a rainwater harvesting facility in the village forest which would need negotiation for forest land which can benefit 12 villages in the watershed.

In urban Indore problem is also acute but state level legislation exist in favour of roof top water harvesting. Geologist Gupta feels it is important to scientifically judge how far farmers' perception of groundwater recharge capacity of farm pond is effective and to design scientifically effective recharge systems. Holistic approach for basin wide/watershed based water management is a welcome approach everybody understood but how to implement involving community is less understood. But community preparedness for innovative water management and awareness is understood to be a positive

G. Meetings/consultations January 2011

1. 3rd January CWC

In an introductory meeting held on 3rd January 2011 with CWC and on perusal of documents shared by Mr Kharya, Director, Climate change wing of CWC. Broad issues were discussed around the various themes below:

Issues[6]

The pressure on our water & land resources is continuously increasing with the rise in population, urbanization and industrialization and threat of adverse impacts of climate change. Consequently, a number of issues have cropped up in water sector which call for timely and effective redressal. A macro level perspective of the issues and challenges is listed as below:

- Food security including water security;
- Poverty reduction and economic growth;
- Declining per capita availability of water;
- Lack of coordination among planners at one hand and stakeholders at other hand;
- Inadequate thrust to integrated water resources development and management;
- Rise in Water related conflicts, crisis of water governance;
- National perspective overlooked by the States;
- Climate change preparedness;
- Some of the issues and other relevant challenges are discussed briefly in following paragraphs:

Spatial and Temporal Variation in Water Availability The spatial unevenness and temporal variation in precipitation has led to complex situations like the distinctly different monsoon and non-monsoon seasons, the high and low rainfall areas and the drought-flood-drought syndrome. Therefore, storage capacity in the country needs to be increased.

Declining per Capita Water Availability: Though from the point-of-view of the National level scenario, India may be above the internationally accepted standards of water scarcity (1000 m^3 per capita per year) , yet the figures at the basin level vary widely from 13636 m^3 per capita per year in Brahmaputra-Barak basin to 298 m^3 per capita per year in Sabarmati basin. The situation is projected to get even more serious in 2050 when, about 22% of the area and 17% of the population in the country may be under absolute scarcity condition. Taking into consideration the projections of the population for the year 2025 and 2050, the average annual per capita availability of water is estimated to be 1340 and 1140 cubic metre respectively. Thus, there is seriously decreasing trend in the per capita water availability due to increase in population, urbanization and industrialization which needs to be addressed.

Low Water Use Efficiency: The water use efficiency in irrigation sector in our country is of the order of only 25% to 35% in most irrigation system, with efficiency of 40% to 45% in a few exceptional cases. Some of the prime reasons for low irrigation efficiency are completion of dam/ head works ahead of canals, dilapidated irrigation systems, unlined canal systems, lack of field channels, lack of canal communication network, lack of field drainage, improper field leveling etc. This needs to be improved.

[6] Source: Restructuring of CWC a draft report: Chapter 2

Over-exploitation of Ground Water Resources: Rapid pace of ground water development has resulted in a number of problems. In many arid and hard rock areas, overdraft and associated water quality problems are increasing. In addition to problems caused due to human interference, natural factors like occurrence of high content of fluoride, arsenic and iron are also affecting the ground water quality in several parts of the country.

Other issues: Apart from above, there are also governance issues like addressing the growing conflicts amongst the users of various sectors as also different regions, lack of co-ordination among the agencies involved in water sector; policy issue like need of shifting from project specific planning to integrated approach with basin or sub-basin as a unit; and administrative issues like problems of land acquisition and Environment & Forests clearance of projects.

Climate Change: This is the most important emerging challenge at hand. India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. Climate change may alter the distribution and quality of India's natural resources and adversely affect the livelihood of its people. With an economy closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water and forestry, India may face a major threat because of the projected changes in climate.

Considering the likely impacts GoI has formulated National Action Plan for Climate Change wherein eight missions have been conceptualized. National Water Mission is one of the eight missions for understanding the impacts of climate change on water resources and accordingly plan adaptation measures.

Restructuring of CWC "Restructuring CWC must be guided by the nation's long-term strategy for management of water resources, in the classical spirit of management theory that deals with the linkage between strategy and structure of organizations" (Source: ASCI report on CWC restructuring) Key prompters for organisational restructuring

- Recommendations of Hashim Commission based on its independent assessment
- Recommendations of Administrative Staff College of India based on its independent assessment
- Food security including water security
- Inadequate thrust to integrated water resources development and management
- Rise in Water related conflicts, crisis of water governance
- National perspective overlooked by the States
- Emerging challenge: Climate change preparedness
- Limited potentials that the present thrust areas offer to enhance competencies
- Lack of coordination among planners at one hand and stakeholders at other hand
- Inadequate thrust to integrated water resources development and management
- National perspective overlooked by the States
- Need to address likely impact of Climate change
- Need for holistic planning & development of water resources considering river basin as a unit
- Improvement in Efficiency in Operation and Management of Projects
- Need for Capacity enhancement to meet the future challenges
- Poverty reduction and economic growth
- Declining per capita availability of water
- Lack of coordination among planners at one hand and stakeholders at other hand
- Need for an Independent neutral Institutional Framework
- Move toward River Basin based Approach to Integrated WRM.
- Focus on Value Addition to Integrated and conjunctive use of water
- Requirement of effective Coordination Between GOI and States leading to Integrated WRM.
- Huge data requirement in various areas related to water sector
- Findings of the in-depth study of regional offices of CWC
- Thrust on Integrated water resource management (WRM)
- Rigorous appraisal of projects from environmental angle.
- Continuous search for value addition to water
- Sharper focus on conjunctive use of water.
- Ensure richer coordination among all water related wings of GOI and states leading to better integration.

- Projected water resources scenario for the next decade and emerging challenges to integrated management of water resources.
- The constitutional and operational interface between central and state governments in management of water resources.
- Identifying stakeholders and analyzing their expectations from as also contribution to WRM
- Crystallize forces in the political, socio-economic and technological environment that are likely to impact on CWC's role and responsibilities.
- Identify areas and activities that CWC needs to additionally take up or give up from the existing ones as part of the organisation's vision for future.
- New Competencies needed to cope with new challenges in the environment.
- Changes needed in the organisational structure and operating systems to allow greater clarity in the flow of accountability, authority and responsibility at all levels of the organisation.
- Identify units, functions and divisions where scope exists for rationalisation and development of human resources.

Key advantages of restructuring as perceived by CWC include:

- Help to achieve Optimal Utilisation of Water Resources through Integrated Development and Management of Water Resources
- Efficient execution of its mandate under National water Mission
- Help revisiting its existing key result areas to new explore new key result areas or validation of the emerging new key result areas
- Provide comprehensive information about availability, utilisation and demand of water in the Basin which shall lead to meaningful dialogue among the Stakeholders for resolving various issues.
- Help in optimal planning to address temporal and spatial variation of water availability (intra-basin as well as inter-basin)
- Lead to comprehensive planning of all the related aspects of water sector, such as, conjunctive use, water quality, ecology, environment etc.
- Focused attention to Water Management aspects which would lead to efficient use of water
- Set-up in the field closer to the states would help in speedy implementation of the programmes and policies of Ministry of Water Resources
- Focused attention to dam safety issues would play a major role in disaster management
- Provide a platform for addressing Coastal Erosion related issues
- Opportunity to prepare basin plans for the entire country
- Opportunity to work in niche area like River Engineering
- Opportunity to scale up its operation (expansion of hydrological network from 874 to 2794 sites: sites for monitoring from 130 visits to 330 visits per year; Appraisal of water resource projects from 35 to 100 in number; appraisal of hydro power projects 25 to 35 in number)

Implications of restructuring: increase in employee strengths from existing 5901 to 11691 (Group A, B and C), Annual financial implication 57 crore.

2. Meeting Mr Takashi Chandigarh 4 th January

In a short meeting with Mr Takashi, key problems relating to water sector was highlighted by Mr Takashi, which in my view are critical and relevant in the context of climate change. More focus was on ground water situation in Punjab. Also Mr Takashi responded to my specific questions relating to water regulation in Punjab . The following were evident from the discussion and the write up by Mr Takashi

On Ground water :Mr Takashi stated in clear terms that the state of Punjab is not in favor of ground water regulation as it is felt that such a regulation will create a hardship to its farmers. However, in order to minimize its over extraction, the state is willing to adopt different measures such are a) large scale artificial recharge b) modification in cultivation practices like sowing of paddy after mid June so as to decrease evaporation c) Conforming to controlled, regulated and metered electricity supply d) promotion of micro irrigation e) crop diversification through guaranteed minimum price support and encouraging industries. The other measure includes banning of tube wells completely and restricting the energy power to 10 HP so that deeper aquifers are spared from exploitation.

Further he shared the gist of the meeting that was held under the Chairmanship of Chief Secretary to Govt. Punjab on 26.7.2005 regarding release of electric connection of tube wells in the Dark Blocks of the Punjab State and to check the declining ground water resources. He informed that after detailed deliberations and going through the information on the subject, based on the criteria that the stage of development is > 125%, water table depth is >15 m and rate of fall >20cm/yr., the 17 Most Critical Dark Blocks of the State, including 5 Notified Blocks by CGWA i.e. Moga-I, Moga-II, Sangrur, Mehal Kalan and Ahmedgarh, were identified, in Moga, Sangrur, Patiala and Jalandhar Distts. for taking the following measures to control over-exploitation of the ground water and further to improve electricity scenario of the State.

- Artificial Recharge Schemes to be taken up in the Critical Dark Blocks.
- Roof Top Harvesting be made mandatory in all buildings having an area of 500 sq. yards and above. Both the Departments of Housing & Urban Development and Local Govt. will issue necessary orders in this regard.
- Housing and Urban Development Department and Local Govt. Deptt. to have schemes to tap the city rain water flowing through the storm water drains.
- Suitable Drainage Policy be evolved for cleaning of drains wherever required so as to use these drains for natural ground water recharge.
- Electricity supply to be controlled in these blocks through Board by introduction of meters.
- Crop diversification be implemented in these blocks so as to discourage paddy crop.
- The Irrigation Deptt. to frame schemes for utilization of the available water in the flood plains.
- To encourage modern means of irrigation, such as, sprinkler & drip irrigation.
- To encourage modern methods of paddy plantation, which do not require flooding of the fields?
- Re-modeling of canals to increase water allowance in these areas.

In addition to above, he informed that the state is also adopting various measures to manage, conserve and augment its water resources like contract farming, mass awareness, construction of check dams/low dams, artificial recharge schemes, provision of under ground pipe conveyance distribution system at low dams, preventing early plantation of paddy by restricting electricity supply before 16th June, etc. The regular census of wells/tube wells is being carried out in the State and the number of ground water extraction structures present in the state is well known. These figures are being used in calculating the ground water draft in estimation of dynamic ground water resources of the state as per latest Methodology i.e. GEC-1997, circulated by Govt. of India (Source: Er Takashi. It was agreed to discuss institutional issues on the 6th Meeting

3. Discussion with Mr YB Kaushik on CGWB and Ground Waer Problems in Punjab held on 6th January 2011

A brief discussion with Mr YB Kaushik took place on 6th January 2011. He gave an overview of the core mandate of CGWB and informed that he Central Ground Water Board is a national apex organization with responsibility to carry out scientific surveys, exploration, monitoring of development, management and regulation of country's vast ground water resources for irrigation, drinking, domestic and industrial needs.

In the discussion, he mentioned (if not an accurate number) an indication to the severity of ground water problems in Punjab (103 blocks were over exploited while 5 blocks were critical, 4 blocks were semi-critical). Artificial recharge of ground water is being contemplated in a big scale. What could be inferred from the discussion (though not definitive) are the following

- The severity of the restrictions which are to be imposed upon ground water withdrawals will vary according to the existing ground water resources in the block areas. This necessitates the strengthening of legal provisions for proper implementation.
- Lack of proper institutional structure & capacity to manage ground water along with insufficient human resources and small holdings of farmers hamper the implementing process.

- No classification of ground water bodies by an analysis of the pressures and impacts of human activity on the quality of groundwater with a view to identifying groundwater bodies presenting a risk

- The absence of registers of protected/notified areas within each river basin districts for those groundwater areas or habitats and species directly dependent on water with information on all bodies of water used for the extraction of drinking water and all protected areas covered under various provisions of acts and policies of the state and the nation
- The absence of groundwater monitoring networks based on the results of the classification analysis so as to provide a comprehensive overview of groundwater chemical and quantitative status.

On questions concerning the monitoring of ground water development and monitoring, I was informed that present manpower availability is disproportionate to the magnitude of tasks required to be executed by the regional unit. Mr Kaushik opined that the manpower shortage is affecting the work of the regional unit. The meeting ended cordially

4. Meeting Cauvery Delta 11 to12th January

A brief discussion on Cauvery delta and the institutional arrangement was held between 11th and 12th January 2011. Mr Kumaresan, Engineer-in-Chief was in the chair. He highlighted the following problems in Cauvery delta (which was again shared during the wrap-up meeting held after the regional consultation workshop in Myiladuthurai. The following points were evident

- Roads are acting as barriers & causing inundation. Opening of culverts and recharging measures are important
- Up to 9 km of sea water intrusion is creating problems
- Eviction of encroachers is also a problem for taking up works
- Opined that holding capacity of tanks are higher in lower contours
- Restoration of existing tanks are important
- Tail end regulators are most essential requirement as it helps fishing, facilitate irrigation and protect from sea water intrusion
- It was opined that construction of farm ponds not good idea given the complexity of the terrain in delta area.
- Opined that GW tapping zones are needed for better conjunctive use.
- It was considered that a series of barrages to hold the run of the river is a good option in the delta as a flood protection measure will be of great help for water storage (ie creating river reservoirs) and Kattalai barrage was quoted as an example which was constructed at a cost of Rs 200 crores
- Vegetation in the drainage is a problem. Some mechanical devise is needed for its regular upkeep as manual remedial measures are not feasible
- Opined that for efficient reservoir operations and water use efficiency, a scientific assessment of water requirement is essential
- “Periyar Vaighai” modernization project executed in Madurai district was cited as an example of good practice which helped to irrigate 1.6 lakh hectares through main canal network running into 58 kms and branch canal network running into 200 kms. This project has helped to save 35 MCUM of water and stabilized the crop area and helped farmers to take more than one crop
- Meeting concluded with an assurance from Engineer-In-Chief that in all four officials will be deputed to attend the workshop

The meeting concluded with thanks

H. Meetings/consultations February 2011

1. Discussion on functions of various water centric departments in MP held on 19th February 2011

- A meeting with Mr NK Singh and with various sector departments was held in the office of SWaRA in Bhopal. From the discussion what became evident were the following

- As far as functions are concerned, unfortunately sectoral /departmental, isolated, unplanned approach restrain their potentials to explore answer to some of the critical questions challenging the institutional changes/ role transformation within the sectoral departments in general and water resource departments in particular & especially failed to answer questions like a) which are the key factors that motivate these institutional changes? b) What are the nature and direction of these changes? c) How adequate are these changes for addressing both the existing and emerging water sector challenges? And d) what do they ultimately mean for overall water sector performance?
- There is fairly a minimal level of integrated or coordinated strategies and planning. In most of the departments, catchment planning and integrated water resources is conspicuously absent which is critical to sustainable and water resource management especially when new challenges like sharply increasing demand on water resources from various users (Industries, domestic, environmental and fish culture) in conjunction with growing quality problem associated with water.
- The current functions restrained their potentials to locate their water related institutions in a broader context as "water institution" falls in a domain which is intersected by economics, law, and public policy, sociology, environment and is also strongly influenced by factors like resource endowment, demography, and science and technology, where in such a context, the basic approach needs to be inherently inter-disciplinary in orientation and analytical in character
- Although local institutions play a critical role in supporting adaptation, the intensity of adverse future climate impacts is likely to increase – thereby also increasing vulnerability and reducing existing adaptive capacity. however, the current responsibilities and functions of the department (s) negates the fact that their interventions if planned and executed differently in the form of new information and technology aimed at improving coping capacities, institutional coordination for better articulation (connections among institutions) and improved access (connections of institutions with social groups), and inflows of finances support for local leadership will be critical to strengthen local institutional capacities, has the potential to increase local institutional capacities
- Functions performed as of now, do not lend support for greater coordination between adaptation policies and measures adopted by institutions and decision makers at the national level, and their counterparts at the local level & further do not lend support for integrating climate risk management in development as adaptive development
- It is observed that, as of now there are no clarity on roles performed by the sectoral departments and other stakeholders
- There is no agency dedicated to water resources management providing properly functioning regulatory services to equitably share resources and to protect the common property environmental and social uses;
- Existing agency structures which do not adequately separate functions create potential conflicts of interests between resource management and service provision;
- Duplication of institutional effort arising from overlapping mandates and lack of a coordinating agency. Little or no transparency and poor accountability arising from ill-defined institutional structures (overlaps, gaps, conflicts of interest); few mechanisms for stakeholder involvement and public participation related in part to limited focus on building awareness on water issues
- Human resource management: A weak institutional capacity arising in part from an inability to develop specialist skills because of staff mobility;
- Inefficient water and weak sanitation service providers at the district level resulting from delegation with inadequate capacity building and support;

2. Regional Consultation in Indore held on 24 -25th February 2011

The key points/issues/views /suggestions emerging form the discussion is presented below

a. District Level Official Meeting [24/02/2011]

- Efforts should be made to recharge the dug and tube wells by constructing graded filter materials with gravel and sand filled above the perforated pipes.
- Permission for the construction and operation of new tube wells with recharge structure around them

- The experience sharing on the effectiveness of “Balram Talab” has been very positive. They have been effective in providing irrigation water and also for ground water recharge. Subsidy of Rs 80000 under general category and an amount of 100000 for SC and ST has been instrumental to some extent. However, number of such Talab’s are limited in Dewas district and felt by many to upscale them to cover larger number of farmers in Malwa region. Some expressed their concern that “Balaram Talab” is not for small holders.
- It was reported that Balaram Talab demand much higher than target given to districts
- Mechanism to stop runoff and top soil flow from field during Soya fields are to be stopped by balaram talab concept.
- The policy of standardized cost norms came in for criticism towards undertaking construction works in the basin some times making it inevitable to spend 300-400 crores of rupees towards electricity for lifting water for drinking purpose (Indore and Ujjain where land price is high uniform rule of 2 lakhs per hectare of irrigation land is a barrier as costs are much higher so there is need for revision in the rule)
- The concept of integrated planning is in practice and the district officers of various department in the district planning board meeting work out an integrated strategies on issues related to water and sanitation.
- Zilla pariashd is actively engaged in River Revival project has been taken up in 1000 ha spread over 6 villages in Kshipra basin through construction of various structures like series of ponds and other water saving devices and also total sanitation campaign
- Many opined that Polluted Khan River can be used for irrigation rather than allowing it flow and pollute Kshipra.
- Budget constraints has been a limiting factor for good & proper maintenance of irrigation and tanks systems and ground water schemes are very limited in number in Ujjain
- It was reported that huge amount of soil erosion from fields (10-12 tons/ha) during rainy season causing siltation of downstream Nallas and rivers. Measures such as gully plugging and check dams are being taken up in large scale.
- Many expressed their concern towards loss of biodiversity (plants like keora, Tamarind, Gular) due to GW level decline
- Field bunding and farm ponds are being promoted by agricultural department to check soil erosion and for retention of water in the field. Up scaling of these measures are suggested.
- The relevance of zero tillage was discounted by many and opted for deep ploughing (despite its relevance for black cotton soil, field preparation and good water retention qualities). This was evident during the discussion on the “history” and “changes” in cropping pattern. The Soya bean has been a catalyst of change in land use pattern in Shipra. Cultivation practice of soya bean compelled farmers to drain the water from the field fearing standing water in the soya field is harmful and not realizing the fact that draining of water results in loss of water and soil moisture.
- Learnt that many places in Malwa region is not fit for zero tillage and need is for deep ploughing but expressed the need for financial support for technological interventions as well.
- Many voiced their concern of extreme rains and rise in temperature causing damage to their crops and suggested that 110/120 days duration crops need to be replaced by 90 days Soya bean variety despite lower yield of shorter duration variety
- The need for Rehabilitation of old government tanks was felt by many
- The need, for taking up major and medium schemes in addition to the construction of small ponds and recharge structure, was felt by many participants.
- Many opined that abandoned wells can be recharge points. Farmer level efforts have been proven successful
- Many expressed that Indore and other districts are in grey zone where recharge need is high, and felt strongly for river and canals rejuvenation
- Many voiced their opinion in favor of Integrated planning both for assessing and formulating schemes consisting of small, medium and large scale of short term, medium term and long term plans- almost suggesting a basin planning approach with an integrated approach. Many expressed the need and usefulness of a Chambal-Shipra holistic plan. The support for basin level water management approach was forthcoming as they felt such an approach can address local specificities and larger connected issues.
- Huge subsidy has been a positive stimulus to farmers for cultivating horticultural crops in the basin.
- Many voiced their opinion in harnessing the good potential of Khan River for irrigation.

- The SE of Ujjain, expressed his concern towards administrative hurdle restricting their right to utilize the full quota of 10% of the yield. At present hardly 1% of the yield is being used. He also mentioned that there were no problems in taking up any measures (like constructing small and medium projects) to utilize their quota o of 10% yield in accordance with the Inter State Rriver Sharing dispute award. and therefore suggested for revoking the 10% share agreement of Gandhisagar water sharing norm for the benefit of MP as only 1.5% has been used up so far
- Concern was expressed to the effect that there were several projects which integrates issue and schemes like Saberkheri, Khan, and Chambal Gmbhir connectivity are lying on the table without sanctions and funds allocation thus restraining the state initiatives for water resource development and management thereof.
- Also opined that a) for drinking water local resource use is preferred through rejuvenation of local sources b) to store run off (40%) during rainfall in MP as less runoff is in Narmada and costing 100-300 crores of rupees per annum towards electricity bills to lift the water again from Narmada (Phase III) transfer back to MP. This can be done through 13-14dams which are also proposed.
- Some expressed the need for enacting an act to the effect that famers are made responsible for recharging of water in proportion to their extraction of ground water
- WRD department expressed their need for special grant to execute works through machineries as provisions under NREGA is not adequate and enabling enough
- To provide sustainability to water resource supply all possible sources are to be tapped. Finance found to be the major entry barrier for works in the basin
- Though many opined that recharge measures are good but felt as most important to rejuvenate and maintain surface water flow in rivers, nallas, and ponds.
- Many expressed the need for large scale effort. Some times small efforts are costly but small structures have short lifetime and efforts are to be spread through out the state.
- Declining rainfall is reported to be the major prompting factor to take up afforestation works in a more strategic manner.
- Potential exists for farmers to take up such works in their farm land on the ridges also and land is available to take up such task but needs incentives and planned effort.
- Few progressive farmers are getting yield more than average of the state and trying out alternative income sources with better return and need is a mechanism for scaling up of these good practices.

b. District Level Farmers Meeting [24/02/2011]

In reference to climate change, farmers expressed that, the crop yield were severely affected by untimely frost

- 12 climate zones have varied production levels and climate variability. “Climate zone specific” measures are needed and opined that the formula of “one fit” does not augur well in the current context
- Emphasized the importance of water conservation and protection measures
- Rain water to be stored through construction of storage structures like stop dams and farmers to be made responsible for this.
- Small check dams to be made on the “Choti Kali” river
- Many opined that Balaram Talab, through subsidies extended to both big and small farmers be made popular and up scaled in numbers
- Need for revival of “heavily silted” government ponds felt by many farmers. Through community participation, scope exists for removal of silt from such water bodies and apply in their farm fields for productivity enhancement.
- Small farmers must be encouraged to adopt water saving technologies like sprinkler and drip irrigation through well designed and administered subsidy measures.
- Conservation department is executing stop dams and also water harvesting structures but without adhering to good governance principles which stipulates “corruption free work culture” which in turn excluded the needy from taking such employment and revenue generating works. Need for efficient monitoring of work is needed
- Payment for Environmental Services (PES) as a concept was accepted by many as a good idea as it adds to income with potential multiplier effects but at the same time felt that in practice, the concept is yet to gain it currency

- Towards better governance of public works, the community has taken a pro-active role in reporting the bad and incomplete works to the collector but felt disappointed that no action has been taken yet on such reporting
- many expressed the need for a) more recharge tube wells b) farm ponds in every field c) simplification of crop insurance towards compensating the crop loss
- Crop insurance policies are very complicated and there is need for consultation with farmers
- Many opined that fund allocation for drip irrigation and buying of agricultural equipments to be increased
- Though many appreciated the relevance of Watershed approach etc but felt that scaling up of watershed works are equally important
- Some expressed that the support for organic farming is important as it helps water & soil conservation and has the potential to integrate with livestock and recycle with other wastes generated (Suggested to scale up the Jalgoan Model of Maharashtra)
- Many expressed that Roof top harvesting is needed given the large scale of urbanization and consequent water problems.
- Participants expressed their concern to the effect that that many nallas were created with NABARD money and the lack of funds for its maintenance has made these nallas dysfunctional.
- Many opined that Dhar example of Jan bhagidari model be used for desiltation with the help of farmers with silt sharing norm.
- Expressed the need for Minimum Support Price for safflower oil seed cultivaton
- Some suggested that ITC model for managing farming in select district may be used as model for institutional and policy reform
- It was expressed the need for more communication to be two-way process between farmers, WRD, Horticulture dept and agriculture department.

3. State Level Official Meeting [25/02/2011]

a. Principal Secretary [Agriculture]

- Advocated to follow user perspective to understand practical relevance of our intervention
- Cited (Based on his arial view) an example of an open well with water up to its brim level during the month of April and in this context suggested to demonstrate at least in 10 out of 100 micro watersheds verifiable and measurable impacts through independent monitoring
- Stressed the importance of stakeholders consultation and their views to be taken note of while preparing the project (s)
- He opined that quantification of recharge work is critical so that progress of work could be easily measured
- Suggested that project be conceived in a way the interventions as proposed in the project are doable
- He agreed in principle and in totality the strategic framework as proposed by ADB for Shipra basin and that actions lines as suggested are implementable.

b. Principal Secretary (Horticulture)

- Opined that efficient use of technologies are needed to reduce ground water extraction
- Informed as how the soyabean cultivation has changed the whole scenario of soil and water eco-system of Shipra basin and suggested as useful to study the history of crop pattern and land use practices in the region for putting our insights in a better perspective
- While agreeing to the fact that, drip irrigation (through high subsidy) has been contributing to minimize the use of water especially for high value horticulture crops , but felt that, protocols for such technologies are yet not developed for field crops like Soybean & Wheat systems.
- Opined that through study and analysis of various watershed programs executed in Ujjain in Shipra catchments and in other places, lessons could be drawn and incorporated in our study.
- Suggested that sustainability potential of Interventions as proposed in the strategic frame work could be studies after the project is withdrawn
- Restated the fact that project approach to focus among others, the comprehensiveness, sustainable processes, farmers extension, post harvest management issues (including agricultural vale chain) planning, implementation and monitoring
- Also opined that preparation of community is important.

c. Principal Secretary (Irrigation)

- On the issue of energy, he opined that making power available is not an issue but willingness to pay on the part of the user of energy is an issue
- As many schemes are owned by the government, appeasement policies of the government does not allow ownership to farmers
- Opined that farm ponds are successful
- Strongly felt that community ownership and management approach does not work in Shipra region whereas Individual ownership and management approach has the potential to succeed
- Opined that Sewerage treatment issues become critical in urban management
- Opined that water loss is substantial in urban areas. Management of urban water, its recycling and sewerage treatment is critical and Municipal Corporation of Ujjain is engaged on these issues.
- Also indicated that using Narmada as a water source is cost prohibitive
- Advocated to allow tube well installation only in places where farm ponds are available
- On IWRM he opined that, integrating functions and functionaries is complex in practical terms. At most one could achieve coordinated planning through IWRM
- On subsidies, he strongly felt that a) subsidized schemes do not work well and b) only those interventions which are economically proved to be viable and feasible to be subsidized and not otherwise.
- Concluded by saying that training and awareness raising are important

I. Meetings/ Consultation March 2011

1. Regional Consultation in Punjab held on 28th February to 2nd March 2011

Major points points/issues/views /suggestions emerging form the discussion is presented below

a. State Level Official Meeting [28/02/2011] In The Chambers Of Principal Secretary [Irrigation]

ADB team while explaining the water related problems and issues in Sutlej basin, presented framework plan proposal to address the current problems in the basin and which covered four components namely a) conjunctive water management b) Establishment of IWRM c) Devolvement of water management to the communities and d) Establishment of efficient agricultural systems. Principal Secretary, in principle conveyed his agreement to the proposed framework plan and also shared his views and possible measures to address the current problems of the basin as highlighted in the interim report and asked other department officials to share their views as well. The following views /suggestions/observation emerged during the discussion.

- Given the problems of ground water depletion, measures like, educating farmers, introduction of water saving technologies and testing of soils were suggested
- Construction of recharge wells, revival of deep ponds, and laying underground drainage could be thought of as some remedial measures
- It was informed that where water requirement is less more water is lost and study needs to focus on such issues
- Some opined that scientific feedback, technical knowledge, modeling exercise could help in generating climate sensitive weather forecast.
- Technology like laser leveling has been popularized in the region and 10-15% of water saving is achieved
- As short rain fall induces panic, advance information on weather is useful for providing farm advisories to the farmers.
- Theft in the upper canal reaches is posing the problems and this needs to be checked and prevented
- As existing system of weather prediction is not accurate, an efficient and reliable weather forecasting system is needed.
- Some opined that Moisture meter can help for proper planning

- Ponds existed before 1965 as conservation technique but fragmentation of holding etc has destroyed such ponds.
- Opinion expressed towards establishing an information system for efficient planning
- Given the situation of ground Water depletion and over extraction, some opined that establishment of a regulatory authority is necessary (as recommended by the 13th finance commission)
- Concerning IWRM, the present 3 tier coordination-communication and program review mechanisms could serve the purpose of IWRM
- Coordination mechanism among WRD, agriculture and Horticulture needs to be examined
- Drip irrigation as an effective technology for water savings is yet to be demonstrated on a scale for field crops though micro irrigation is found useful for horticulture crops
- It was reported that area under citrus cultivation is on the increase
- Crop diversification as an alternative option for minimizing ground water extraction is a slow process and farmers needs a package of education, extension, technologies and financial incentives for crop diversification
- National food security mission prompted Punjab to adopt paddy-wheat cycle during green revolution and many opined that a second green revolution is needed to explore options to resolve problems posed by wheat-Paddy cycle
- Some expressed that cotton could be other potential crop to be promoted as it does not face marketing problems and cotton production is viable
- However, It was opined that Paddy –wheat cycle is labor saving, current mechanization practices augurs well for continuation of wheat-paddy cycle
- Need of action plans, new information not regular generic info which they are looking for.

b. District Level Official Meeting [01/03/2011]

- Many expressed that, the erratic power supply coupled with auto corrections has led to wastage of water
- Erratic power situation is leading to inefficiency in irrigation practice because of uncertainty in water supply timings.
- Optimum but reliable power supply and management is believed to help overcome the situation
- Towards minimize ground water extraction, many officials opined that promoting less water consumptive crops, crop diversification, strengthening marketing facilties and appropriate pricing mechanisms for crops, are necessary
- Some opined that the late plantation is helping and becoming a practice
- PAU is providing knowledge support to the farmers towards water conservation technologies
- Promoted successfully the direct seeding of rice which has saved 3 or 4 additional irrigation
- The use of seed drill and tensometer is gaining popularity
- SRI had mixed result in Punjab. The need for large scale transplantation has not changed the situation which is also labor intensive in a situation where labor is in short supply
- Mung and maize, potato are also grown by some. However, price fluctuation and low demand combined with uncertainty in incomes has constrained their popularsation
- Farmers are ready to do cropping pattern change if market for other crops are assured. \
- Canal water meets demand to only small extent.
- Some farmers suggested enforcing an act/rule /issuing an order to the effect that the extraction of ground water is permitted to irrigate only up to a maximum limit of 5 acres and not beyond.
- Suggestions were made to rehabilitate village ponds and also for desilting
- Many opined that repairs, renovation and restoration of tanks is to be taken seriously

2. Regional Consultations held in Tamil Nadu 07/08 March 2011

Major points points/issues/views /suggestions emerging form the discussion is presented below

a. State Level Meeting

- What is evident as of now based on the preliminary assessment is the fact that number of rainy days are decreasing while temperature is increasing , but felt as necessary to have firm projections on sea level rise.
- The Modernization project scheme provides a sound basis to formulate the strategy plan for Cauvery delta.
- The key components of the strategic plan namely a) Modeling & Planning design b) Project implementation c) Agricultural Systems to meet adaptation needs d) Institutional development and training were agreed as the relevant component for Cauvery delta
- There will be reduction in the south west monsoon by up to 10% in the middle of the basin and ranges between 10-20% in Cauvery delta by mid century
- Reduction in end-century south west monsoon rainfall in Cauvery delta is expected to be less than for mid century. In brief, the situation in Cauvery basin is going to be critical
- Necessary to carefully examine the flows under different conditions to evaluate usefulness and viability of investment options in the basin
- Works not to be executed in isolation but to be carried out in river system as a whole
- Any quantifiable facts from past experience will be useful information to assess the magnitude of impacts
- Capacity building and Institutional development is necessary to understand the relevance of dynamic modeling in collaboration with other institutions like IWS, Institute of Hydrology, IWMTI etc
- Discussions on Coastal protection issues are in progress with ADB team and we were informed that the Institute of Ocean Management is currently mapping the coastal areas in the state.
- Further informed that up to 500 meters from the high-tide line, regulation of different activities are being done and once the hazard-line is demarcated, regulation areas will also increase stretching beyond 500 meters and up to 1000 meters.
- Caution needs to be exercised in dealing with Cauvery delta area
- Diversion of flows from the upper reaches is necessary to stop inundation
- Conversion of drainage into irrigation is posing difficulties
- Modernization of irrigation project in Cauvery delta will not bear fruit as its terrain is complex (quoted from a study by Mr AS Krishnaswamy)
- Given the problems in the basin, need to develop short duration crops

b. District Level

- In the context of change, department official opined that controlling green house gas emission is critical as Paddy cultivation releases green house gases and farmers to be educated on judicious use of fertilizers
- Strict adherence to timing of water release is important as any delay in release will affect the crop calendar and also yields
- Many opined the need for storage tanks and many opined that fresh water storage is a good idea
- Also expressed that heavy clay soil profile of the delta restricting the potentials for recharging the aquifer
- Many opined that storing water in village ponds and low lying area (called Alaam in local) shall help in GW recharge in big way.
- Infrastructural development works like roads is blocking drainage and reported to be the major problem
- Prawn farming is reported to be affecting the drainage
- Short duration intense rainfall causing problems.
- Many expressed that sea water intrusion posing lot of problems.
- Use of less of fertilizers and more of organic manure will help in reducing green house gases.
- Farm ponds are very important to give irrigation water as supplement, for fishing and for GW recharge.
- Government is providing subsidy to an extent of 90% to construct a pond of size 30m x 30m X 1.5 m depth pond. Easy for big farmers. Oil pumps for using water of these farm ponds are also subsidized by govt.

- Small farm ponds as well as community farms both are important for water conservation
- Ground water recharge in minus zone (depressions below sea level) can also be utilized for water conservation, fishing etc..
- Many opined that drainage needed higher level and the drainage work is not found to be effective in low land
- SRI cultivation is getting more and more popular and It needs farm equipments for easy operations as labor is in short supply (area under SRI is steadily increasing from 8000 ha in the beginning to the current level of162000 ha and the seed rate is reduced from 40kgs to 3 kgs.
- Concerns expressed by many villages that continuous sea erosion is causing great threat to their peaceful existence and requested for immediate action to protect them through construction of RMS wall.
- No scheme of compensation for shifting of habitat to higher land in case of severe threat to their security against sea erosion.
- Environmental conscious farmers expressed their concern that plastic and poly bags causing a lot of harm for fish lying of eggs in sea shore and consequently fishing is being shifted to deeper zone where the fish yield is not promising for fishermen.
- Some water storage structure like barrage at Collidam river should be made to conserve water.
- Village ponds under enchroachment should be evicted for water storage.
- Continuous sedimentation flow is causing closure of river mouths which affecting the movement of vessels
- Opined that river training is required and Opined that "V-shaped drainage works better

c. Wrap-Up Meeting With Engineer-In-Chief 9th March 2011

- Roads are acting as barriers & causing inundation. Opening of culverts and recharging measures are important
- Up to 9 km of sea water intrusion is creating problems
- Eviction of encroachers is also a problem for taking up works
- Opined that holding capacity of tanks are higher in lower contours
- Restoration of existing tanks are important
- Tail end regulators are most essential requirement as it helps fishing, facilitate irrigation and protect from sea water intrusion
- It was opined that construction of farm ponds not good idea given the complexity of the terrain in delta area.
- Opined that GW tapping zones are needed for better conjunctive use.
- Opined that series of barrages to hold the run of the river is a good option in the delta as a flood protection measure will be of great help for water storage (ie creating river reservoirs) and Kattalai barrage was quoted as an example which was constructed at a cost of Rs 200 crores
- Vegetation in the drainage is a problem. Some mechanical devise is needed for its regular upkeep as manual remedial measures are not feasible
- Opined that for efficient reservoir operations and water use efficiency, a scientific assessment of water requirement is essential
- "Periyar Vaighai" modernization project executed in Madurai district was cited as an example of good practice which helped to irrigate 1.6 lakh hectares through main canal network running into 58 kms and branch canal network running into 200 kms. This project has helped to save 35 MCUM of water and stabilized the crop area and helped farmers to take more than one crop
- Meeting concluded with an assurance from Engineer-In-Chief that in all four officials will be deputed to attend the workshop
- ADB offered the help of a resource person to help prepare the presentation by the state level officials if their presentations on 15th March 2011

3. Interim Workshop: 15th March 2011

a. Introduction

The project TA 7418-IND-Support for the National Action Plan for Climate Change. An Interim report with key findings based on analysis, interactions with senior officials at state and district levels and with farmers through PRA, was circulated to various stakeholders. An Interim workshop was organized on 15th March in Delhi with a view to discuss and review till date the findings of the study.
The workshop was attended by both central and state level officers. The workshop began with a welcome address by Dr Vidhisha Samarasekara, Climate Change specialist of ADB New Delhi followed by series of presentations.

The presentation covered the following topics

- A Background and introduction to the study
- An overview of water and climate changes in ADB Asia Pacific Regions
- Water Resource Management and Climate Change
- An overview and methodology of the study
- Analysis of Current Issues in the three Sub-basins
- Climate and hydrology
- Ground Water
- Strategic Frame work planning
- Water Use Efficiency
- Status and strategies of ground water resources management in Punjab state
- Climate Change in Shipra basin
- Cauvery delta and water management

b. Key points emerging from the presentations

CWC in its presentation, in addition to making reference to climate change impacts, also highlighted the following

- A need for reliable assessment of Impacts of climate change on water resources in quantitative terms
- Determination of scale at which assessment is needed for planning the adaptation measures
- the importance of convergence of database and knowledgebase
- To present area specific issues and alternative solutions
- The importance of Coordination among policy makers, planners and executing agencies at one hand and users and stakeholders at other hand
- To focus on Increasing efficiencies of water resources facilities at all levels

With reference to assessment of the potential for improving water-use efficiency, specific mention was made of the following

- Options for improving management organizations to address poor service delivery and cost recovery;
- Conjunctive use of surface & groundwater;
- Potential for structural improvements including water reuse and improved distribution systems;
- Review of water-allocation system and the potential for volumetric water allocation and establishing effective regulation and control
- Alternative and appropriate arrangements to initiate and develop sustainable change and strategies for scaling up, including private sector participating or other management initiatives;
- Assessing legal framework & mandates; and Identifying appropriate indicators and monitoring
- Assessment of sector responsibilities and effective institutional arrangements for managing water resource and sectoral coordination;
- Identifying new management imitative, including the potential involvement of the private sector in research, planning, design, management, and investment;
- Institutional and control strategies to manage and control groundwater and surface water usage for ensuring compliance with environmental regulation; and

- Assessing current and future requirement for research related to climate change and the links to planning and managing water resource
- Prepare specialist training modules, with training materials information, education, and communication modified for the Indian context
- Establishment of Hydrological observation (river flow) & groundwater stations
- Establishment of Automatic weather stations and automated rain gauge stations, evaporation data
- Creating Data network for river morphology
- Creating Surface storage/water bodies data network
- Creating Snow & glacier related data collection network
- The focus on estuaries and coastal areas

CWC concluded its presentation with an explanation of the on time lines

- Observations/Comments on Interim – 31 Mar
- Final stage consultations - 25 Apr-06 May
- Draft final report – 31 May
- State workshops (2 days presentations + w/s)
- Tamil Nadu: Trichy 13-14 Jun
- MP: Bhopal or Indore 16-17 Jun
- Punjab 20-21 Jun
- Final workshop: Delhi 27-28 Jun
- Observations/Comments on Final – 10 Jul
- Final Report – 31 Jul

c. Dr Charles Rodgers, Senior Natural Resources Specialist, Regional & Sustainable Development Department, ADB, Manila

- ADB, Climate Change and Water
- Citarum Integrated Water Resources Management Investment Program (Indonesia)
- Khulna (Bangladesh) Resilience of Water Sector Infrastructure
- Summary Observations
- The key observations emerging from his presentation are the following
- ADB's climate change adaptation programs and projects are client-driven (extensive consultation)
- Relatively small adaptation grant financing manages risks to much larger loan portfolios
- Climate science plays a fundamental role in generating usable knowledge (projections) to guide investment planning and decision-making, but…
- Focus on vulnerability assessment (this can be done prior to developing scenarios – "bottom up" approach)
- Spatial risk mapping is an important early step (develop high-resolution GIS coverage)
- Identify all drivers of change, not just climate
- Begin by addressing, managing risks of present climate variability
- Develop modeling capacity
- Maintain, expand dialog with scientific community

d. The key messages from JNU 's presentations are

For sustainable development it is essential to have resource security (water resource)
It is essential to understand the climate change pattern, global warming and other episodic events including earthquake, tsunami, glacial melting etc.
Modeling of the environmental parameter, events and resources should be done with latest techniques.
Solution to address climate change impacts covered a) Scientific Site selection of rainwater harvesting by using satellite data, resistivity surveys, magnetic surveys b) Maintenance of Rainwater Harvesting sites c) Plantation of suitable species based on terrain characteristics and d) Sun-Earth-Cosmic connection to understand Global Water Resource

On Facts about the Earth's climate, the following points were presented

- The Earth's climate is not just a question of global average temperature. Wind patterns, precipitation, sea levels and moisture content all form part of the climate and play a vital role for the conditions for Bio-systems
- The climate is created through the interactions of many factors, for example radiation from the Sun, the ability of the ground surface to reflect sunlight and the ability of the atmosphere to retain heat. A small change in one of these factors could start a chain reaction, resulting in major changes in the global climate.
- Mutual feedback mechanisms are very complex, and large amounts of research and computing power are required to map and model them.
- The objective is to be able to predict how the climate will develop as a consequence of natural and man-made influences.

e. On Space Environment Viewing Network (Sevan), The Following Points Were Highlighted

- A network of middle to low latitude particle detector called SEVAN is being implemented in the framework of the International Heliophysical Year (IHY) to improve fundamental research in Space Weather and Sun-Earth Environment understanding for sustainable development.
- The network will detect changing fluxes of the most of species secondary cosmic rays at different latitudes and altitudes those constituting powerful integrated device in explaining solar modulation effects.
- During violent solar explosion sometimes additional secondary particles are added to background studies of changing time series of secondary particles shed light on the high energy particle acceleration mechanisms by flares and coronal mass ejection driven shocks.
- SEVAN network will be sensitive to very weak fluxes of Solar Cosmic rays above 10 Gev.
- Upper layer is selecting mostly electrons and muons. The middle layer is more sensitive to the neutral fluxes and lower layer to three high energy muons.

To understand the tectonic influence on water resources towards sustainable development, following were highlighted

- Tectonic activity can influence surface water and groundwater
- Return of Kosi River induced by Tibet earthquake
- Micro tremor can influence aquifer
- Cosmic Ray variation can influence hydrosphere

For ground water depletion in Delhi, the following were cited as reasons

- Climate Change, Seismotectonic activity, Improper land use and overexploitation of groundwater resources are responsible for lowering down of groundwater level in Delhi and its surrounding NCR region

Mr Adrian Young , the Team leader, in his presentation while outlining the time line of the current study highlighted the Strategic Frameworks for the India Water Systems and Strategic Frameworks for Three Pilot Sub Basins. Also covered the following in his presentation

- Background and rationale for support to National Water mission
- Methodology adopted for the India water system study
- Methodology for the pilot sub-basin
- Approach to framework planning
- Outputs for Strategic Frameworks for the India Water Systems and for Strategic Frameworks for three Pilot Sub Basins
- Time line of the study
- Summary findings on India water Systems which covered among others the following
    - IWRM and Climate Adaptation-in parallel
    - Data management climate change to be incorporated, open access
    - Conjunctive water use efficiencies
    - Control and subsidies as a means to meet conservation and efficiencies
    - Climate change projections-useful but need for increased accuracies, applications of probabilities required
    - Basin Management-important to include climate change scenarios
    - Estuarine and coastal management-understand processes, environmentally appropriate approaches
    - Flood and Disaster management, water quality

- Weather forecasts
- On climate scenarios included Different climate models might produce different results
- Need to broaden spectrum of model results available is essential
- Important to test impacts of a range of possible futures
- Uncertainties in model projections will reduce in time, but for now essential to have "no regrets" initiatives

Mechanisms to develop adaptation plans covered the following

- Strategies for Present Issues
- Climate change scenarios
- Assess viabilities of strategies against climate change impacts
- Preparation of a climate change adaptation framework
- Road Map –step by step, periodic reviews refinements
- **Key strategies for the 3 basins covered the following**

Sutlej basin: Strategy

- conjunctive water management;
- water management to address salinity and water quality
- Establish efficient agriculture production systems
- Control and Support Mechanisms for sustainability
- Establish IWRM

Kshipra basin : Strategy

- Reduce GW abstraction to sustainable levels
- Improved agricultural productivity
- Sustainable water supply and sanitation
- Improved water quality in surface and groundwater
- Institutional development

Cauvery delta: Strategy

- Modelling Planning and Design
- Implementation of Projects
- Agricultural Systems to meet Adaptation
- Institutional Development Training and Awareness

f. Mr Indra Raj, Deputy Team leader in his presentation highlighted key issues in the 3 river basins namely

Sutlej basin:

- Indiscriminate use of ground water through tube wells have caused steep decline in levels of ground water in many districts
- Agricultural operations unsustainable in long run.
- Stalinization & rising ground water leading to salinity & water logging.
- No control over groundwater extractions. (Electric power highly subsidized)
- Pumps left switched on & run when power supply is available
- Irrigation not on need-based on moisture requirement, but availability of power to pumps
- Quite limited recharge potential in the basin
- Need to further study for recharge potential and methodology and cost effectiveness of the various measures**.**
- Fluoride in groundwater in various districts
- Chromium & Nickel in Ludhiana
- Biological contamination also cause of worry.
- Aquifers contaminated by agricultural chemicals like fertilizers, pesticides.
- RO filters being used by rich farmers.
- Poor farmers & laborers using unfiltered water.
- Punjab: Green Revolution at cross-roads
- Farmers reluctant to change from guaranteed prices for wheat and rice
- Shifting to alternate cropping tried but no viable options
- Water saving agricultural operations developed:
  - zero tillage
  - laser leveling
  - ridge planting of rice

    - direct seeding
    - Promotion of timely plantation of rice very effective to save water and accepted by farmers.
- Ponds can absorb floods -- fight drought conditions.
- Farm ponds not favored: takes away portion of agriculture land.
- Village ponds degraded & illegally occupied. Major efforts needed to revive water harvesting structures.
- Bhakra dam reservoir: major buffer to uncertainties of river flow under present & projected climate change projections.
- Need for improved reservoir operations. An improved decision support system for flood management being developed under HP II.
- Reservoir sedimentation has to be controlled for long life of Bhakra system.
- Lack of data of meteorological parameters and river flows.
- Lack of information & data on snow & glaciers in the basin.

Kshipra sub basin:

- Groundwater main source for agricultural and drinking water
- Groundwater use over 100% of sustainable level in Ujjain and Indore districts; 66% in Dewas
- Variations of use in the block wise scenario
- Limited availability of groundwater in hard rock aquifers ◊ gradual decline of groundwater table
- Fluoride & other contaminants reported in groundwater.
- Major concern: Drying up of Kshipra river during non-rainy season
- Kshipra does no dry season base flow from groundwater to the streams have stopped due to over exploitation of groundwater
- Acute shortage of water during holy festivals like Kumbh Mela
- Special arrangements needed for water supply in the river as well as for other consumption
- Micro irrigation highly popular, but large scale adaptation difficult (not suitable for some crops)
- Need to upscale micro-irrigation for:
- major water saving
- drought proofing
- Increasing agriculture & horticulture production
- Farm ponds and community ponds very effective for:
- storing rain water
- mitigating droughts
- providing groundwater recharge
- Need to upscale ponds to a large scale
- Major crops: soya bean, wheat
- Soya bean does not tolerate any accumulation of water in fields, so farmers quickly drain rainwater.
- Rainwater run-offs without any use or groundwater recharge. The availability of moisture for Rabi cultivation is also reduced.
- Catchment area development schemes have been taken up in Ujjain: need to be evaluated to understand their effectiveness in water management.
- Erratic rainfall pattern reported by farmers: causing stress to farming operations.

Cauvery Delta:

- Cauvery Delta experiences wetter conditions during NE monsoon (Oct, Nov, Dec): over 50% of rainfall. Not properly used ◊ causes flooding & drainage congestion in lower delta.
- Torrential rainfall cause problems to harvesting of Kuruvai and Thaladi transplantation.
- SW monsoon rainfall deficient: rice farmers depend upon Mettur reservoir water: deficient and unreliable canal water supply.
- Reduced surface water ◊ dependence on groundwater
- Groundwater has medium to high salinity & alkaline hazard potential.
- Increased land salinity caused by:
    - Over-abstraction of groundwater
    - land use,
    - surface water ingress of sea water
    - changes to upstream surface water discharges

- Large scale flooding & inundation caused by back water combined with floods.
- Water quality problems: Aquaculture adding to contamination.
- Sea erosion major problem reported by villagers: threatens safety of many villages ◊ demands for RMS walls along coasts
- Unfavorable weather ◊ heavy incidence of pests & crop diseases
- Policy and planning not developed for contingency cropping if routine cultivation fails
- Poor maintenance of irrigation channels & drains ◊ excessive weed growth & damaged conditions to channel bed and sides.
- Masonry structures in poor conditions: need repairs.
- Tail-end regulators are important structure for drainage and control of backwater from sea.
- All these regulators need reconstrction; also need more regulators.
- Most of delta in Nagapattinam district below sea level: difficult to drain water.
- Closure of river mouth a major problem. Boats get stuck in sand blocking fishing operations. Villagers demanding immediate action to clear river mouth.
- 100% villages supplied piped water, but potable water becoming a problem.
- Water shortage ◊ groundwater extraction.
- Freshwater harvesting is important but gradually reduced.
- Need for rainwater harvesting in village ponds, farm ponds & depressions

Issues common to all the 3 basins:

- Erratic weather conditions reported by villagers ◊ problems in agricultural operations. More effective weather advisory forecasts, and flood hazard forecasts needed.
- IWRM concept not in planning and management of water.
- Conjunctive use planning not very effective.
- Lack of coordination between state agencies on water issues. However, committees at state level & district planning committees are effective in different issues related to water, agriculture, environment & socio-economic problems.
- Farmers need support with:
  - Lower transaction costs
  - proper packaging
  - storage and marketing facilities for agricultural & horticulture produce
  - micro credit facilities
- Lack of quality information system and computerized MIS.
- Need for manpower management and cadre management in depts related to water & agriculture.
- Urgent need for training and skill up grading in IWRM; weather and reservoir inflow forecasting

g. Prof. A.K. Gosain and Dr Robin Wardlaw in their presentation covered the following

- Basin profiles and current issues
- Sutlej
- Kshipra
- Cauvery Delta
- Possible climate changes and impacts
- Climatic Features – Lower Basin
- Mean Annual Precipitation
- Variability in Annual Precipitation
- Mean 10-day Flows in Bhakara Main Canal

The presentation on possible climate changes covered the following

- PRECIS model being used to explore the potential impacts of climate change at mid-century and end-century for A1B SRES scenario
- This is one of many possible future climate scenarios
- Most models agree well on temperature changes, <u>but not on precipitation changes</u>

Potential impacts

- In lower basin increased potential evapotranspiration, and increased rainfall

- Possible flood and drainage issues

	ETo (mm)		
Location	Baseline	Mid-century	End-century
Southwest	1890	1900	2080
Middle	1680	1660	1810
Ropar Headworks	1260	1290	1350

- In upper basin increased snow and glacial melt
- In upper basin possible increase flood magnitude and frequency

Possible Changes in Surface Water Availability at Bhakara

- Currently a lack of definitive research findings on glacial storage and melt regimes
- Indications are for no significant changes in Bhakara inflows from snow and glacial melt in short term
- In longer term a decline in base flow from glacial melt may be expected
- Catchment hydrological response being explored with SWAT model

Issues / Questions from Climate & Hydrology

- Lack of climatic data in upper catchment
- Increased runoff in response to possible increased precipitation – implications for drainage and flood mitigation
- Indications from SWAT are that flood frequency and magnitude could increase
- How are canal discharges used in March, April and May when there should be very little irrigation demand?
- Possible Change in Annual Precipitation
- Possible Climate Change Impact on Water Resources: SWAT Modelling
- Evaluation of Simulation Using PRECIS Weather Data
- SWAT Simulated Average Annual Water Availability

Indications of PRECIS A1B Scenario & SWAT Simulation indicated the following

- Possible increase in precipitation
- Smaller increase in potential evapotranspiration
- Possibly increased runoff
- (effects on recharge still being assessed)
- Possible flood and drainage issues

Vulnerability to Sea Level Rise in Cauvery delta

- IPPC AR4 indicates a possible eustatic sea level rise of 0.3 m by mid-century
- Very low tidal range makes impacts of sea level rise on drainage more acute

Indications from PRECIS A1B Scenario

- Possible reduction in water availability during the southwest monsoon
- Possible increase in precipitation during northeast monsoon in delta area
- Deteriorating drainage conditions exacerbated by rising sea levels
- Further saline intrusion likely

h. Dr Sharma TA Groundwater Specialist

Ground water resources in India

- On Ground water issues
- Uneven exploitation across India
- Power subsidies has been a major driver in groundwater development
- Declining water tables in many areas due to unsustainable exploitation

- Water quality, salinity and water logging also prevalent in some areas
- Saline intrusion in some coastal zones
- Sub-basin Assessments
- Three sub-basins
- Contrasting hydrogeological conditions and recharge regimes
- Different degrees of exploitation
- Some common issues, some basin-specific issues
- Groundwater in Sutlej Sub-basin
  - Annual GW resources available: 21.44 BCM
  - Annual draft: 31.16 BCM
  - Average of 145% GW development (up to 254%)
  - 80-90% of the area is irrigated by groundwater
  - Multi-layered alluvial aquifer system: unconsolidated permeable sand, silt and gravel layers, up to 300m deep.
  - Shallow ground water occurs under unconfined and deeper under semi-confined conditions.

- **Sutlej basin Issues**

- Declining water tables in the NE and North Central areas
- GW Table decline in North East area (0.025 – 0.68 m/yr) and North Central area (0.11-1.32 m/yr).
- Groundwater quality issues include salinity, localised arsenic, localised selenium, flouride and nitrate.
- Rising water tables in South West area
- Associated issues of water-logging and salinity
- GW Strategies for Sutlej
  - Decrease the non-beneficial evapotranspiration losses (e.g. delayed rice transplanting) and non-beneficial losses to saline waters.
  - Better planned conjunctive use of SW and GW.
  - Switching to less water-consuming crops or crop varieties.
  - Artificial recharge in areas with suitable infiltration, transmissivity & storage. AR gains may be less important than demand options
  - Multi-well point system to “skim” freshwater, thereby distributing drawdown and minimising up-coning.
  - Conjunctive use of canal water and poor quality GW, to encourage drawdown. Gypsum to reduce soil alkalinity.
  - Biodrainage using high transpiring species.
  - Sub-surface drainage to lower groundwater table.
  - Effective monitoring programmes to assess problem.
  - Water treatment options and alternative supplies.
  - Identification and control of emissions from point sources.
  - Better on-farm management of fertilisers.
- Issues in Kshipra basin
- Declining water tables all three districts
- 0-2 meters per decade for Dewas and Ujjain and 2-4 meters per decade for Indore (1997-2008)
- Kshipra river has become ephemeral with decline in base flows due to groundwater table decline
- Groundwater quality issues include flouride and nitrate.

GW Strategies for Kshipra

- Decrease the non-beneficial evapotranspiration losses
- Better planned conjunctive use of SW and GW.
- Switching to less water-consuming crops or crop varieties.
- Artificial recharge in areas with suitable infiltration, transmissivity & storage. Low storage of hard rock aquifers may limit benefits. Some promising AR projects completed in Indore/Dewas districts.
- Community-based participatory watershed management
- Effective monitoring programmes to assess problem.
- Water treatment options and alternative supplies.

- Identification and control of emissions from point sources.
- Better on-farm management of fertilisers.

Issues in Cauvery delta

- Varying groundwater table trends: some areas declining other areas rising
- Water-logging, salinity and sodicity
- Overexploitation of GW
- Sea-water intrusion
- Some nitrate issues in groundwater
- Sea water Intrusion
- Impacting a strip of approx 20km inland, greatest in SE corner of Delta
- Inland migration rates of 1-2km/year
- May have been exacerbated by 2004 Tsunami
- Hydraulic gradient and height of water table above msl are key determinants of seawater intrusion
- Groundwater pumping may also induce up-coning of saltwater

- Ground water strategy for Cauvery delta
- Decrease the non-beneficial evapotranspiration losses
- Better planned conjunctive use of SW and GW – blending of poorer quality GW with SW.
- Switching to less water-consuming crops or crop varieties and salt tolerant varieties in salt-affected areas.
- Artificial recharge in areas with suitable infiltration, transmissivity & storage, in combination with further development of tanks & ponds
- Integrated GW-SW approach required
- Modelling of saline-freshwater interface migration
- Tail-end regulators to prevent surface seawater ingress
- Reduction in GW abstraction (as indicated above) to maintain sufficient hydraulic gradient
- Better on-farm management of fertilisers.
- Common strategy for Cauvery delta
- **River-basin, sub-basin and catchment approach to GW resources assessment and management**

- Need for <u>planned</u> conjunctive use of GW and SW
- Improved understanding of recharge to shallow and deep aquifers and potential climate change impacts
- Reduction of non-beneficial losses to evapotranspiration and to saline water bodies
- Artificial recharge part of solution but not panacea
- Different hydrogeological settings will require different approaches

i. Mr AK Jain CWC

- Mr Jain shared the Findings and Recommendations for improvement from Water Use Efficiency Studies of Irrigation Projects **–**

- **Present status of Irrigation**

- Agriculture is the prime source of livelihood for more than 50 % of the population.
- Irrigation is a vital input in the agricultural productivity & agricultural growth.
- Ultimate Irrigation Potential:140 million ha
- Irrigation potential Created: 102 million ha.
- **Water availability in India Usable Water Resources: 1123 BCM**
    - 690 BCM as surface water;
    - 433 BCM as ground water.
- **Irrigation sector presently consumes about 78 % of developed water resources and thus biggest consumer of water**

- Water Demand Projections

- Need for efficient use of water
- It being finite and scare resource needs to be used efficiently.
- Need for increased food production to keep pace with the increasing population.
- Need to bring more land under irrigation and multi crop farming.
- Irrigation Sector biggest consumer of water but having relatively low efficiency (30 -35%).
- Making water available for other developmental needs.

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- Water Losses in Irrigation Projects
- Losses in main/branch canals/ distributaries, minors & subminors (Conveyance efficiency).
- Losses in field channels and water courses (Field channel efficiency).
- Losses in field application i.e. during application of irrigation water to individual farm plots (Field application efficiency).

- Water Use Efficiency Studies
- To assess the water use efficiency of irrigation projects by actual measurement of losses in conveyance and on farm application;
- Identify reasons for low efficiency and recommend remedial measures for bringing the efficiency of various components of project as considered at project formulation stage

Main findings:-

- Wide variation in the water use efficiency of projects.
- Varies from as low as 14% to high up to 62%.
- Average values of efficiencies:
    - Conveyance: about 70 %;
    - On farm application: about 50 %;
    - Overall project efficiency: 35 %
- 'On-Farm application Efficiency' is relatively less in comparison to conveyance efficiency.
- Poor or non maintenance of irrigation systems resulting in growth of weed & vegetation, siltation, damages in lining etc.
- Distortion of canal sections due to siltation and collapse of slopes.
- No provision of lining in canal reaches passing through permeable soil strata.
- Leakages in gates and shutters
- No regulation gates on head regulators of minors causing uneven distribution of water.
- Over irrigation due to non-availability of control structures.
- Poor management practices.
- Lack of awareness among farmers about correct irrigation practices.

Recommendations included the following

A. Structural Measures

- Regular maintenance of canals & distribution system like removal of weed/ vegetation growth etc.
- Repair of damaged lining in canals and its regular maintenance so that its progressive damage could be avoided.
- Selective lining of canals in reaches passing through permeable soil strata
- Restoration of channel sections to their designed sections.
- Lining of field channel/water courses having high losses.
- Repair / Replacement of damaged gates & shutters and their regular maintenance to eliminate losses on account of leakages.
- Provide appropriate control structures in canals and distribution system.

- Volumetric supply of irrigation water.
- Rehabilitation & Restoration of Structures

Non-structural Measures:

- Formation of Water Users Associations in the command area.
- Active involvement of farmers in the management of irrigation systems by adopting Participatory Irrigation Management for ensuring equitable distribution of irrigation water.
- Appropriate pricing policy for irrigation water to avoid wastages and over irrigation.
- Training of farmers on various issues related to correct irrigation and agricultural practices.
- Providing agricultural extension facilities.

Actions proposed for improvements

Improvement in water use efficiency constitute an important component of National Water Mission, one of the 8 National Mission under National Action Plan on Climate Change;
Identified action points for improvement:

- Improvement of conveyance efficiency through ERM of major/medium irrigation projects;
- Improvement in water use efficiency through command area development activities;
- Improvement in water application efficiency through adoption of micro irrigation system (Drip & Sprinkler);
- Better operation & maintenance of irrigation systems by allocation/ generation necessary funds;
- Improvement in management and encouragement of participatory approach in water management;
- Volumetric supply of irrigation water and fixing water rates on rational basis at least to recover O&M cost;
- Setting up Water Regulatory Authorities in States for management of water resources sector;
- Adoption of water auditing in irrigation sector;
- Benchmarking of irrigation projects.
- Research in area of Water Use Efficiency;

Conclusion

- Usable water being limited, there is an urgent need to take necessary steps to increase water use efficiency particularly in irrigation.
- There is a need of regular maintenance of created irrigation infrastructure to drive envisaged benefits.
- Need for adoption of water saving technologies.
- Need to have active involvement of farmers in the management of irrigation systems through Participatory Irrigation Management.

j. Dr Takashi (Punjab)

Dr Takshi in his presentation covered among various statistics, the following Consequences of Ground water exploitation

- Ground water levels have declined
- Constrained the farmers to deepen their wells
- Drilling of new wells to greater depths by farmers
- Lowering of pumps to greater depths
- Replacing shallow depth Centrifugal Pumps by expensive Deep Submersible Pumps (30% done)
    - Huge initial capital investment and increased maintenance cost
    - Higher power/diesel requirements – erratic power supply
- Leading to Ecological Imbalance
- Effecting socio-economic condition of farmers
- More power needs affecting state's economy
- Irrigated area may decrease 83% to 73% by 2025 AD

Proposed measures

- Need to sustain agriculture production & improve yield to meet ever growing demand for food security – Adopt Crop Management
- Adopt conservation farming and say good bye to exploitative farming – Modern Irrigation Technology/Cultivation Practices
- Evolve optimal GW management strategy to check decline and dependency on GW – Increase Canal Irrigation Efficiency
- Adopt concepts of real water saving and more crop per drop of water more effectively
- Shift from water guzzling crops to water friendly crops
- Conserve, replenish, harvest and augment water resources
- Control misuse and encourage recycling
- R & D needs to be carried out on priority for increasing water efficiency, cost effective recharge technology & to evolve hybrid varieties with better yields & low water consumptions.

Ground water management strategies

- Scarce Precipitation, irrigated agriculture a major industry & spread of new housing sub-divisions across arid landscapes makes water management a serious business.
- Groundwater management per se is complex due to the invisible character of the resource and its common property nature and the associated difficulty in delimiting and quantifying the extent of the resource
- For effective utilization of GW, there is need to shift from development (i.e. additional extraction activities) to management.
- Demand-side Management Interventions
- Ground Water Legislation
- Promoting crop change
- Water conservation and increased water use efficiency by adopting proper agricultural and irrigation practices
- Supply-side Engineering Measures
- Water harvesting techniques at local level
- Appropriate recharge enhancement structures (utilizing local surface run-off)

Demand Side Management

- Effective legislation to regulate GW withdrawal
- Model Bill 1970, 1992, 1996 & 2005
- Institutional and regulatory actions may create inspector raj
- Due to permits, small, poor and marginal farmers (65%) will be affected and wealthy will get benefit-social injustice
- Harsh due to coercive measures-may cause unrest
- Lack of proper institutional structure and capacity, in sufficient human resource and small holdings of farmers (35%) may hamper its implementation
- Deeply problematic & will not be very effective & requires community cooperation
- Production of food grains in States is not sacrificed at any cost for want of water resources.

Future perspective

Crop Diversification

- Wheat – Paddy cropping rotation has raised socio-economic condition of farmers
- Area under rice has increased 12 times and wheat 2.5 times in 46 years
- 4% targeted agriculture growth by GOI
- Requirement:-
    - Other crops be covered under MSP Policy
    - Better marketing of agriculture produce
    - Better crop remuneration in any form
    - Water Conservation and increased water use efficiency
    - The following measures are suggested for the effective conservation and management of groundwater resources for agriculture sector which is major consumer of water resources to sustain and increase agriculture production:-
    - Modify Electric Transmission System to restrict supply of power to tubewells
    - On farm Agriculture and Irrigation Management Practices

- Micro Irrigation – Drip and Sprinkler helps in saving in water and increase in yield of crops & increase on farm irrigation efficiency
- Proper Land Leveling (Laser)- Save 20-30% water, increased yield by 20-35%
- Pre-Sowing Irrigation- of 4cm increases yield of wheat
- Post-Sowing Irrigation- Improved practices lead to optimum grain yield
- Furrow Method- More efficient and saves 25-35% water
- Straw Mulching – Conserves water, control weeds and saves water
- Tillage- Reduces percolation losses in paddy
- Contract Farming- Ensures procurement of produce
- New Techniques of Paddy plantation – Saves 30-40% water
- Encourage short duration (125 days than 160 days) paddy varieties – reduces ET by 71mm
- Irrigation Scheduling- Proper application saves 34% water
- Irrigation with Tensiometer could save 15-25% water
- Transplanting Date- Shift from 5th May to 25th June reduces ET losses by 66mm
- Underground Piped Distribution System –Reduces losses of evaporation and seepage

- Industrial Water Recycling and Reuse-Saves 50% water
- Exploration & Research of Deeper Aquifers –For proper planning and augmentation of irrigation water
- Minimize Pollution/Wastage
- Adopt dual supply system in domestic & industrial units

Supply Side Measures

- Rainwater Harvesting
- Incentives for water conservation & artificial recharge
- Roof Top Rainwater Harvesting mandatory-legislation/ amend building By Laws in new buildings
- Encourage conjunctive use of GW & SW in saline ground water areas.
- Water Auditing
- Fixing water allowance
- Charging beyond useable limit
- Continued monitoring of GW
- Awareness raising through NGOs & Media
- Selective lining in conveyance system.
- Remote Sensing for assessment
- Adopt Technologies to enhance productivity & reduce water consumption
- Incentives for use of water saving technologies
- Encourage demonstration projects & information campaigns for community management
- Modernization, rehabilitation & extension of existing canal systems
- Protection of wetlands & village ponds
- Ground water development in flood plains to create cushion for natural recharge.

Presentation concluded with some success stories

k. Madhya Pradesh

The representative from MP gave an overview of information systems in MP and also covered in his presentation the following

Basics of climate change

- The climate system is inextricably linked to the Earth's biogeochemistry and to human activities.
- To achieve its goals of understanding and predicting climate variability and change, and their effect on humans, it must contribute to studies of the fully integrated Earth system.
- The Earth System behaves as a single, self-regulating system comprised of physical, chemical, biological and human components;
  Human activities are significantly influencing Earth's environment in many ways in addition to greenhouse gas emissions and climate change;

- Global change cannot be understood in terms of a simple cause-effect paradigm;
  Earth System dynamics are characterized by critical thresholds and abrupt changes;
  Human activities could inadvertently trigger such changes with severe consequences for Earth's environment and inhabitants;
  In terms of some key environmental parameters, the Earth System has moved well outside the range of the natural variability exhibited over the last half million years at least; and
  An ethical framework for global stewardship and strategies for Earth System management are urgently needed.

Important parameters of climate change

- Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. Climate change may be limited to a specific region, or may occur across the whole Earth.
- In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. It may be qualified as anthropogenic climate change, more generally known as "global warming" or "anthropogenic global warming" (AGW).
- Human influences :Increase in Atmospheric CO2 Levels
- Vegetation : A change in the type, distribution and coverage of vegetation may occur given a change in the climate;
- In any given scenario, a mild change in climate may result in increased precipitation and warmth, resulting in improved plant growth and the subsequent sequestration of airborne CO2.
- Larger, faster or more radical changes, however, may result in vegetation stress, rapid plant loss and desertification in certain circumstances.
- Snowpack: A possible reduction of snowpack could change water supply.
- Glacier melt: Reduced water supply from shrinking glaciers
- Forest fires: Warmer, drier summers and earlier springs may lead to increased forest fires.
- Extreme weather: A possible increase in extreme weather e.g. tornadoes, hail storms, heat waves, droughts, dust storms, floods, blizzards
- Agriculture: Increased demand for irrigation and a change in crop types due to a longer growing season
- River flow: Lower river flow reduces water supply, water quality, and recreation activities.
- Habitat: Warmer river temperatures stress cold-water species such as trout.
- Groundwater: Reduced recharge causes lower water tables which in turn cause some shallow wells to go dry.
- Hydroelectric power: Reduced flow decreases power generation

Summary of climate change data

- No significant change in mean annual rainfall (-15 to +15%) is projected for your site.
- No significant change (-10 to + 10) in consecutive dry days is projected for your site
- A moderate increase in temperature (1 - 2.5º C) is projected for your site.
- A significant increase iin runoff (>35%) is estimated for your site. A significant increase can lead to some shifts in biodiversity and ecosystems. Increase of agricultural land will intensify land use changes. However, lack of soil cover and water holding capacity can promote floods, excess runoff, and siltation in surrounding areas.
- No significant change (± 25 mm) in the maximum 5-day precipitation (rainfall extreme events) is projected for your site.

Assessment of climate change impact on water resources

- Review and establishment of network for collection of additional necessary data by Jun 2011.
- Development of water resources information system and bringing all information in public domain except the data of classified and sensitive nature by March 2012.
- Reassessment of basin wise water situation by March 2012.
- Impact of climate change on water resources based on reliable data by March 2012.
  - **cc**

Need for Information

- Planning, design & management
- Domestic, industrial, agriculture, power
- Floods & droughts
- Growing with growth in population
- Variability of occurrence
- Space & time
- Adequate measurement networks
- For sufficient period of time
- Upgradation of existing system
- Availability, reliability, presentation
- Standardisation of procedures

Main Components of DSS-five main components:-

- Data acquisition System - Data collection by all means
- User-data-model interface - Data transfer to database & meaningful access to data(software)
- Database- Depository of all the data
- Data analysis tool - user-friendly means to visualize and analyze various datasets

Models of DSS

- Prepared in a view of development of decision support system (DSS) to move towards IWRM. DSS are technical tools Designed for policy maker and Water Resources stakeholder.
- The scope of DSS for IWRM is the processes developing and implementing shared vision planning and management strategies for sustainable water resources utilization.
- Due consideration to all spatial and temporal inter dependencies among natural process and human water resources

- Ground water and climate change
- Ground Water is more compatible than surface water with climate change
    - Aquifer can store excess water during high rainfall and protect quality
- Adaptation Needs
    - Scientific Management and Development
    - Research & Development
    - Awareness, Education and Training.
- TA for Developing Groundwater Reserves for drinking water supply during acute drought :
- TA for Development of Methodology for assessment of Static Groundwater Reserves.
- TA for Need assessment of observation network density for monitoring
- deeper aquifer.
- TA for assesment of Static Groundwater .
- TA for locating Sanctuary wells in Flood plain and augmentation of deep aquifers by surplus surface water. Utilization of sanctuary wells for water supply, only during emergency and as monitoring wells for GW levels to help in management of the resources.
- TA to Identify through Remote Sensing Data the hydro geological conditions in
- the flooded areas and adjoining areas (buried channels, deeper aquifer, potential
- for recharge etc)
- TA to prepare schemes for immediate implementation to create ground water
- Repositories.
- TA for Regulating Over Exploitation of Groundwater:
- Through Community?
- Through legislation?
- Or Both?
-

I. Representative of Tamil Nadu

Flooding in coastal area

- The vegetation growth in Rivers, Channels and Drains requires biological destruction.
- The roads are acting as barriers obstructing free flow of water
- Urbanization in Coastal area

- Industrialization in Coastal area
- Prawn culture farms are acting as barriers.
- Sufficient Drainage facilities to be provided.

Migration of Agrarian society from coastal area to upland area

- The Spatial and Temporal distribution of precipitation is erratic.
- Heavy rainfall in short duration.
- Frequent Cyclonic storm.
- Agricultural activities are not assured.
- Fishing activities affected
- Monthly income meager.
- Poor become poorer year after year.

Sea Water IntrusionDue to over exploitation the Ground water table is depleted.

- A rise or fall of ground water by 1m will induce a fall or rise of 40 m in the underlying sea water.
- Total 8 blocks are classified as saline blocks and 7 blocks are over exploited in the Cauvery Delta.
- Sea Water intrusion can be prevented by ponding of surface water near coastal area.
- Artificial Recharge of Ground water such as Rain water harvesting can be attempted.

Problems in coastal area

- Sediment movement is from South to North.
- Sandbar formation in Sea mouth obstructing the free flow of flood water into sea.
- The coast in Cauvery delta is under a threat of heavy erosion. The net shore loss is at the rate of 2.50 m (appr.) per year. (Observed in Vanagiri Village of Tharangambadi Taluk of Nagapattinam Dt.)
- Fishing activity and fish rearing activities gets affected due to heavy inundation.

Tail end Regulators

- There are 20 Nos. of Important tail end regulators in Cauvery Delta.
- All the Regulators were Constructed with Brick Work in Lime Mortar very long back (In between 1883-1903)
- All tail end Regulators are to be Rehabilitated/Reconstructed to the latest standard.

Suggestions

- Field visit of ADB Technical Team on November 2010 and March 2011 are very effective.
- Participatory rural appraisal had on 8.03.2011 at Myiladuthurai, Nagapattinam Dist. with farmer and fishermen community is a welcoming thing .

SUB BASIN PROFILE.

- G.A. Canal Sub basin is a 18th sub basin of Cauvery Basin and it is suggested to include in this study itself Because – G.A.Canal Sub Basin
- Drainages have greater influences on Vennar Sub Basin.
- Recharging aquifer are more in G.A.Canal Sub Basin having influence up to Nagapattinam Dist.
- At present sea water intrusion observed in G.A.Canal Sub Basin and affecting Drinking water Sources in the Coastal area.

Present Issues

- **Present issues of Cauvery Delta System are analysed in detail and is very excellent.**

Ground Water And Surface Water Irrigation

Tail End Regulators and their Rehabilitation are to be analyzed in detail because each case is a unique in nature. Confluence point with sea also unique in nature.

Planning Strategy

- Steps evolve in this report is very good .
- Ground water model studies data of Cauvery Delta are already available
- in Tamil Nadu Ground water wing .
- Rehabilitation and Modernization of all the Tanks in order to increase the Capacity and widening and strengthening of major Drainage Rivers in Vennar Sub Basin are to be given priority including Tail End Regulators of Vennar Sub Basin

4. Summary of State Level Consultations March 2011

Visits to each of the three sub basins were made in February and March 2011. The objectives of the consultations were to present the preliminary findings of the study and obtain feedback and Consultations were made at farmer, district and state levels. A summary of the main points from the discussions is given below.

a. Punjab District Level

- Many expressed that, the erratic power supply coupled with auto corrections has led to wastage of water
- Erratic power situation is leading to inefficiency in irrigation practice because of uncertainty in water supply timings.
- Optimum but reliable power supply and management is believed to help overcome the situation
- Towards minimize ground water extraction, many officials opined that promoting less water consumptive crops, crop diversification, strengthening marketing facilties and appropriate pricing mechanisms for crops, are necessary
- Some opined that the late plantation is helping and becoming a practice
- PAU is providing knowledge support to the farmers towards water conservation technologies
- Promoted successfully the direct seeding of rice which has saved 3 or 4 additional irrigation
- The use of seed drill and tensometer is gaining popularity
- SRI had mixed result in Punjab. The need for large scale transplantation has not changed the situation which is also labor intensive in a situation where labor is in short supply
- Mung and maize, potato are also grown by some. However, price fluctuation and low demand combined with uncertainty in incomes has constrained their popularsation
- Farmers are ready to do cropping pattern change if market for other crops are assured. \
- Canal water meets demand to only small extent.
- Some farmers suggested enforcing an act/rule /issuing an order to the effect that the extraction of ground water is permitted to irrigate only up to a maximum limit of 5 acres and not beyond.
- Suggestions were made to rehabilitate village ponds and also for desilting
- Many opined that repairs, renovation and restoration of tanks is to be taken seriously

b. Punjab State Level

- Given the problems of ground water depletion, measures like, educating farmers, introduction of water saving technologies and testing of soils were suggested
- Construction of recharge wells, revival of deep ponds, and laying underground drainage could be thought of as some remedial measures
- It was informed that where water requirement is less more water is lost and study needs to focus on such issues
- Some opined that scientific feedback, technical knowledge, modeling exercise could help in generating climate sensitive weather forecast.
- Technology like laser leveling has been popularized in the region and 10-15% of water saving is achieved
- As short rain fall induces panic, advance information on weather is useful for providing farm advisories to the farmers.

- Theft in the upper canal reaches is posing the problems and this needs to be checked and prevented
- As existing system of weather prediction is not accurate, an efficient and reliable weather forecasting system is needed.
- Some opined that Moisture meter can help for proper planning
- Ponds existed before 1965 as conservation technique but fragmentation of holding etc has destroyed such ponds.
- Opinion expressed towards establishing an information system for efficient planning
- Given the situation of ground Water depletion and over extraction, some opined that establishment of a regulatory authority is necessary (as recommended by the 13th finance commission)
- Concerning IWRM, the present 3 tier coordination-communication and program review mechanisms could serve the purpose of IWRM
- Coordination mechanism among WRD, agriculture and Horticulture needs to be examined
- Drip irrigation as an effective technology for water savings is yet to be demonstrated on a scale for field crops though micro irrigation is found useful for horticulture crops
- It was reported that area under citrus cultivation is on the increase
- Crop diversification as an alternative option for minimizing ground water extraction is a slow process and farmers needs a package of education, extension, technologies and financial incentives for crop diversification
- National food security mission prompted Punjab to adopt paddy-wheat cycle during green revolution and many opined that a second green revolution is needed to explore options to resolve problems posed by wheat-Paddy cycle
- Some expressed that cotton could be other potential crop to be promoted as it does not face marketing problems and cotton production is viable
- However, It was opined that Paddy –wheat cycle is labor saving, current mechanization practices augurs well for continuation of wheat-paddy cycle
- Need of action plans, new information not regular generic info which they are looking for.

c. Kshipra District Level

- Efforts should be made to recharge the dug and tube wells by constructing graded filter materials with gravel and sand filled above the perforated pipes.
- Permission for the construction and operation of new tube wells with recharge structure around them
- The experience sharing on the effectiveness of “Balram Talab” has been very positive. They have been effective in providing irrigation water and also for ground water recharge. Subsidy of Rs 80000 under general category and an amount of 100000 for SC and ST has been instrumental to some extent. However, number of such Talab’s are limited in Dewas district and felt by many to upscale them to cover larger number of farmers in Malwa region. Some expressed their concern that “Balaram Talab” is not for small holders.
- It was reported that Balaram Talab demand much higher than target given to districts
- Mechanism to stop runoff and top soil flow from field during Soya fields are to be stopped by balaram talab concept.
- The policy of standardized cost norms came in for criticism towards undertaking construction works in the basin some times making it inevitable to spend 300-400 crores of rupees towards electricity for lifting water for drinking purpose (Indore and Ujjain where land price is high uniform rule of 2 lakhs per hectare of irrigation land is a barrier as costs are much higher so there is need for revision in the rule)
- The concept of integrated planning is in practice and the district officers of various department in the district planning board meeting work out an integrated strategies on issues related to water and sanitation.
- Zilla pariashd is actively engaged in River Revival project has been taken up in 1000 ha spread over 6 villages in Kshipra basin through construction of various structures like series of ponds and other water saving devices and also total sanitation campaign
- Many opined that Polluted Khan River can be used for irrigation rather than allowing it flow and pollute kshipra.
- Budget constraints has been a limiting factor for good & proper maintenance of irrigation and tanks systems and ground water schemes are very limited in number in Ujjain

- It was reported that huge amount of soil erosion from fields (10-12 tons/ha) during rainy season causing siltation of downstream Nallas and rivers. Measures such as gully plugging and check dams are being taken up in large scale.
- Many expressed their concern towards loss of biodiversity (plants like keora, Tamarind, Gular) due to GW level decline
- Field bunding and farm ponds are being promoted by agricultural department to check soil erosion and for retention of water in the field. Up scaling of these measures are suggested.
- The relevance of zero tillage was discounted by many and opted for deep ploughing (despite its relevance for black cotton soil, field preparation and good water retention qualities). This was evident during the discussion on the "history" and "changes" in cropping pattern. The Soya bean has been a catalyst of change in land use pattern in Shipra. Cultivation practice of soya bean compelled farmers to drain the water from the field fearing standing water in the soya field is harmful and not realizing the fact that draining of water results in loss of water and soil moisture.
- Learnt that many places in Malwa region is not fit for zero tillage and need is for deep ploughing but expressed the need for financial support for technological interventions as well.
- Many voiced their concern of extreme rains and rise in temperature causing damage to their crops and suggested that 110/120 days duration crops need to be replaced by 90 days Soya bean variety despite lower yield of shorter duration variety
- The need for Rehabilitation of old government tanks was felt by many
- The need, for taking up major and medium schemes in addition to the construction of small ponds and recharge structure, was felt by many participants.
- Many opined that abandoned wells can be recharge points. Farmer level efforts have been proven successful
- Many expressed that Indore and other districts are in grey zone where recharge need is high, and felt strongly for river and canals rejuvenation
- Many voiced their opinion in favor of Integrated planning both for assessing and formulating schemes consisting of small, medium and large scale of short term, medium term and long term plans- almost suggesting a basin planning approach with an integrated approach. Many expressed the need and usefulness of a Chambal-Shipra holistic plan. The support for basin level water management approach was forthcoming as they felt such an approach can address local specificities and larger connected issues.
- Huge subsidy has been a positive stimulus to farmers for cultivating horticultural crops in the basin.
- Many voiced their opinion in harnessing the good potential of Khan River for irrigation.
- The SE of Ujjain, expressed his concern towards administrative hurdle restricting their right to utilize the full quota of 10% of the yield. At present hardly 1% of the yield is being used. He also mentioned that there were no problems in taking up any measures (like constructing small and medium projects) to utilize their quota o of 10% yield in accordance with the Inter State Rriver Sharing dispute award. and therefore suggested for revoking the 10% share agreement of Gandhisagar water sharing norm for the benefit of MP as only 1.5% has been used up so far
- Concern was expressed to the effect that there were several projects which integrates issue and schemes like Saberkheri, Khan, and Chambal Gmbhir connectivity are lying on the table without sanctions and funds allocation thus restraining the state initiatives for water resource development and management thereof.
- Also opined that a) for drinking water local resource use is preferred through rejuvenation of local sources b) to store run off (40%) during rainfall in MP as less runoff is in Narmada and costing 100-300 crores of rupees per annum towards electricity bills to lift the water again from Narmada (Phase III) transfer back to MP. This can be done through 13-14dams which are also proposed.
- Some expressed the need for enacting an act to the effect that famers are made responsible for recharging of water in proportion to their extraction of ground water
- WRD department expressed their need for special grant to execute works through machineries as provisions under NREGA is not adequate and enabling enough
- To provide sustainability to water resource supply all possible sources are to be tapped. Finance found to be the major entry barrier for works in the basin
- Though many opined that recharge measures are good but felt as most important to rejuvenate and maintain surface water flow in rivers, nallas, and ponds.

- Many expressed the need for large scale effort. Some times small efforts are costly but small structures have short lifetime and efforts are to be spread through out the state.
- Declining rainfall is reported to be the major prompting factor to take up afforestation works in a more strategic manner.
- Potential exists for farmers to take up such works in their farm land on the ridges also and land is available to take up such task but needs incentives and planned effort.
- Few progressive farmers are getting yield more than average of the state and trying out alternative income sources with better return and need is a mechanism for scaling up of these good practices.
- In reference to climate change, farmers expressed that, the crop yield were severely affected by untimely frost
- 12 climate zones have varied production levels and climate variability. “Climate zone specific” measures are needed and opined that the formula of “one fit” does not augur well in the current context
- Emphasized the importance of water conservation and protection measures
- Rain water to be stored through construction of storage structures like stop dams and farmers to be made responsible for this.
- Small check dams to be made on the “Choti Kali” river
- Many opined that Balaram Talab, through subsidies extended to both big and small farmers be made popular and up scaled in numbers
- Need for revival of “heavily silted” government ponds felt by many farmers. Through community participation, scope exists for removal of silt from such water bodies and apply in their farm fields for productivity enhancement.
- Small farmers must be encouraged to adopt water saving technologies like sprinkler and drip irrigation through well designed and administered subsidy measures.
- Conservation department is executing stop dams and also water harvesting structures but without adhering to good governance principles which stipulates “corruption free work culture” which in turn excluded the needy from taking such employment and revenue generating works. Need for efficient monitoring of work is needed
- Payment for Environmental Services (PES) as a concept was accepted by many as a good idea as it adds to income with potential multiplier effects but at the same time felt that in practice, the concept is yet to gain it currency
- Towards better governance of public works, the community has taken a pro-active role in reporting the bad and incomplete works to the collector but felt disappointed that no action has been taken yet on such reporting
- many expressed the need for a) more recharge tube wells b) farm ponds in every field c) simplification of crop insurance towards compensating the crop loss
- Crop insurance policies are very complicated and there is need for consultation with farmers
- Many opined that fund allocation for drip irrigation and buying of agricultural equipments to be increased
- Though many appreciated the relevance of Watershed approach etc but felt that scaling up of watershed works are equally important
- Some expressed that the support for organic farming is important as it helps water & soil conservation and has the potential to integrate with livestock and recycle with other wastes generated (Suggested to scale up the Jalgoan Model of Maharashtra)
- Many expressed that Roof top harvesting is needed given the large scale of urbanization and consequent water problems.
- Participants expressed their concern to the effect that that many nallas were created with NABARD money and the lack of funds for its maintenance has made these nallas dysfunctional.
- Many opined that Dhar example of Jan bhagidari model be used for desiltation with the help of farmers with silt sharing norm.
- Expressed the need for Minimum Support Price for safflower oil seed cultivaton
- Some suggested that ITC model for managing farming in select district may be used as model for institutional and policy reform
- It was expressed the need for more communication to be two-way process between farmers, WRD, Horticulture dept and agriculture department.

d. Madhya Pradesh State Level

- Advocated to follow user perspective to understand practical relevance of our intervention
- Cited (Based on his arial view) an example of an open well with water up to its brim level during the month of April and in this context suggested to demonstrate at least in 10 out of 100 micro watersheds verifiable and measurable impacts through independent monitoring
- Stressed the importance of stakeholders consultation and their views to be taken note of while preparing the project (s)
- He opined that quantification of recharge work is critical so that progress of work could be easily measured
- Suggested that project be conceived in a way the interventions as proposed in the project are doable
- He agreed in principle and in totality the strategic framework as proposed by ADB for Shipra basin and that actions lines as suggested are implementable.
- Opined that efficient use of technologies are needed to reduce ground water extraction
- Informed as how the soyabean cultivation has changed the whole scenario of soil and water eco-system of Shipra basin and suggested as useful to study the history of crop pattern and land use practices in the region for putting our insights in a better perspective
- While agreeing to the fact that, drip irrigation (through high subsidy) has been contributing to minimize the use of water especially for high value horticulture crops , but felt that, protocols for such technologies are yet not developed for field crops like Soybean & Wheat systems.
- Opined that through study and analysis of various watershed programs executed in Ujjain in Shipra catchments and in other places, lessons could be drawn and incorporated in our study.
- Suggested that sustainability potential of Interventions as proposed in the strategic frame work could be studies after the project is withdrawn
- Restated the fact that project approach to focus among others, the comprehensiveness, sustainable processes, farmers extension, post harvest management issues (including agricultural vale chain) planning, implementation and monitoring
- Also opined that preparation of community is important.
- On the issue of energy, he opined that making power available is not an issue but willingness to pay on the part of the user of energy is an issue
- As many schemes are owned by the government, appeasement policies of the government does not allow ownership to farmers
- Opined that farm ponds are successful
- Strongly felt that community ownership and management approach does not work in Shipra region whereas Individual ownership and management approach has the potential to succeed
- Opined that Sewerage treatment issues become critical in urban management
- Opined that water loss is substantial in urban areas. Management of urban water, its recycling and sewerage treatment is critical and Municipal Corporation of Ujjain is engaged on these issues.
- Also indicated that using Narmada as a water source is cost prohibitive
- Advocated to allow tube well installation only in places where farm ponds are available
- On IWRM he opined that, integrating functions and functionaries is complex in practical terms. At most one could achieve coordinated planning through IWRM
- On subsidies, he strongly felt that a) subsidized schemes do not work well and b) only those interventions which are economically proved to be viable and feasible to be subsidized and not otherwise.
- Training and awareness raising are important

e. Cauvery District Level

- In the context of change, department official opined that controlling green house gas emission is critical as Paddy cultivation releases green house gases and farmers to be educated on judicious use of fertilizers
- Strict adherence to timing of water release is important as any delay in release will affect the crop calendar and also yields
- Many opined the need for storage tanks and many opined that fresh water storage is a good idea

- Also expressed that heavy clay soil profile of the delta restricting the potentials for recharging the aquifer
- Many opined that storing water in village ponds and low lying area (called Alaam in local) shall help in GW recharge in big way.
- Infrastructural development works like roads is blocking drainage and reported to be the major problem
- Prawn farming is reported to be affecting the drainage
- Short duration intense rainfall causing problems.
- Many expressed that sea water intrusion posing lot of problems.
- Use of less of fertilizers and more of organic manure will help in reducing green house gases.
- Farm ponds are very important to give irrigation water as supplement, for fishing and for GW recharge.
- Govt is providing subsidy to an extent of 90% to construct a pond of size 30m x 30m X 1.5 m depth pond. Easy for big farmers. Oil pumps for using water of these farm ponds are also subsidized by govt.
- Small farm ponds as well as community farms both are important for water conservation
- Ground water recharge in minus zone (depressions below sea level) can also be utilized for water conservation, fishing etc..
- Many opined that drainage needed higher level and the drainage work is not found to be effective in low land
- SRI cultivation is getting more and more popular and It needs farm equipments for easy operations as labor is in short supply (area under SRI is steadily increasing from 8000 ha in the beginning to the current level of162000 ha and the seed rate is reduced from 40kgs to 3 kgs.
- Concerns expressed by many villages that continuous sea erosion is causing great threat to their peaceful existence and requested for immediate action to protect them through construction of RMS wall.
- No scheme of compensation for shifting of habitat to higher land in case of severe threat to their security against sea erosion.
- Environmental conscious farmers expressed their concern that plastic and poly bags causing a lot of harm for fish lying of eggs in sea shore and consequently fishing is being shifted to deeper zone where the fish yield is not promising for fishermen.
- Some water storage structure like barrage at Collidam river should be made to conserve water.
- Village ponds under enchroachment should be evicted for water storage.
- Continuous sedimentation flow is causing closure of river mouths which affecting the movement of vessels
- Opined that river training is required and Opined that “V-shaped drainage works better

f. Tamil Nadu State Level

- Strengthening of existing institutional arrangements needed like i. Institute of Hydrology and Hydraulics, ii. Institute of Water study iii Irrigation management and training Institute
- Strategy suggested by ADB is good and fit into the overall thinking of the WRD and is in conformity with with Cauvery modernization project.
- Drainage main problem. Tidal fluctuation most troublesome to drainage.
- NE monsoon water goes waste.
- Roads are acting as barriers causing inundation.
- Opined that holding capacity of tanks are higher in lower contours
- Restoration of existing tanks are important
- Tailend regulators are most essential requirement as it helps fishing, facilitate irrigation and protect from sea water intrusion
- Opined that series of barrages in the delta as a flood protection measure will be of great help for water storage (ie creating river reservoirs)
- Vegetation in the drainage is a problem. Some mechanical devise is needed for its regular upkeep as manual remedial measures are not feasible
- GW tapping zones are needed for better conjunctive use.
- More meteorological stations required for forecasting.
- Buckingham canal (vaidraman canal needs to be mordenised for better water management.
- Coastal mapping needs to be under taken on a priority basis

- Efforts are towards defining hazard line for coastal regulation
- Infrastructural development works like roads is blocking drainage
- Short duration intense rainfall causing problems.
- Sea water intrusion a lot of problem.
- It was also opined that farm ponds not good idea

J. Meetings/ Consultations April 2011

1. Punjab Agricultural University (PAU) Tuesday, 26 April

Morning meeting with VC, PAU, Ludhiana

- Met with PAU on the advice of PS, WRD, Government of Punjab (GOP) with the purpose of finding out current activities on cc/agriculture and water resources management and prevailing expertise at PAU in subjects of mutual interest to the TA related to both the ongoing TA and also emerging operational research areas of the TA.
- Water Management and climate change (CC) are strong thematic areas that PAU are working on. They have several publications of interest to the TA: (I) (2007) CIC Press – 'Preparing Agriculture to Climate Change Impacts"; (2) Water and Agricultural Sustainability Strategies – CRS Press.
- M.S Swaminathan delivered a seminar on cc and agriculture on 26 April at PAU.
- PAU have made significant headway in recommending to GOP the need to delay paddy transplantation till 15th June. .This measure has proved to give good impact on ground water table as late transplantation saves about 20% of water consumption with no negative impact on yield. Their work laid the foundations to the 2008 Water Conservation Act/Ordinance. This Act is fully accepted and implemented across Punjab.
- Land leveling is another initiative the PAU are advocating which they state would lead to further savings in water – up to 15-20%.
- Tenso-meter use (-with minimal modification by the PAU) would help save one fifth of irrigation water if farmers are able to mange the soil moisture properly with the help of this instrument.
- PAU School of Biotechnology is currently developing short season rice varieties which are drought resistant.
- PAU is also advocating water harvesting activities like restoration of village ponds.
- They are currently funded by IACR to undertake some short term research projects. Have also carried out a study on the reasons behind Farmer suicides in Punjab.

2. Afternoon meeting with PAU research staff

- Meeting was well participated by PAU staff working on cc and water.
- PAU recommendations for reducing cc impacts and water exploitation include:
    - Delayed planting of paddy - deemed most effective;
    - Use of varieties known to utilize less water (research ongoing in these aspects);
    - Use of direct seeded rice growing varieties – gaining popularity;
    - Laser land-leveling;
    - Bed-planting for rice and wheat;
    - Use of alternative crops and cropping systems;
    - Mulching;
    - Rainwater Harvesting and water recharging;
    - Drip-Irrigation;
    - Zero Tillage.
- PAU also advocates further delayed of paddy farming till 20th June (though this has been found to have labor and other implications).
- PAU staff advises that farmers are keen to adopt hybrid varieties but for this to be taken on board there are certain policy issues which need to be addressed with the Food Corporation of India (FCI) i.e. decisions relating to procurement etc. There are major savings that may be made through the use of hybrid varieties (up to 25 days), however it should be noted that the

hybrid variety of Basmati is a coarse grain which is not valued as highly as conventional basmati. There are also associated marketing and other constraints which prevent its uptake by farmers.

- Minimum Support Price for Non Basmati rice fixed – this doesn't apply to Basmati. There is a strong lobby in place which influences basmati rice uptake.
- In response to a question on decreasing the area under paddy by 25%, it was opined that, it is possible to reduce but gradually at 5% per year over a period of 5 years and it is further required to take note of production and marketing aspects and associated risks. According to PAU staff investigations related to direct seeded rice is still in the pilot stage. Aerobic rice varieties come with associated "issues" including reduction in yields. Not at the stage yet where these varieties may be taken on. With no puddling, weed control is also a major problem associated with direct seeded rice. PAU mentioned that they needed to test for 2 more years, towards getting more conclusive evidence and in order to determine whether it is possible to up-scale the activities through participatory research. In this context, reference was made to an ongoing research collaboration with Columbia Earth Institute's Water Research Group and PAU[7].
- Under the PAU is currently investigating field studies towards water saving devices like tenso-meters, direct-seeded rice10 villages in each of the sample districts under study.PAU staff advise that farmers need to be provided with a package of technologies as this is likely to be accepted more readily Agri-insurance products need to be developed which enable Farmers to take on changes
- GoI Food Security Act will put a demand on procurement of food grains of the order of 72 million tones– this will have huge impacts on Punjab if this Act is enacted.
- According to PAU staff Canal network is not utilized effectively and advocates that these systems be revived from Ludhiana onwards as they are currently not functioning. If SW systems are better utilized then this will undoubtedly take away pressure on GW systems.
- Punjab has the maximum cropping intensity in the country. A Water pricing Policy needs to be put into place for SW as well. At present limited WRM research work ongoing at PAU – Drip irrigation is being popularized - especially in orchards. However associated cost implications with drip irrigation need to be considered.
- Re: addressing salinity issues – Fish culture in saline areas should be considered as an option, though the Farmers would require a subsidy to maintain ponds. PAU staff indicates that rainwater harvesting needs to be taken with greater gusto. Power conservation is an upcoming threat with the imminent establishment of thermal plants in Punjab.
- Soya bean has not been found viable in Punjab due to soil and agroclimatic conditions.) Pigeon Pea is a water efficient crop but is not being taken on as readily as it could be in Punjab because of marketing problems. Similarly, marketing of maize is a problem in Punjab. Rice doesn't have these problems.
- PAU staff have analysed rainfall data in Punjab – shows decreasing trends in rainfall coupled with increases in temperature. These will present new issues/problems to farming in Punjab. This work by PAU is post NATCOM. Increased frequency of extreme events has been observed in the last 30-35 years. Rises in temperature may attract black rust which is a fungal infection which can be devastating to crops. Currently it doesn't exist in Punjab. This is a real concern. Powdery mildew in wheat is a problem now. Crops in Punjab may follow a similar scenario as seen in HP of slowly being pushed out. This is a real concern.

3. Wednesday, 27 April - Field Visit to Moga District (- accompanied by PAU Kamal Vatta)

- PepsiCo is funding the joint research work between PAU and Columbia. **(Action: Columbia Research Institute Project office is in Haus Khas - Team may like to facilitate interaction).** 5 districts identified for study including Moga. Budget of USD 55,000 to begin with but this has been increased (an additional 70 lakhs) and project timelines and scope

[7] *This work is being coordinated by: Kamal Vatta/Agricultural economist – 94630-35085/ kmlvatta@yahoo.com/kmlvatta@pau.edu Department of Economics and Sociology, PAU Ludhiana.*

extended. Districts selected for study are all the most water stressed. Used a cluster village approach. Much of work in Moga is being coordinated through the Village Cooperative Society which is very strong.

- Village leaders involved in study which basically looks at how we may use less water in agriculture through: (i) Innovation in technology and practices; (ii) diversification; (iii) enabling environments. Approach – includes use of tenso meters, levellers, delayed transplanting direct seedling rice and ground water recharge particularly through village ponds.
- At present there is no standardization on irrigation scheduling for direct seeded rice cultivation. The process has been initiated in collaboration to standardize practises with IRRI (irrigation scheduling, seed rate, chemical use and fertilser use) Drainage is not appropriately addressed. 500 acres of land is targeted for direct seedling activities. Approximately 250 tenso- meters installed in field this figure has now risen to 525. Farmer uptake on testing has been significant. According to Vatta, despite last year being an ”abnormal” year, 3 irrigations were saved. However full Farmer ‘buy-in’ is yet to be seen.
- Land holdings in the area are approximately 4ha and the Farmers get 6 hours power at night. Cost of leveling is approximately 300 rs per ha. PAU has engaged in a sms messaging service to farmers providing them with details of weather forecasts etc.
- Vatta advocates better water resources management overall to address the multiple problems in Punjab, together with better waste water recycling. He advised that the lessons of Punjab would be transferred across to another research programme underway in Gujarat also funded by Pepsico.

4. Moga Irrigation Department Office – Meeting organized by WRD staff.

- Meeting included a gathering of farmers and officials and was facilitated by the WRD. The Mission posed following question to the group: ’how may water savings be established on a large scale?”Response: Farmers felt that basmati needs less water but requires a much bigger market if it is to be profitable. The Farmers expressed that 65- 70 days are required for basmati after transplanting. Overall the marketing of basmati is not acceptable to the farmers. At present the Basmati crop is exported mainly to the Middle East – where it is highly valued. The Framers state the prices for Basmati are not properly fixed and as such they lose out – if however this situation was rectified to their advantage they would be more willing to farm this variety. American cotton also suffers the same fate as basmati in terms of fluctuating prices. Urban and semi urban sprawl has affected the farmers significantly. Farmers are facing water problems this year. Southern Bypass project is ongoing because of this canals have been stopped in the current year). . The Farmers are not inclined to grow crops which utilize less water since the market for such crops still remains to be limited. It is evident that a blame game exists on absence of market which in turn leads to current exploitative practices continuing.
- Maize requires 90 days. Pulses usually planted after rice season is over. Direct seeded rice in this district not used as it doesn’t provide good yields. Labour is a constraint in this district. The Farmers stated that if they received more canal water this would be welcome. It appears that there is flooding in the tail end of the canal. If the Farmers were charged for water there would be greater adherence to water conservations. A metered supply would thus be an effective savings strategy.
- General reluctance to pursue higher yielding rice varieties.
- Drinking water supplies also seem to be a problem in this district.

5. Thursday, 28 April Meeting with WRD Staff (together with related sectoral agencies)

- Meeting coordinated by Mr. Harinder Singh, designated focal point for the TA
- Comments to Draft Interim Report were provided by WRD – comments included those from WRD and also Science & Technology.
- Group confirmed need to integrate financial control mechanisms in the water balance. The need for Government regulation is important and has been duly recognized by all stakeholders. Need for a water regulator was also emphasized as being key together with crop regulation. Both should work together but also be simultaneously backed up with appropriate awareness programmes.
- Agreed that MSP remains a sticking point.

- DoA Representative pointed out that the colder than usual January this year led to more shoots being produced for wheat which led to an overall increased productivity - a bumper crop this year. In this regard, cyclical changes in temperature and rainfall have favoured Punjab. Since cyclical trends are not predictable, management of WR becomes even more crucial.
- Participants at this meeting emphasized that before we proceed towards remedial measures we need to tackle the reasons behind the problems and assess how remedial measures may be taken on in the current political environment. Assistance is required in implementation.
- Punjab has plans to export produce to Ukraine and other bordering countries thus measures for WRM must be put into place now with expansion plans of state. The effects of changes need to be appropriately focused on impacts to poor farmers as they are likely to be the group most seriously affected by changes. Staff present indicated that bio-drainage and other remedial adaptation measures need to be taken up. We must think in a more coordinated manner as to how we may utilize/recycle waste water.
- The prevailing energy scenario must also be taken on board. Models which will stop further water depletion are very important. The group requested that Pilot demonstration activities be taken on board as part of ADB initiatives. A micro- level study in this regard may be taken on.

- Lack of regulation of industrial water- use is a big problem – the beverages industry takes in excess of 5 lakhs of water a day but nothing is being done to address this.
- Catchement Protection and Management is crucial and may be addressed through forest afforestation.
- WRD staff indicated the need for the FR to provide '**innovative"** ideas as currently written the FR doesn't in their opinion say much new.
- Science and Technology staff rep indicated that she would use our report findings to fit into the water section of the SAPCC. She further indicated interest in external financing support for implementation of the SAPCC – especially with regard to the vulnerability assessments. She also voiced interest in our studies to look at wetland recharge as a potential water saving mechanism. Punjab has three wetland sites - 9man-mad lakes and 12 natural water bodies. They have requested NIH to assist them in this regard. She also requested that our work look at water/cc and health interactions. Finally she stated advise as to how we may more meaningfully harness flood waters and make use of them.

6. Meeting with Principal Secretary, WRD

PS welcomed mission with keen interest. Talked of efficient water resources use, resource strengthening. Mentioned a key meeting of all the PS, WRD of all states in Delhi on the 27th April chaired by Minister and Planning Commission on WRM. Based on the Delhi meetings deliberations, the PS WRD was keen to explore how these initiatives may be meaningfully taken with respect to Punjab. In particular he mentioned:

- Need for water conservation at the state level;
- Building awareness on the need to manage and conserve water;
- How do we engage with WUA's more meaningfully;
- How do we prevent excessive water wastage through seepage etc
- How do we cement role of National Development Council in this initiative?
- How do we convince political leaders to make the necessary changes?
- Need to target subsidies to achieve water use efficiency.
- Requested ADB to consider pilot basis prgrammes/interventions to demonstrate what needs to be done;
- Need technological transfer demonstratration projects;
- Strong research programmes needs to be factored in together with this work as a complement
- How do we make the most use of season discharge? Flood water? Rainwater harvesting?
- The PS has a background on MSP pricing.

7. Friday, 29 April, National Institute of Hydrology (NIH), Roorkee, Uttarakhand

- Meeting was chaired by Director Dr Singh and included presentations by NIH staff on current and planned water/cc work. Presentations have been included on a CD and distributed to all mission members.
- Dr Manohara Arora, arora@nih.ernet.in, phone: 01331249234(O); 9760315885(M)
- The NIH research programme is decided at the beginning of the financial year with inputs from the working group and advisory group and TAC folks. NIH have a series of reports of direct value to the TA
    - How may our work assist in the direction of operational research of NIH?
    - GSI – WADIA Research Institute in Dehra Dun are involved in Glacier studies.

8. Meeting with Department of Hydrology, IIT Roorkee

- Met with faculty – see List of persons met in AM.
- Have expertise in surface hydrology and now expanding into the area of cc. Focusing on hydrological design practices in a changing climate. Involved in Indo-Italian Conference – October 2010 (copies provided to team of proceedings).Worked in Arunachal Pradesh – Margochoo and Norwanchoo – Looked at snow cover depletion costs. They are also able to undertake work on a commercial basis.
- Not linked to IIT Delhi/Gosain et al.
- Have worked on Chenab Basin and Sutlej

9. Department of Civil Engineering and Water Resources Development Centre IIT, Roorkee

- Brochures provided by both Departments detailing work and expertise. The Water Resources Department is keen that ADB provide assistance towards funding their training programmes. They have worked on Shipra basin – reports exist for this work with DC Ujain/ Shipra Water Conservation Plan. WUE study is being coordinated in collaboration with ICR

- Focus areas of research include:
    - water resources development e.g. hydropower to see variability of flows in rivers;
    - water security from drinking water point of view;
    - crop planning for irrigation management;
    - Ganga Basin Research programme;
    - Downscaling parameters of models to predict impacts of cc;
    - Focus on management aspects.

10. Department of Civil Engineering, Roorkhee

- Met Dr A.K Jain – Head of Civil Engineering Department – IIT
- Have considerable expertise – are also involved in consultancy work.

K. Meetings/ Consultations May 2011

1. Wednesday, 4 May 2011, Ministry of Environment and Forests (MOEF), New Delhi Meeting with Dr. S Satapathy, Scientist E, MOEF, GOI

- The Mission was informed by MOEF that broad guidelines have been provided to the States as general guidance for the preparation of State Action Plans on Climate change. These guidelines follow a broad structure based on their own internal process which in turn helps the States to identify their priorities (as every state has its own process of preparing their SAPCC). States have been requested to submit their SCCAP'S to the MOEF which will review it through an expert committee. The Expert committee, during their review will discuss cross-border

issues (if any). The SCCAP is then sent to the National Committee with a recommendation to the Planning commission for fund allocation. The Mission was further informed that for the state of Punjab, the SAPCC preparation is well underway, while MP has finalized its SAPCC and Tamil Nadu (GTZ will assist with funding to cover preparation) yet to start the process. The Mission was informed that Himachal Pradesh has also prepared its SAPCC, Rajasthan in its final stages, Pondicherry in progress. The Mission was informed that the NATCOM-2 report was in the process of preparation and in all likelihood should be released in July 2011.

- It was emphasized to the Mission that the SCCAP's be seen as 'evolving' documents and MoEF welcomed the added value of the in-depth work provided to the water sector in the sample states under study.
- MoEF in discussions with the Mission emphasized the need for obtaining integrated solutions to the cc/water/agriculture sector and welcomed the modeling work we were doing in this regard. There was also interest expressed by MoEF for MOWR/NWM to also address water quality issues.

2. Meeting with Dr. Subodh K Sharma, Advisor, MOEF, GOI

- While expressing his keenness to learn details of implementation plan of the TA, Dr. Sharma expressed the importance of our work addressing: a) development of linkages and associations with the SAPCC and the current response of the State governments to implement the operational plan and b) the key actors involved at the operational level. He noted that innovation is welcome but that it should address a range of actions. He also expressed the need for the IWRM plan developed to work at the operational level. He proposed a "project" approach with an adequate level of ownership at the implementer's level as being a positive means by which to address this. In his assessment, the ownership of State and Central Governments and stakeholders in general as being critical for sustainability of the project and welcomed the Missions highly consultative approach. Similarly he requested the Mission to look at: (i) the depth at the viability and feasibility of actions needed to be specified; (ii) investigation of convergence between MoWR and MoEF; (iii) investigate how we might make the plan a reality – ie what steps would be required for this (with adequate attention to funding and conservation measures - working incrementally.
- In response to some of the recommendations on required shifts in cropping pattern, he stated that the state cannot take such shifts. Based on his earlier initiatives on range land development, he stated that the economics and conviction on positive benefits always guide the farmers to accommodate any shift from their current practices and it is always incentive driven and therefore he felt that the 'projects' have to be seen from a practical point of view. He was happy that the MOWR, the key ministry relating to the Water Mission of NAPCC is the executing agency for our work. He concluded by informing us that the NATCOM report shall be released before October 2011 (-please note inconsistency of dates for release).

3. Ministry of Water Resources (MOWR), GOI, New Delhi

- Meeting with Mr. M. E. Haque, Member, CWC, Mr. Kaushik, Mr. R.K Sinha, Mr. Sarath Chandra (Irrigation Planning) and Mr. Lalith Kumar (Basin Planning), CWC
- The discussion began with an overview by the TA team of work to date, the options being posed for each sub-basin, need for regulation and how WUE is being tackled. Member CWC requested that the team ensure that they not be overcritical on existing authorities (e.g. Maharashtra) and also to look at the problems at hand and suggest how these may be managed based on study and analysis.
- Mr. Sharad Chandra that the Interim report is not explicit in its reference to the impact of climate change on agriculture, in particular the changes in inter-cropping patterns. He welcomed more work on these aspects as the consultants proceed towards finalization. This was acknowledged by the Team.
- He was also keen that the Report clarify whether whether an IWRM cell would be established at the State level. Mr. Sharad also stressed that IWRM could not be meaningfully fulfilled without an adequate institutional set-up. He requested that the team provide workable, concrete solutions which the centre and state could take up. In particular he requested that the TA look at developing "models" – illustrating how problems may be addressed. He stressed

the need for adequate data exchange from CGWB and that the RBO should play a 'preventative' role especially with regard to interstate issues.

- Mr. Lalit, while agreeing to the problems as highlighted in the interim report on institutional limitations, suggested that in the context of IWRM concept and strategies, suggested that there would be no harm in suggesting new institutions which are manageable at the sub-basin or at the state level. He is of view that the concept of IWRM at the operational level is by and large (90%) institutional in nature. He suggested that a workable mechanism is needed at the district level and that IWRM could even begin at the basin level. For moving forward in terms of measures, quantification of impacts is essential- subsequent to projections of climate change impacts.
- On WUE, the basic question raised was whether India is behind in WUE in relative terms as compared to other countries? If so how they might address this. Mr. Haque mentioned that from a CWC perspective, efficiency is of the states system – this needs to be further clarified in the report.
- Mr. Haque seemed to endorse our view that the conjunctive use efficiency is high in the selected sub-basin. He further cautioned that canal lining is not the solution to improve efficiencies as it impacts recharge potential of ground water and also that artificial recharge is not a solution on its own as it has other dimensions (e.g. physical & quality related), further it has the potential to alter the soil stratification. Our proposal on institutional arrangements like a) State Level steering committee b) IWRM cell within WRD and c) Regulatory Authority was given a patient hearing by the members with the suggestions that caution be exercised in making links with the business of a regulatory authority (specific to the state of Maharashtra) with that of proceedings in the assembly on water bill in the state of Maharashtra.
- The meeting concluded with a request to TA team to come with some practical solutions to the problems encountered on account of climate change – an action plan of sorts.
- At the end of the day CWC expressed how do we "increase yields" in the most efficient manner.
- The Mission informed the group of the interest expressed by DFID in supporting pursuing operational research themes emanating from the TA. This was welcomed by Member CWC who said this GoI could also contribute to this process of strategic partnership with national agencies. He welcomed further discussion on this topic.

4. Thursday, 5 May 2011, Ministry of Urban Development (MoUD) Meeting with Ms E Nivedita, Director, MOUD, GOI

The meeting started with the Mission requesting specific schemes (if any) within Ministry of Urban Development towards addressing climate change. In affirmative, Ms Nivedita responded that in order to identify the key elements of the adaptive capacity of Indian cities and to develop a rapid assessment frame work (based on indicators of vulnerability to climate change), 14 schemes (cities) out of 65 Indian cities under JNNURM have been selected for a vulnerability assessment in the first phase of the study. A detailed study of Vulnerability assessment for 2 of the 14 cities (Hardwar and Surat) has been completed

- **On Industrial waste water use**, Ms Nivedita informed that only corporate bodies who could afford to pay are working on this subject close to industrial areas. However, these initiatives being small in number, nowhere did it reach a critical mass in scale. Many such small initiatives could be cited. It was informed that, a sub group has been constituted to study the issues on Industrial waste water use.
- **On desalinization of water,** though the city of Chennai, took the lead in demonstrating its technical feasibility, but proved O & M cost of such desalinization plant to be very expensive to implement on a large scale and therefore opined as not sustainable. Further, she opined that a) Conservation of water, is meaningful than producing and wasting water b) distribution loss is high and c) tariff fixation is a complex issue, not in favor of desalinization.
- **On the constitution of a National Bureau of Water use Efficiency on the lines of Bureau of Energy Efficiency,** she opined that, it will be difficult to establish such an organization given the "sensitivity" involved.
- Meeting concluded with an assurance to give comments on our TA Draft Final Report and to extend invitation to Urban Development for their participation in the final workshop scheduled for 27th June 2011. Ms Nivedita stated that not much has been done by the MoUD on urban

water re-use and not much on mainstreaming – most of the work in this regard has been largely anecdotal. She did not advocate de-salinisation, but was more amenable to conservation/re0-use approaches. This is especially so given the huge O&M costs involved.

5. Ministry of Agriculture (MoA) Meeting with Dr Subrata Nath and Mr Rath, Department of Agriculture and Cooperation, GOI

- Meeting started with an emphasis on Food Security as an objective of the Sustainable Agriculture mission of the NAPCC by Dr Subrata Nath. In his overview on the context, he informed that agriculture sector is a major consumer of water at 75% of its use. In comparison to the food production projected at 280 million tones, the deficit is estimated at 50 million tones in absolute terms and it represent a deficit of 20% in percentage terms and this needs to be bridged in next 5-10 years.
- In order to increase the food production by 20%, as a thumb rule principle, an increase in water use (efficiency) by 20% needs to be achieved. It was felt that due to climate change impacts; approximately 7-8% decrease in food production would be foreseen. In this context, efficient water management becomes important and this will require three measures a) Economic measures b) WUE measures and c) conservation measures. Further it was stated that direct correlation is observed between the levels of food production and monsoon deficit. In this context, WUE is given biggest emphasis to produce additional 20% of food production to ensure food security and the sustainable agriculture mission of NAPCC address among many others to ensure food security of which soil health management has become critical as it holds the key to improving the return from investment in other inputs like seeds and water. In this context, he felt that dry farming areas need particular attention from the point of view of overcoming micro-and macronutrient deficiencies in the event of climate change impacts on land use pattern. Reference to National Rainfed Areas Authority[8] (NRAA) was made.
- A reference was made to the key areas under NAPCC which are a) Development of drought and pest resistant crop varieties and b) improving methods to conserve soil and water to ensure their optimal utilization c) financial support to farmers to invest in adopt relevant technologies to overcome climate related stresses. The biotechnology options cover among others: a) development of strategies for low input sustainable agriculture by producing crops with enhanced water and nitrogen use efficiency which may result in crops with greater tolerance to drought, high temperature, submergence and salinity stresses, and b) development of national strategies for managing heat stress in dairy animals and also for heat tolerant seeds.
- **Integrated Nutrient Management** was also referred to as a strategy to increase productivity and enhance food production towards ensuring food security.
- Dr Nath stated that the case of Punjab needs to be looked at from a contextual angle since over the years; Punjab has become essentially a climate resilient state at the cost of excessive ground water exploitation. The cultivation of rice in Punjab is more for the markets and less for internal consumption and therefore, he felt that business principles should be applied while deciding on institutional measures such as - Minimum Support Price (MSP) for crops like Basmati Rice. In his opinion creating MSP, for Punjab rice growing areas could be

[8] The Cabinet approved proposal for setting up of National Rainfed Area Authority was accordingly set up vide GOI order No.9-2/2005 RFD-lV dated 03.11.2006/ Website: http://nraa.gov.in/. The key mandate among others include a) to evolve common guidelines for all schemes of different Ministries including Externally aided project (EAPs) for development of Rainfed/ Dry land Farming Systems b) to coordinate and bring convergence within and among agricultural and wasteland development programmes being implemented in rainfed areas of the country c) to identify rainfed areas in different States which need priority attention and prepare watershed development programmes for integrated natural resource management, in consultation with States, focusing on multi dimensional crop, livestock, agri-pasture integrated systems and programmes for landless farming communities d) to identify gaps in input supply, credit availability, dissemination of approprait technology and other requirements relevant for development of rainfed areas e) to develop plans/ programmes for capacity building and centre/ State Government functionaries in rainfed areas g) to suggest modalities to strengthen National and State Level Institutions concerned with Rainfed/Dryland areas, and establish institutional linkages with prioritized watersheds h) to monitor disbursement of rural credit/insurance cover/ safety net programmes developed for rainfed areas.

termed as a "tragedy of commons". He further stated that Punjab Agriculture, is run on a business model and therefore should be treated as such. To run such a business model through a cooperative management principle is possible if incentives are withdrawn to reduce area under paddy to a sustainable level.

- The meeting concluded by making reference to a) the formation of two task forces to address the concerns of W.India and b) a book on Punjab Agriculture food patterns by HS Siddhu.
- The Mission was informed by MoA representatives that though the Sustainable Agriculture Mission has yet to be launched, that the cc inputs for agriculture (documented in the plan) have been incorporated into the 11th Five Year Plan.
- MoA representatives agreed that water regulation and pricing were important components requiring attention. They agreed that conjunctive use is an important aspect needing study in Punjab in particular.

6. Meeting with Mr. Vijay Kumar, Minor Irrigation wing of MOWR, GOI

- The Mission briefed Mr. Vijay Kumar on the progress of the NAPCC TA, including discussions held in Punjab, Roorkhee and meetings in Delhi with CWC/MOEF /MOUD and MOA.

- Mr. Kumar spoke at length on GoI's stance on providing 100% assured irrigation, however he emphasized in discussions the associated difficulties in doing so, as creating irrigation infrastructure is expensive and neither the state nor the centre can afford such investments readily. In his opinion, private participation is not feasible as water is a state subject. In reference to the proposed workshop in June, he suggested that stakeholders from other states be invited to attend to know their views. Mr. Kumar suggested to involve CWC at every stage so that inter-state issues (-if any) are dealt with appropriately. He stated that unless the MOWR explores alternatives such as this current TA assistance programme, farmers would be compelled to continue to follow their own practices and suggested for more fund allocation to recharge ground water.
- The Mission emphasized that in an inter-state river system, irrigation improvement options are difficult to exercise. Similarly the Mission emphasized the need through the TA to explore a portfolio of actions (policy measures, technology options in agriculture, Water resources etc). Mr. Kumar welcomed this approach and informed the Mission he would ensure that other MoWR staff were kept in the loop through him vis-à-vis developments relating to the TA and the onward programme of a PPTA and investment programme.

7. Friday, 6 May - Geological Survey India (GSI), Lucknow Dr. Arun Chaturvedi and Dr S.P Shukla and Dr. L.S Jain

- The Mission travelled to Lucknow on 6 May and held in-depth discussions with senior GIS staff, including the Deputy Director General and HoD.
- The Mission was informed that the main focus of the GIS was to gather evidence of CC in the Indian Himalayas through the use of remote sensing maps and with a strong focus on ground truthing (1:50,000 scale) of glacial snouts using precision instruments. With this focus they have no doubt of the data they generate. The recessions of glacier snouts have been mapped – HP has been a focus since 2000– especially the Lahul and Spiti areas. Depth and other studies are ongoing.
- They use Mullers "thumb – rule" for the sounding of volume which enables them to assess volume but they recognize this is not adequate.
- From 1974 systematic studies have been initiated.
- Wadia Institute (director@wihg.res.in) has been involved in Mass Balance work as have they in 9 glaciers but their priority of work is HP. In all 15 snout terminuses of glaciers have been mapped. GPR is now in the process of being studied. In Antarctica this has produced good results. SIR-20 model (Company GSSI-USA) is able to go to 50-60 metres in depth. Nehner Glacier – Kashmir drilling methodology has been used. In the past multi-disciplinary techniques were sued but now not so. Funding continues to be an issue and the GSI are now in the process of linking with the DST/Ahmedabad for work on remote sensing etc
- At present GSI is not involved in any regional cc work.
- Defense and Research (MoD) – SASE – Snow Avalanche Study Establishment – Chandirgarh.

- Ongoing GSI work includes: (i) Preparation of an inventory of Himalayan Glaciers (2009;(2) Mass Balance studies of Glaciers; (3) Discharge Measures (- Hydrometry); (4) suspended sediment flows and (5) Meteorology – on site collection separate from IMD activities.
- At present no one institution is pulling all this work together – there is thus potential scope for collaboration e.g. GS/Roorkhee/Wadia and international institutions to pull this work together. This could be a useful engagement. GIS are keen to look at hydro-glaciology measurements and the development of a methodology for mapping work.
- GSI falls under the Ministry of Mines.
- Glaciers in Kharakorum are advancing maybe as a result in a weakening of western disturbances. GSI also recommends hydro-meteorological stations to be out into river-basins and advocates small storage dams in upper catchment to make use of snow melt waters.
- GoI clearances need to be sought for work especially in border areas.
- The Mission obtained very useful information and insights into glaciers studies during the meeting with GSI staff and welcomed the possibility of joint collaborative programmers on areas of mutual interest.

8. Friday 6th May Central Groundwater Board (CGWB) Lucknow

- The Mission used the opportunity of being in Lucknow to simultaneously meet with the CGWB. Both the Superintending Hydro geologist and Director Research had extensive experience and service in Punjab and the Team used the opportunity to gain insights on the GW issues pertaining to Punjab in addition to measure currently in place in Lucknow designed to tackle GW issues with a potential view of transferring experience and know-how. A presentation was made to the Mission by the CWGB staff.
- According to Mr. Biswa, Regional Director, CGWB, the main thrust of their work is related to water conservation strategies – recharge is being addressed through establishment of check dams, rw harvesting; impoundment of water etc. CGWB is not involved in sub-surface dams in UP. Cascading structures are employed in the alluvial areas the main aim being to harvest RW.
- When asked what in their opinion was the prognosis for Punjab – they felt that GW wasn't having much effect on water/energy issues in the State (!) They felt that Farmers in Punjab would face problems in the draw-up and this would lead to more stress on aquifers. In Punjab according to Superintending Engineer Dr. Sanjay Marwaha (mar_sanj@hotmail.com), farmers have been tapping aquifers for the last 5 years.
- In Punjab the water level has in some places gone down to 15-20 metres.
- There is much scope for drainage works (as a means to arrest and store water) in Punjab. The Mission was referred to the work of USAID in the State. GW is yet to be modeled in Punjab. There is scope for this work – perhaps in conjunction with NIH.
- In Punjab it is mandatory for new buildings to have recharge structures built into them

L. Meetings Consultations June 2011

1. State Workshop Trichy 13th June

State Level Workshop-Tiruchirapalli: Proceedings of the workshop held at SRM Hotel Tiruchirapalli on 13th June 2011

The Asian Development Bank, Indian Resident Mission, New Delhi in collaboration with the Government of Tamilnadu organized a one day state level workshop on National action plan on climate change at Trichy,TamilNadu on 13.6.11 in which 20 State and District level officials including Engineers from water resource organization & 40 Farmers of Cauvery Basin actively participated in the group discussion and shared their views and problems encountered due to climate change, apart from the suggestions made to address them. The entire proceedings went on dual languages, both in English and Tamil with an intention to make the farmers to understand and to involve them in the process without any hurdle.

Dr Krishnan and Mr Bhaktavatsalam in their opening remarks welcomed the participants and gave an overview of the process and journey of ADB supported project undertaken by the WRD, ADB and CWC thus leading to the current workshop.

Er Balasubramanian in his brief welcome remarks made specific reference to climate change and its impacts and therefore he opined, that the current workshop being held under the joint auspicious of CWC, WRD and ADB, is useful for farmers in particular. He informed the gathering that the Tamil Nadu Government has taken initiatives to address climate change impacts and cited, IAMWARM project interventions, drainage improvement, SRI to increase the production as some examples. He therefore, requested the participants to give their useful suggestions and help prepare a comprehensive plan for consideration by ADB.

Mr Govindaraj, Director of IWS referred to problems consequent to increase in temperature and rainfall and mentioned that TN Government, has been contemplating some measures to address the problems but opined that other measures, in the context of climate change, needs to be looked into in a holistic approach and opined that, people representing marketing agencies to be part of the discussion and planning process wherein the changing crop varities are being contemplated. In conclusion, he thanked both ADB and CWC for taking up the pilot project in Cauvery delta

Ms. Vidhisha Samarasekara Climate change specialist, ADB Indian Resident mission initiated the discussions after elaborating the purpose of the workshop. She also made an appeal and invited whole hearted participation by all the delegates and informed that, this workshop is specially organized for the stakeholders to articulate their views/ opinions and suggest measures as felt appropriate by them

Mr Adrian Young Water resources Environment Planning and management unfolded the findings of the study carried out in Cauvery Delta – coastal area along with the objectives, methodology and suggestive measure though Power point presentation. For the better understanding by the delegates especially for the Cauvery delta farmers the same was translated in local language by Dr.R.Krishnan officer Technical that was well received by the delegates. In his brief, he shared the findings of climate change projection of 1 to 2 degree increase in temperature, 2-10% reduction of rainfall in south west monsoon, 3 to 15% increase in rainfall of Northeast monsoon and reduction in average rainfall. **The group discussion** followed the presentation.

The process followed for group discussion

Step-1: Group formation

Step-2: Identification of

Group leader
Time keeper
Writer for the group discussion
Presenter

Step-3: Briefing to the group leader of the issues
Step-4: Group leader in-turn explain the task to his team members
Step-5: Presentation of group work in the plenary
Step-6: Questions and answers
Step-6: Finalization of group work based on the feedback received

Outcome of the group work: Following the steps as mentioned above, all the participants were divided into three groups consisting of officials, Engineers and farmers. Necessary space and time provided for them to discuss, analyses the present scenario, problems and suggestive measures to address in a collective manner on three different topics namely

Topic-1: *Flood and salinity management.*
Topic-2*: Sustainable agricultural System*
Topic-3*: Shoreline protection and management*

Within each group, the group leader was identified who initiated the discussion on the topic assigned to the group. The key discussion points were documented by the writer as identified by the group leader. The discussion was facilitated by the ADB consultants Mr Nalaka Gunawardene and Dr.

NR.Jagannath and were suppoted by Mr Inder Raj and Dr KS Sharma. Each group was given a time of an hour to discuss and prepare their presentation

In the post lunch session, each group presented their group discussion outputs. The following table summarizes the problems and proposed measures as discussed in their respective group.

Group 1	**Problems**	**Proposed measures**
	Inundation of flood water	Dredging of the mouth of River
FLOOD AND SALINIT MANAGEMENT	Ground water Table	Desiliting of all Tanks (priority to coastal tanks) in Delta area to fill the Tanks which improves the Ground water
	Leakage of Shutters	Repair, Renovation and Rejuvenation of Shutters
	To attract the Rain or clouds.	Sapling Trees (Illupam Trees) , proposed 2 Acres, for every 10 acres of land.
	Encroachment	Eviction (Fix the boundary and fencing)
	Desilting , all aspects	Participatory approach
	Maintain the Theortical Bed	Bed Dam. Reduces Sea water intrusion.
FLOOD AND SALINITY MANAGEMENT	Improve Ground water	Artificial mechanical Recharging Shaft and Infiltration gallery along the River, based on the zonation map(IWS)
	Sea water intrusion	Provide Tail End Regulators Nearer to the Sea and provide Tail End Regultors at every 2km in u/s of the river up to sea water intrusion line
	Drainage Problem	Removal of Iphomea (weeds) in all Rivers and Drains. (percolation)
	Reduce Sea water Intrusion	Storm surge barrier as in Japan, Geo Syenthtic fiber bag (Gabion tubes) used as barrier along the coast.
	To improve the carrying capacity of Drains/Rivers (Percolation)	Standardizing the bund level
	Aquaculture	Pond should be made as water tight. Reduces salinity percolation
	Problem Flood inundation	The East coast Road constructed along the coast is formed by raising the road with necessary vent ways for Drains and Channels. The number of vent ways are to be increased as the raised road behaves as a flood barrier.

Group2	**Problems**	**Proposed measures**
SUSTAINABLE AGRICULTURAL SYSTEM	Lot of Hindrance in the river and channels due to Ipomea, Iccornia	Cleaning all the rivers and channels
	Drainage of water is a great problem	strengthening of bunds and broadening of rivers
	Saving flood water	For every 100 acres one pond in an area of ten acres may be formed.
	Labor scarcity	Machineries such as transplanted, harvesters, tractors, laser leveler may be given to each panchyat for providing farmers at cheap rent.
		Other machineries like power tiller and rotavaters and corn weeders may be supply to farmer at 90% subsidy.
	Bore well irrigated areas Deposited by salt.	Required inputs may be supplied at 80% subsidy.
	Crop diversification	Low water required crops like pulses, millets, cotton and sugarcane may be encouraged by providing all the inputs at 80% subsidy.

	Flood water harvesting	Formation of lakes near the sea coast to save the flood water which can be used for summer crops
	Input sale point	For each 3000 acres one input sale point may be opened at least during the cropping seasons.
	Inundation of paddy crop	Paddy variety to with stand flood and yield well may be realized.
	Encouragement to traditional paddy varieties.	Old traditional paddy varieties may be retrieved and given to farmers.
	Marketing problem	Arrangements may be made to make value addition to be coastal area agriculture produces
		Govt. may fix fair price and organizations may be developed to sell the farmers produces

	Rain water harvesting	Rain water harvesting structures in rivers, tanks and pump set areas may be created at free of cost.
Power problems		More no. of farm ponds in the farmers holding at 90% subsiding. Diesel for agriculture machineries at subsidy cost Encouraging Solar energy
Other Problems		Crop loan to lease lands by commercial banks required Crop insurance at revenue village level unit to be taken up. TNCSC provide more mobile procurement centers NABARD loan should not be given to prosphis Agriculture subsidies may also be provided to communities and groups.

Group-3	**Problems**	**Proposed measures**
SHORELINE PROTECTION AND MANAGEMENT	The drinking water facilities and irrigation lands are affected due to intrusion of sea water along the coast line.	To increase drainage width Removing the encroachments Forming tanks in low lying area Improvements to Mangrove forest End regulators should be constructed with non rusting materials.
	Diversion of excess flood water without affecting the coastal area.	The excess flood from the upstream areas should be diverted before entering the delta.
	Damages due to the prawn culture and pollution of GW due to mushrooming aquaculture.	All costal area prawn culture should be controlled with strict regulation.
		New rules and regulations should be formulated to avoid pollution of the GW due to aquaculture.
	Inadequate width of river	To accommodated irrigation water and drain water during the flood the width of the river must be widened. Both banks of the drainage should be raised.

	Estuary of rivers are blocked	The estuaries river mouth should be dredged regularly. The existing straight cuts of drainages should be desilted and new straight cuts should be excavated wherever the coast line is affected by floods. 3) The man made obstructions across rivers for inland fishing should be removed permanently.
	Encroachments in the river and drainage bed should be cleared.	Strict action should be taken to clear all types of encroachments. Necessary actions should be taken to implement the existing act and rules to avoid further encroachments.
	The improvement should not destroy the beach beauty and flora and fauna.	The end regulator, sea wall shall be constructed without affecting the existing beauty and facilities. Nagai district is the home for Olive Ridley Tortoise. Hence, costal management works should not affect the life cycle of Alive Redley Tortoise and any other existing rare flora and fauna.
	Sea water intrusion due to over expoilation of GW	Construction of end regulator and formation of recharging reservoir Construction of check dam and appropriate places on the U/s side of drainages. Providing recharging shallow bore wells.
	Bed level of the drainage is below the bed level sluices are not commendable.	Construction of grade walls at designed bed level and maintaining actual bed level
	Shifting of population and adaptation	The Govt. should take necessary appropriate steps for proper resettlement of people shifted by global warming and sea water intrusion.

Emerging discussion points: (Mr Baktavasthalam and Dr Krishnan expanded and added some more discussion points)

- It was opined that advance technology in agriculture needs to be improved for sustaining agricultural production in addition to improvements in market infrastructure as observed by the TA study team. ***A proposal was made to establish ONE "sale point" for every 3000 acres cultivated.***
- Some farmers opined that post harvest technology is the need of the hour and proposed the establishment of cold storage plants
- While reacting to the climate change projection as observed in the study, farmers opined that the disappearance of forest is further added to the impacts of climate change and therefore, felt that protection of catchment and forest are considered as critically important to restore the ecological balance of nature
- To a proposal on private investments in agriculture, a voice of dissent was observed and many opined that in the absence of government playing an active and support role, the partnership between Farmer & private enterprises/companies will negate the interest of farms and farm families and in support of their voice of dissent, cited example of private company disappearing half –a –way through the process and leaving the farmer in great financial stress of repayment of loan borrowed by the company from a commercial bank. The farmers strongly argued for Government to absorb such financial risks in any such Farmer-Private company partnership.
- Some opined that energy as a critical centrality to livelihood is becoming important and given the energy cost, there is a need to harness the solar energy for water lifting/ pumping activities and also a suggestion was made to take advantage of the tides of sea water rise to generate electricity for energy based pumping/lifting activities

- Farmers while expressing their serious concern of low return on their investment in agriculture, forcing them at times to distress selling of their produce strongly felt that the fertile lands are also being taken over by the real estate agencies thus leaving the farmers in a state of helplessness.
- Also a question was posed to ADB, whether any mater plan pending with ADB for funding and this was responded to by ADB to the satisfaction of the questioner
- *In the process of agricultural activities, the timely water input is being affectedly due to non availability of electrical power supply to operate pump set, stipulation of solar energy system in the proposed project will be of assistance to pump the water. Raising of mangrove forest in the coastal areas may be encouraged with an intention to minimizing nature's fury, if any. they will also help to reduce soil erosion and provide a haven for the fish and shrimp larvae to breed, which, in turn, facilitate the fishing communities*

Concluding Remarks

Shri A.K.Kahriaya and Ms. Vidhisha Samarasekara appreciated the interest and involvement shown by the delegates during entire process of this workshop and assured them that their proposed measures outcome of the workshop will be of due consideration and invited the participants to attend the final workshop scheduled for 27th June 2011 in New Delhi

At the end the programme vote of thanks was given by Mr Inrdra Raj, Deputy Team Leader of the study team and followed by Er.Bakthavatchalam Executive Engineer WRO, Myiladuthurai. The workshop was successfully concluded with a National Anthem

Table 2 List of Participants Trichy Final Workshop

Sl. No.	Name & Designation	Address	Cell Number	Email ID
	Thiruvalargal.			
1	Er.S.Asokan, ME (IWM), Superintending Engineer, WRD	Lower Cauvery Basin Circle, Thanjavur.	94434-76626	
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4	M. Sambandam, Executive Engineer, WRD	Grand Anicut Canal Division, Thanjavur	94432 - 20320	
5	S. Chelladurai, Deputy superintending Engineer,WRD	Lower Cauvery Basin Circle, Thanjavur.	94434-96692	
6	M.Veerasamy, Asst.Director (Geology)	Ground water Division, Thanjavur		
7	K.N.Rajendran, Farmer	Killukudi, Nagapattinam District	94448 - 57096	
8	S.Panchanathan, Farmer, Uzhavar Mantra Thalaivar	Eluppur, Nagapattinam District	90035 - 14958	
9	M.Pandian, Assistant Engineer, WRD	Vennar Sub Division, Nagapattinam	94433-36057	
10	P.Balasubramanian, BE., Chief Engineer, WRD	Trichy Region, Trichy	94435-04858	
11	V.Sathiya Narayanan., General Secretary,	Consortium of Cauvery Delta	94420 - 38111	

Sl. No.	Name & Designation	Address	Cell Number	Email ID
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14	R.Kothandaraman, Member	District Administrative Council, Sirkali, Nagapattinam District.	98654 -47255	
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21	K.R.Govindaraju, BE., Chief Engineer & Director	Institute of Water Studies, Chennai.	96000-42231	
22	S.Selvaraj, Joint Director,	Institute of Water Studies, Chennai.	98409 - 10670	
23	K.Pari, B.E., Assistant Executive Engineer,WRD	Cauvery Basin Sub Division, Mayiladuthurai.	94433 - 28933	
24	M.Thiruvenkadam, Farmer	Poraiyar, Nagapattinam District.	90920 - 68882	
25	Vidhisha Samarasekara, Climate Change Expert,	Asian Development Bank	97170 - 20087	
26	Nalaka Gunawardare	Asian Development Bank	94777 - 125829	nalaka @ tveap .org
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30	K.Manuraj Deputy Superintending Engineer	Plan formulation Circle, Trichy.	94431 - 06922	-
31	P.Balasubramanian, BE., Superintending Engineer	Plan formulation Circle, Trichy.	99442 - 31106	
32	K.Manoharan, Assistant Engineer, WRD	WRD	94435 - 86121	
33	Annie George CEO,	Bedroc, Nagapattinam.	94421 - 00074	annie @ bedroc .in
34	P.Helan cecil, Executive Engineer, WRD	Quality Control Division, Trichy	94435 - 87196	
35	S.Natarajan, Executive Engineer, WRD	Aganiar Basin Division, Pudukottai.	98652 - 68054	

Sl. No.	Name & Designation	Address	Cell Number	Email ID
36	G.Anbalagan, Farmer	Nalluchery, Nagapattinam Dt.	94869 - 69040	
37	S.Kunchidapatham, Farmer	Anaimattam, Nalluchery, Nagapattinam Dt.	94867 - 39947	
38	A.Alexandar, President.	Cauvery Delta Farmer Association, Mayiladuthurai.	94425 - 28685	
39	S.Dharmaraj, Farmer	Memathur, Nagapattinam	96551 - 31085	
40	C.Ramalingam Farmer	Main Road, Vazhkai, Nagapattinam District.	90037 - 62857	
41	S.Ramakrishnan, Farmer	Poraiyar, Nagapattinam District.	73738 - 22015	
42	Guru.Gopi Ganesan, (Farmer) Gl. Secretary.	Cauvery Pasanatharar (E) Mantram, Eravanchery, Nagai Dt.	94425 - 85958	
43	Dhesingu, Farmer	Poraiyar, Nagapattinam District.	99407 - 55024	
44	R.Anbalagan, Farmer	Memathur, Nagapattinam Dt.	90032 - 27740	
45	R.Sukumar, Farmer	Boothanur, Nagapattinam District.	99429 - 20902	
46	R.Ganesan, Farmer	Boothanur, Nagapattinam District.	94438 - 77613	
47	P.Karunakaran, Assistant Executive Engineer, WRD	Quality Control Sub Division, Thanjavur.	99423 - 76230	
48	G.Durairaj, Farmer	Thillaiyadi, Nagapattinam Dt.	04364 - 288437	
49	K.Parthiban, Farmer	Nalluchery, Nagapattinam Dt.	95002 - 89548	
50	M. Kanagarathinam, B.Tech., Assistant Engineer, WRD	Cauvery Sub Division, Aduthurai.	94433-25911	
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53	C.Sivan, Executive Engineer,	Hydraulic Division, Trichy	94431-33894	
54	R.Sornakumar, B.E., Asst.Exe.Engineer.	Cauvery Sub Division, Aduthurai	94430-26813	
55	R.Sathishkumar, NGO	Bedroc, Nagapattinam.	98659 - 69918	
56	K.Mayilvahanan,	District Director of Agriculture, Nagapattinam.	94430-26813	
57	B.Muruganantham, Fisherman	District Director of Agriculture, Nagapattinam.	94430-26813	
58	C.Samidurai, Farmer	Mayiladuthurai Taluk.	93441 - 71100	
59	R.Subramanian, Farmer	Akkur, Nagapattinam District.	97888 - 86901	
60	P. Mariselvan, B.E., Assistant Engineer.	Cauvery Sub Division, Sirkali.	99444-16803	
61	C. Ganapathy, B.E., Assistant Engineer.	Cauvery Sub Division, Sirkali.	94439-76402	
62	Nandagopal, Fisherman.	Thirumullaivasal, Nagapattinam District,	95858 - 23490	

Sl. No.	Name & Designation	Address	Cell Number	Email ID
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64	K.P.Chandrasekaran, Fisherman.	Thirumullaivasal, Nagapattinam District,	94438 - 72806	
65	C.Lakshmanan, Fisherman.	Thirumullaivasal, Nagapattinam District,	96260 - 11057	
66	A.Kaliamoorthi, Fisherman	Thirumullaivasal, Sirkali Nagapattinam District,	96260 - 11057	
67	T.Velu (Fisherman), Panchayathar	Thirumullaivasal, Nagapattinam District,	99434 - 28036	
68	G.Kasinathan (Fisherman), Panchayathar	Kuthalam Taluk, Nagapattinam District,	04364 - 230169	
69	Thillai Govindarasu, Farmer, President	Poraiyar Pasanatharar sangam, Poraiyar, Nagapattinam Dt.	80988 - 05611	
70	K. Anbanantham, B.E., Assistant Engineer, WRD	Cauvery Sub Division, Poraiyar	87601 - 94055	
71	S. Rajagopalan, Junior Engineer, WRD	Cauvery Sub Division, Poraiyar	94865-67458	
72	C. Gunasekaran, Junior Engineer, WRD	Cauvery Basin Sub Division, Mayiladuthurai.	94439-40634	
73	S. Prabakaran, B.E., Asst.Exe.Engineer, WRD	Cauvery Sub Division, Sirkali.	89038 - 54965	
74	R. Majeed, BE., MBA., Assistant Engineer, WRD	Cauvery Sub Division, Sirkali.	94438-50417	
75	K.Thiyagarajan, Assistant Executive Engineer, WRD	Sub Division, Pattukottai.	98949 - 89412	
76	A. George Antony Baburaj, Junior Engineer, WRD	Cauvery Basin Sub Division, Mayiladuthurai.	94439-44132	
77	K.Chakkaravarthi, Farmer	Vasistacheri, Nagapattinam District.	94437-85232	
78	S.Thangasamy, Farmer	Achalpuram, Sirkali Taluk	99654 - 78151	
79	V.Viswanathan, Farmer.	Kothandapuram, Sirkali Taluk	90954 - 44263	
80	K.Muthumani, B.Tech, Junior Engineer, WRD	Cauvery Sub Division, Aduthurai.	94431 - 51796	
81	M.Sellappa, Farmer,	Thirungari, Nagapattinam Dt.	98436 - 17910	
82	A.Sivaprakasam, Farmer.	Achalpuram, Sirkali Taluk		
83	K.Varadharajan, Farmer.	Sattanathapuram, Sirkali		
84	K.Muthumani, B.Tech, Junior Engineer, WRD	Cauvery Sub Division, Aduthurai.	09442280767	
85	Dr R Krishnan, AEE, WRO PWD,	Tiruchirappalli Division		

2. Follow on Discussion Chennai 14th June

Follow on discussions were held with the Tamil Nadu WRD on the 14th of June. The discussions focused around the outcome of the workshop and the necessary follow on actions.

3. State Workshop for KShipra Indore 16th June

Asian Development Bank sponsored state level workshop on climate change adaptation , was held at Indore Madhya Pradesh on 16th June, 2011 for review of draft final report on Kshipra Sub basin prepared by ADB consultants under TA 7417 NAPCC Support to National Water Mission. The

Workshop was attended by political representatives, farmers, and Government officers from various departments, Panchyaat Officers, NGOs, media and members of civil society. The list of participants is enclosed at Annexure A.

The Inaugural session was chaired by Sh Om Prakash Parsavadia Chairman Indore District Panchayat Board. The other people present at the dais were: (i) Mr. Kanan Singh local political figure, (ii) Mr. Rajesh Kumar Chief Engineer Central Water Commission (iii) Mr. J K Patni Chief Engineer Water Resource Department Government of Madhya Pradesh (iv) Mr. S. K. Sojatia member of civil society who is former Engineer in Chief of Water Resources Department Government of Madhya Pradesh (v) Mr. Adrian Young Team Leader ADB consultant team ;and (vi) Dr. Vidhisha Samarasekara Senior Climate Change Expert ADB.

Mr. Parsavadia and Mr. Kanchan Singh gave detail description of various water resources and agriculture issues in the Kshipra sub basin and narrated the difficulties being faced by sub basin farmers and general population. The most significant issues raised by them are: drastic depletion of ground water table and drying up of the holy river Kshipra. They highlighted the urgent need for finding the solutions like new methods of water conservation, recharge to the ground water, regulations etc. They appreciated studies being carried out by ADB related to existing problems of the sub basin and the future projections related to climate change and its effects on water resources. Mr. Kanchan Singh was of the strong view that strict regulations should be imposed for further construction of bore wells and further deepening of such wells in the Kshipra sub basin.
Dr Vidhisha Samarasekara gave the back ground of the Technical Assistance and various initiatives taken by ADB to complete the study in time and chalk out strategy for future investment planning in Madhya Pradesh in water sector.Mr. Rajesh Kumar explained the objectives of National Water Mission and works being initiated by MOWR and CWC for the NWM.

Mr. Sajatia advocated for river interlinking so that flood water can be saved and transferred to deficit regions. He advised that water should be conserved and stored as per age old Indian traditions.
Mr. Adrian Young gave the detailed presentation of the draft final report of Kshipra sub-basin, various climate change scenarios for the sub-basin, adaptation strategies and strategic frame work plan to meet the key objectives of development needs, and sustainability and adaptation to climate change. The plan comprises of: [1] Sustainable Agriculture and Conservation, [2] Water Resources and Catchment Management, [3] Water Quality Management and Pollution Control, [4] Water Supply and Sanitation.Mr. Adrian Young also presented the Road map for the Kshipra Sub-basin Water Conservation and Development Programme, programme scope, and studies and planning required taking the plan ahead for implementation. The presentation of Adrian Young is given at Annexure B.
Mr. Adrian's presentation was simultaneously translated into Hindi slide by slide for the benefit of larger audience.Water Resource Department made the Hindi Translation of the executive summary of the draft final report and circulated to the participants.After the lunch break, the participants formed three sub groups to discuss three topics:

(1) Group 1: Water Conservation and storage.

(2) Group 2 : Ground Water Extraction and recharge

(3) Group 3: Water Supply Sanitation and environment.

The findings of the group were presented in the workshop and detailed discussions were held on all the topics.Water Resources Department, Government of Madhya Pradesh issues a press release on the Workshop. Workshop meeting ended with vote of thanks presented by Mr. Gaharavar Executive Engineer Water Resources Department Govt of Madhya Pradesh.

Table 3 List of Participants Kshipra State Workshop

Name and Designation and Address	**Phone No.**
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Mr.Ramashwar	……..
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Mr.Bonder Singh Patel	……..
Mr.Devi Singh Patel	……..
S.C.Vijay WangiyaS.D.O, WRD	…….
Sej Rao Deshmukh WRD Indore	……
Vijay UmthereWRD, Indore	……..
MR.M.L.SoniWRD, Indore	……..
Mr.Kesi DhansiaS.D.O,Indore	…….
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Mr.A.M.Dube SE,N.C.A Bhopal	…….
Mr.Rakesh Gaurave AEE,CWC, Indore	……
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Mr. Lale WRD	…….
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Table 4 Suggested Actions

Water demandmanagement saving of water for farming.
1.Silt excluder in stop dam
2. Field border work
3.Soil conservation in field
4.Plantation of tree's along banks
5.Crop's of deep root and surface root
6.Organic forming
7.Boulder work in nalla of the farm.

Table 5

Priority use of water = एक मात्र निदान है।
जन्म लेते ही नदी का बाढ़ का पानी बह जाता।
जो बचा वह सिंचाई के काम आता दिनांक : 16/06/2011, इन्दौर

क्षिप्रा पुर्नजीवन अभियान हेतु कार्य योजना

वर्ष : 2011-12

1. क्षिप्रा नदी की अप्रवाहित सतह गाद मिट्टी से भर चुकी है। नदी के दोनों तटों का सीमांकन कर गहरीकरण कर क्रमानुसार जल संरचनाएं बनाई जायें। यह कार्य क्षिप्रा उद्गम स्थल से आरंभ किया जाये।
2. क्षिप्रा उद्गम स्थल के आस-पास नदी के प्रवाह क्षेत्र में अतिक्रमण है। उसे हटाया जायें व प्रवाह क्षेत्र में अवरूद्धता को दूर किया जाये ताकि नदी के उद्गम स्थल का जल उज्जैन की ओर प्रवाहमान रहें।
3. क्षिप्रा नदी के प्रवाह क्षेत्र में आस-पास कई बड़े तलाब है। उन्हें अतिक्रमण से मुक्त किया जाये व उनका गहरीकरण कर सीमांकन किया जायें।
4. क्षिप्रा नदी के सुखने का प्रमुख कारण उसके आस-पास लगाये गये हजारों ट्यूबवेल है। जिनके कारण धरती का जल स्तर घटा है। प्रवाह क्षेत्र में लगे समस्त ट्यूबवेलों को आधुनिक रिचार्ज कर वर्षा जल संग्रहण हेतु नवीन ट्यूबवेल क्षिप्रा प्रवाह क्षेत्र के आस-पास कर जल पुर्नभरण किया जायें।
5. क्षिप्रा नदी क्षेत्र इन्दौर, उज्जैन, देवास में नदी रक्षा समिति का गठन किया जायें जो स्टाप डेम का रख-रखाव व क्षिप्रा प्रवाह क्षेत्र की सुरक्षा कर सकें।
6. क्षिप्रा नदी के उद्गम स्थल के आसपास से वर्षा काल में बहने वाले नदी नालों पर डेमों का निर्माण कर प्रवाह क्षेत्र को क्षिप्रा नदी की ओर मोड़ा जायें।
7. क्षिप्रा नदी के उद्गम स्थल क्षेत्र में वृहत्त पौधा रोपण क्षिप्रा महांकाल वन कार्य योजना बनाकर किसानों के जनसहयोग से पौध रोपण कराया जायें।
8. क्षिप्रा पुर्नप्रवाह अभियान में वर्तमान में किये गये जल संवर्धन कार्य का निरिक्षण कराया जाये ताकि किसानों द्वारा किये गये कार्यों को प्रोत्साहन मिल सकें।
9. क्षिप्रा नदी के प्रवाह क्षेत्र पर बनी सड़कें व बनने वाली सड़कों पर पुलिया को स्टाप डेम में पुलिया के रूप में परिवर्तित किया जायें।
10. नदी क्षेत्र के आसपास किसी भी प्रकार के उद्योग, धंधे व फैक्ट्रीयां लगाने पर पूर्णतः प्रतिबंध लगाया जायें।

C.N. Saxena
16/6/2011

Shri V. K Gupta
FYE (Elect)

क्षिप्रा पुर्नप्रवाह अभियान, उद्गम क्षेत्र
जिला-इन्दौर (म.प्र.)
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a. Group discussion-;Group 3 Environment & pollution control, water quality ,supply and sanitation

- Kanchan singh---conservstion of of water in nallahs also by construiction of series of stopdams .
- Anil Patel—Silt has increased in near old water supply dam for Deaws. Desilting should be done. Public Partcipation sholkd be mobilized like Gayatri parivar work MNREGS shouls take it up.
- R,C. Raghuvanshi---only treated water shuld be allowed tofolw in theriver . Plantation increased .
- Narain singh---Stop dams should constructed .Water should not be Over used for agri.
- Waterr hysinth should be removed from river.
- Kumawat *Poluted Water from Khan should be sent in oxidation pond village jastakhedi.
- AbdulGaffar Patel---- Silt be removed .
- Intesive programme for privater & Public toilets should
- *sewage from small tobe treated in oxidton ponds
- Sharmaji--* Submrsion of Ganesh & Devi Idols should be restricted either by public awreness or administrative steps.
- Jagdish Choudhari ---Kshipra has vanished in 12 km from origin Kampel. Mundla –Sonvay wal Boundary should be marked. Panchayats should demarcate and maintain flow area .
- Lakshmi narain dangi---Waste water naallas should be stopped .
- Vishnu Kamdar—Illegal felling of trees should be curbed .
- Afforestation schemes Should be realistic ,and just not the paper work. P.P. should bepromted Targets shoul d be given to farmers .Expenses should be given after 5 yrs.
- Mumtaz Sheikh---- Claening of Kshipra necessary . poly bags be rstrcted.
- Dhanotia ---Catchmrnt should be fully trapped by deep dug ells.
- Lele--- biodegarable and non degradable wasts shoul separated at the origion.
- Non degradable type should not be allowed tobe dumped near river or nallas.
- Ravindra shukla--- Availablity of pollution free water for livestocks should be ensured .every village pnchat should be made responsible for this . Polution control board should strictly monitor industrial affluents are not flown in river or its tributaris without treatment .

b. PRESS NOTE

A work shop on National plan for climate change for support for the National water mission was conducted on 16 June 2011 in Hotel Sayjaji. In this work shop a task of final report on kshipra sub basin Madhya Prades was discussed in presence of 150 participants mainly representing the sector of major, medium and low holding formers, retired senior officers of various engineering departments and representatives of non government organization (NGO) of 3 Districts, Indore, Dewas and Ujjain.

The function was chaired by honorable Mr Omprakash Parsavadia President Zila panchayat Indore. He was accompanied by Mr A.K. Sojatia retired Engineer in Chief W.R.D. Madhya Pradesh, Mr Ramesh Kumar sitting Chief Engineer C.W.C. New Delhi, Mr Aldrin young from A.D.B. Scotland, Vidisha Samera Shekhara from Shrilanka, Mr J.K. Patni Chief Engineer N.T. Basin, Indore, Mr Kanchan singh President Water User Association Mhow on the dyes.

All the above special guests addressed the audience by explaining the need of re-existence of Kshipra river and bringing the hole environment supporting to the human life as were the situations in the 50 years back. All the speakers present clearly appreciated the job of ADB to be very encouraging and supporting to the needful work for the public of these districts.

After this a power point presentation was presented by Mr Aldrin young showing the stage wise depletion of ground water with respect of climate changes. After this there was tea break. After tea break a work shop was conducted by the participants of 3 groups. Each group contained 50 participants. All 3 groups where given 3 different topics' .

Group 1 Was Given Water Conservation And Storage.
Group 2 Was Given Water Demand And Management.

Group 3 Water Pollution and Environment.

All the above group started their discussion one to one basis and put up so many new parameters which were not covered so far in the history of Kshipra reiver.

This discussion was for a duration of 1 hour. After this lunch was served. After the lunch break all the 3 groups where given opportunity to present their final findings of their group discussion before all the audience present in the work shop. This was done by the team leader/presenter selected by each group in PPT form and presenter replied all interesting questions raised by the audiences and finally they were convinced/replied by the presenter.

In the final movement the Chief engineer of CWC narrated to audience with the outcome of the work shop. Finally Mr Inder Raj Director CWC Delhi paid the vote of thanks to all the audience and guests.

The whole programme was coordinated and conducted by Mr S.S. Gaharwar, Executive Engineer, Water Resources Division, Indore on behalf of ADB/CWC/WRD/Govt. of India.

4. Follow on Discussions Bhopal

5. State Workshop Punjab 21St June

The ADB sponsored State Workshop (Punjab) on NAPCC support to NWM was held at Hotel Park View, sector 24, Chandigarh on 21st June 2011. The Workshop was jointly organized by ADB, MOWR, CWC, GOI and Water Resources Organization, Punjab Irrigation Department, Chandigarh.

The number of participants at Workshop was 130. This included -----Government---- non-government officials. Some farmers from various parts of Sutlej Basin attended the workshop.

The workshop was inaugurated by Shri N.S. Kang (IAS), financial Commissioner, Punjab, Beside the the Chief Guest, Mr Adrian Young Team Leader (ADB), Dr. Vidisha Samarasekhara,Senior Climate Change Specialist(ADB), Shri Harinder Singh, KAD, and Shri Rajesh Kumar, CE, CWC were seated on the dias.

The welcome address on the occasion was delivered by shri. Takshi Director, WRO, irrigation Department of Punjab. Shri. Takshi in his welcome address, gave background of the ABD Project on "National Action Plan on Climate Change (NAPCC) in support for the National Water Mission" . He explained how climate change has effected environment in general and agriculture in particular in Sutlej Basin.

Next Shri Harinder Singh, CE (KAD) delivered his speech. While welcoming the Chief Guest, Shri Singh mentioned that Shri Kang has been the source of inspiration and guiding force in organizing this Workshop. He welcomed all stakeholders and in particular the farmers community attending the Workshop. He mentioned that the Draft Final Report of Lower Sutlej Sub-Basin of Punjab prepared by the ADB Team shall be discussed at the Workshop.

As per programme, the Chief Guest and dignataries on dias were presented with bouquet. The Chief Guest on the occasion lighted the lamp to inaugurate the Workshop.

From ADB side, Dr. Vidisha and Mr. Adrian spoke on the occasion and explained background of Project and the Workshop. Dr. Vidisha spoke about climate change aspect of project and mentioned the ADB team is here to seek views and comments on Draft Report of Sutlej Basin aimed at strengthening various elements of report. She said the Draft Report shall be revised in the light of discussion and views at this workshop and the same shall be presented at All India Workshop on the subject planned to be held at Delhi on 27th June, 2011. Subsequently the final composite report of three sub-basin areas of Cauvery Delta, Kshipra and Sutlej shall be finalized by the ADB team in July 2011. She went on to explain that some potential investment programmes as part of long - term perspective on water, agriculture and environment are being conceived.

Next, Mr. Adrian Young, the ADB Team Leader of the project described to the participants the outcome of the draft report of Lower Sutlej Basin. He explained in brief the impact of climate change on water in Punjab. He also gave account of two other projects being studied by ADB Team each for Kshipra basin in Madhya Pradesh and Cauvery delta in Tamil Nadu. The Team Leader explained problems and issues facing the Sutlej basin. He added that India has examples of well developed farming system which is now faced with critical problem of sustainability and thus the team is now working on how to keep the system sustainable. The Team Leader explained the analysis of climate

change variables made for the basin. He said that the analysis and predictions are robust as far as temperature is concerned and added to say that the predictions for climate change variables for upper part of catchment are not comprehensive yet in view of gaps in our knowledge and information on hydrometry and glaciological studies of the upper catchment.

More research into definition of climate change variables, complexity of snow and glaciers would be needed. However, there is good reliability of data and information to take forward the recommendation contained in the report in respect of lower part of Sutlej Basin. He told that there is need to reduce ground water abstraction and to support recharge measures. He further went on to explain that financial sustainability of farming system is critical element and that the farmers need to stand on their own to adjust to changing environment. He made a mention of the need to take up conjunctive use programme for optimal development of surface and ground water in combination. He also described the outcome of WEAP Model as an experimental model constructed by consultants for Joga distributory whereby it was explained that water saving could occur if a conjunctive management of both surface and ground water is planned.

Further in his presentation the ADB Team Leader described to the participants the various elements of Framework Plan, the road map for attaining agricultural sustainability possible areas of investment being considered and the institutional strengthening of existing organizational set up in the state for efficient implementation of recommended programme in the basin leading to the development of coping capacities for combating impacts of climate change.

Following the presentation Mr. Adrian Young, Shri Rajesh Kumar CE, CWC gave his speech on the occasion. He mentioned about eight missions of Government of India and the National Water Mission as one amongst these eight missions. He explained the hydrological and glacial aspects of basin including problems of agricultural and industrial pollution which would also need to be surmounted.
The comperer at the Workshop, Shri Takshi, Director, WRO, Punjab gave background of Chief Guest and requested him to deliver the inaugural address.

Shri Kang in his address spoke about National Water Mission and eight other missions launched by Government of India and explained that Government of India has asked the ADB assistance to carry out studies and prepare National Action Plan for Climate Change in three select sub-basin of Cauvery delta, where sea level will rise in time, the Kshipra basin in Madhya Pradesh where ground water level depletion will be further impacted by climate change. Shri Kang highlighted the actions taken by the state in combating the diminishing water resources In state as follows:

- The Punjab state has legislated and made mandatory provision for delayed planting of rice which have visible impact.
- Have initiated RCTs on 52% area and the technique and methods of water conservation have been accepted by farmers' communities
- Stressed the need to reduce area under paddy cultivation and that the area under cotton has already been increased as a part of crop diversification
- That the pulses are gradually being mainstreamed and the prices are increasing to the benefit of farmers

In his concluding remarks , the Chief Guest urged to mention that the workshop would provide input in the form of suggestions which will enable ADB Consultants further sharpen acceptable and palatable recommendation of Draft Final Report of Lower Sutley Basin.

The inaugural session ended with vote of thanks which was delivered by Shri Takshi, CE, WRO, Punjab.

After a sort break the Technical Session. was held. In the technical session Mr. Adrian Young the ADB Team Leader made presentation to explain salient features & outcome of the draft report of lLower Sutlej basin. The presentation devoted in detail to the issues, the frame mark plan proposed and its objectives .He went is to explaining the need to develop improved agriculture production and marketing system. The presentation highlighted and illustrated the possible areas of investment such as (i) improved agricultural production and marketing system (ii) up-scaling of RCTs, (iii) water resources conservation and catchment management as well as (iv) institutional regulator and support measures. At the end Mr. Adrian Young described the road map leading to establishing a lower Sutlej

basin sutainability and management programme to address ongoing and potential climate issues. An eight years programme was described to be implemented through new IWRM framework.

Subsequently on demand fom audience the presentation made by Mr. Adrian Young was translated in local language by Dr. S.K. Sharma Consultant (ADB). He was supported .by Shri. Takshi in conyeing contents and the outcome of consultants draft report of lower Sutlej basin to the participants.

The next session denoted itself to discussionds & clarifications on presentation made by ADB on the outcome of its findings given in the draft report. The discussion broadly focused on the issue of crop diversification & MSP system. The views expressed by group of farmers to the workshop have been noted by consultants team for suitable incorporation in final report as may be necessary .

After lunch the group discussions were held on following 3 topics:

- Group I :- Topic : Improved Agricultural Production and Marketing Systems.
- Group II :- Topic : Upscaling of Resources Conservation Technology .
- Group III :- Topic : Water Resources Conservation and Management.

The participants grouped themselves according to their choice for topics of interest and held detailed discussion . The discussions were facilitated by ADB Consultant s.
The last session devoted to making presentation of suggestions made by the above mentioned groups. The group leaders made power-.point presentation of suggestions. The group wise suggestions that emerged at the workshop are placed at annexure-A
The workshop ended with vote of thanks given by Shri. Takshi Director, WRO Punjab.

Punjab Workshop- Group discussions and suggestions

Group-1: Improved Agricultural Production And Marketing Systems

- To fix a specified formula to fix the minimum support price.
- Presently agriculture comes under unskilled labour , it should be changed to skilled work.
- Land rent should be 1% of the actual cost of the land.
- M.S.P to be on all commodities.
- The M.S.P should be decided by the agricultural cost and price commission (ACPC) and the ACPC should be constituted from among agricultural scientist and civil society member.
- M.S.P should be according to the costs i.e.Input costs.
    - Labour as skilled workers.
    - Actual land rent.
    - Profit @ 50%.
- The benefits denied by central govt. should be given by state govt. like compensation for support price.
- Surface water network to be improved and intensified.
- Network of technical govt. institutions for technical guidance is very weak. It should be strengthened; presently farmers are dependent on traders for guidance and are consequently exploited by the traders.
- Loan advance procedures should be simplified.
- There should be slabs of interest charged from the farmers in accordance with their land holding i.e.

    - <5 acre 1% simple interest.
    - 5-10 acres 2% simple interest.
    - 10-15 acres 3% simple interest
    - More than 15 acres 4% simple interest

- Easy loans for any purpose should be available to the farmers according to the value of their land i.e. determined by the land evaluation officer of the Govt. and 10% loan of total value should be easily available.
- Agriculture should be done by people/owner lead co-op. societies. Fifty percent of budget of co-op system should be borne by the Govt.

- Co-operative societies at all levels i.e. villages, blocks and district levels should be financed by the govt. and strengthen more for diversification and marketing.
- The commission agents culture to be abolished and procurement and payment should be the responsibility of the govt. agencies.
- Moisture content of the grains should not be at a fixed value and should be decided b y the agricultural experts on the basis of prevailing weather conditions.

Group-2: Upscaling Resource Conservation Technologies

- Up scaling of RCTs:
- Tensiometer, Laser Leveling, Direct Seeding, Drip/Sprinkler
- Involve farmers' organizations such as Cooperative Societies as an interface.
- Generate Awareness campaigns (including trainings) on
  -Existing RCTs
  -Their economic & non-economic benefits & Env.
- Promote Technologies in a package
  -Combine with other services
  -such as weather info
  -Mkt Price Information
- Drip Irrigation: Micro Irrigation Is Under Promotion But Lack Of Training
  - -Multching
  - -Automation in irrigation
  - -Less salt Accumulation
  - -30% water requirement
  - -Energy saving

- Canal Automation
- Monitoring
- Awareness of Techniques
- Crop Water Requirements (Micro Irrigation)
- Accountability of Implementation
- S R I
- System of Rice Intensification

Group 3: Upscaling Resource Conservation Technologies

- Canals Should Full All The Year to support recharge
- Proper Management of Canals & correlate with cropping pattern.
- Canal should run demand based.
- Water Audit at Regional Level
- Controlled pipe supply.
- Restoration of wet lands & maintenance –min. 1% area under Water Land.
- Compensation for sett aside scheme (30% area)
- Paddy near canals & other crops away.
- Tube wells near Out lets should be used for artificial recharge.
- Pond revival & separate ponds for sewage (treatment needed)
- Subsidy for small & medium farmers (upto 4 Hec. Land) only.
- Proper Planting required .-area wise.
- Increase forest cover.
- Urban Area – Ban on bores-Govt. ensure water supply.
- Industry- Recycle & Reuse.

6. Follow on Discussions Chandigarh 22 June

A meeting was held with PS Science and Technology

7. Central Workshop Delhi 27th June 2011

The National Workshop to discuss Draft Final Report was held at the Ambassador Hotel, Sujan Singh Park, Subramania Bhati Marg, New Delhi on 27th June.

The draft final report was reviewed and discussed at a national workshop in New Delhi on 27 June 2011. The workshop, convened by the Central Water Commission (CWC) and the Ministry of Water Resources (MOWR), was inaugurated by Mr Vincent Pala, Minister of State for Water Resources, and was attended by close to 100 stakeholders from government, academic and civil society sectors.

The national workshop was the culmination of a series of state level workshops held in Triruchirapalli, Tamil Nadu (June 13), Indore, Madhya Pradesh (June 15) and Chandigarh, Punjab (June 21). At each workshop, state and district level officials were joined by dozens of farmers, fishermen, researchers and local activists who reviewed draft findings. They also contributed to shaping recommendations that reflect ground level realities.

Inaugural session

The inaugural session had opening remarks and speeches by high level representatives from the Ministry of Water Resources, Central Water Commission, Asian Development Bank and the consultant team.

Hun Kim, Country Director, ADB India Resident Mission welcome address:

- ADB is heartened to note the very proactive manner in which the Government of India is addressing the Water Sector Management Process to develop and manage its water resources with an overall aim of delivering efficient and quality water services to all users.

- The ADB technical assistance team has studied the issues and opportunities for water resources management in the face of a changing climate and the longer-term objectives of improving water resource management for economic growth, livelihood enhancement, poverty reduction, improved environment and public health. To accomplish this in water-scarce river basins, the study strongly recommends adopting integrated water resources management (IWRM) principles and approaches.
- The study builds on the findings of the National Water Mission of the NAPCC and presents proposals for the operationalisation of the National Water Mission including the incorporation of some refinement and additions from the study.

- The strategic framework for climate change adaptation that has been developed as part of this Technical Assistance draws on technical studies and a consultative process in the three participating state governments and a number of national level institutions.

- To implement this framework, ADB is proposing a multi-pronged programme of action addressing critical aspects such as sustainable agriculture and water conservation, water quality management, domestic water supply and sanitation. It takes into consideration new technologies, skills, funds and institutional arrangements.

R C Jha, Member (River Management), Central Water Commission

- India's water sector is under multiple stresses today. In spite of having several thousand medium and large dams in India, the country's live storage capacity is not adequate.

- Careful planning and investment are needed to meet the increasing water requirements between now and 2050 when the total population would reach between 1.6 and 1.7 billion.
- Climate change is adding to the complexity of existing challenges, but it can also be seen as a blessing in disguise. It adds a new sense of urgency to address sector-wide issues through the National Water Mission.
- CWC is appreciative of ADB assistance for preparing framework action plan for NWM. Three river basins studied under ADB technical assistance reflect different water realities in India.
- Based on the study recommendations, India will now have to develop its own Integrated Water Resources Management practices.

A K Bajaj, Chairman, Central Water Commission

- India's water stresses and disparities are well known. Its ranking is already low in the global statistics comparing countries of the world for water availability.
- Climate change would complicate the formidable existing challenges of managing India's water resources.
- India needs better research, improved assessments and more scenario building to understand and adapt to climate change impacts in the water sector. In short, sound application of science and technology is the way forward.
- The size, diversity and complexity of India requires a sub-basin approach to addressing integrated water resources management.
- The national water policy is being reviewed and revised through a consultative process to meet the new challenges.

Adrian Young, ADB Team Leader, Made a presentation summarising the study process, findings and recommendations.

Vincent Pala, Minister of State for Water Resources,
India's water resource management challenges can be seen at its most basic level as involving the balancing of supply and demand. While water supply remains at the same level, or is declining in some areas, the demand is increasing.

- The government takes serious note of climate change impacts, and in 2008 launched the National Action Plan for Climate Change (NAPCC). Under this, the Ministry of Water Resources is responsible for operationalising strategies for adaptation in the water sector.
- The National Water Mission aims at the "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within states through integrated water resources development and management".
- The water sector has a large number of stakeholders including many ministries, departments and state agencies. For NWM's success, it is necessary for these multiple stakeholders to coordinate better and work more collaboratively.
- There has been a wide consultative process for NWM to ensure integrated water resources management.
- NWM seeks to develop a new regulatory structure that can better meet the current and emerging challenges.
- There is a need for more equitable distribution and sharing of water both within and across states. The government is committed to increasing water use efficiency by a minimum of 20 per cent by 2017.
- The government is pleased that ADB has come forward to support NWM.

- Renowned scientist Professor M S Swaminathan, in a special video message to the workshop, said:

- It is clear that water security is going to be an important casualty of climate change in the future. I hope the study, and the action plan which will be based on the studies, will help India to strengthen its water security.
- The National Action Plan for Climate Change looks at the point of water security in its totality -- looking at aspects of enhancing water availability. Those steps which can ensure a demand management apart from supply augmentation.

- It is very important that we manage the demand by improving the efficiency of use of water -- whether it is for domestic purpose, or for industrial purposes where recycling must be compulsory, or for agriculture purposes where we should aim to get more income and food per drop of water.
- So the National Water Mission, which is a very important part of the National Action Plan for adaptation to climate change, is a very important mission in the country affecting the lives and livelihoods of nearly everyone -- every child, woman and man not only for today, but for tomorrow.
- This study provides deep insights on how to manage the water resources carefully. Management means conservation, sustainable use and equitable sharing of benefits. All these three components of management will be important in the future even more than today.

Technical Session

This session comprised the following presentations:

1. The impact of climate change on a glaciated basin: Case study of Beas Basin, by Dr Sanjay Jain, Scientist E, National Institute of Hydrology (NIH), Roorkee

2. Integrating Climate Change Considerations in the Water Resources Planning using WEAP: Examples from California, Peru and India, by Dr David Purkey, Stockholm Environment Institute

3. Overview of the study findings and recommendations, by Adrian Young, ADB Consultant Team Leader

Dr Sanjay Jain, Scientist E, National Institute of Hydrology (NIH), Roorkee:

He presented the findings of a study whose objectives were:

- To Create Spatial Data (Consisting of Snow Cover Area and DEM) and Meteorological/Hydrological Data Base for The Study Area.
- To Estimate Snow Cover Area and its Temporal Variation Using Remote Sensing Data.
- To Estimate Snow Melt Runoff in Beas River at Pandoh Dam.
- To Study Trend of Precipitation, Temperature and Stream Flow in Beas Basin Using Parametric and Non Parametric Approaches, and
- To Investigate the Impact of Likely Future Changes in Climate on Stream Flow in the Study Area Using GCM/RCM Based Scenarios.

The main findings were as follows:

- It is observed that stream flow is more sensitive to temperature change rather than precipitation change.
- Stream flow and snowmelt runoff increases with the application of different future scenarios with respect to reference scenario.
- It has been observed that for 1°C and 2°C increase in temperature the mean annual stream flow increases about 9% and 8.69% respectively.
- Maximum % increase in mean annual stream flow is 12.12% for T+2°C, P+10% Minimum % increase in mean annual stream flow is 0.37% for T+1°C, P-10%

Dr David Purkey, Stockholm Environment Institute

Dr Purkey presented highlights of developing and applying the Water Evaluation and Planning (WEAP) system by SEI. These experiences were drawn from the state of California, USA; the Rio Santa watershed basin in the Amazon region in Latin America; and the Ganges River basin in India. His concluding thoughts were:

- The steps required to effectively integrate climate change considerations into water planning are not yet fully defined, we are learning.
- WEAP can be a very helpful tool to explore how climate change might impact water management and to evaluate possible adaptation strategies.

- On of the most interesting parts of the work is thinking about how tools like WEAP can fit within formal decision support frameworks.

Adrian Young ADB Consultant
The strategic framework draws on studies carried out by a team of Indian and international experts since September 2010, who looked at both the regional climate projections by the UN climate panel (IPCC) and various national level climate related data. The study process took into account the best available climate projections, and consulted widely with officials, farmers and many others.

Detailed analyses were conducted in three sub-basins: the Sutlej sub-basin in Punjab, Kshipra sub-basin in Madhya Pradesh and the lower Cauvery Delta in Tamil Nadu. The three different sub-basins were chosen to represent different types and levels of sensitivity to climate change:

- In Sutlej sub-basin, the study looked at changes of winter snow-pack dynamics and how it affects a river basin that largely draws its water from snow melt.
- In Kshipra sub-basin, focus was on groundwater as the main supply of water for agriculture and domestic use.
- The potential climate impacts on low-lying coastal areas -- where sea level rise will have affect both surface and groundwater -- was studied at the lower Cauvery Delta.

The Technical Assistance Team worked with state and national level officials conducting numerical simulations studies, preparing sub-basin profiles, reviewing current initiatives and preparing water resource plans and strategic framework planning to meet the needs of climate adaptation. These studies were complemented by a large number of consultations with water related stakeholders at national, state, district and grassroots levels.

There is a clear need for conceptual clarity and taking the 'bigger picture' view.
Defining irrigation water use efficiency is important. Efficiency will be defined very differently by the farmer, irrigation manager and a river basin authority.

The framework is based on integrated water resources management, which takes a holistic look at water resources as an integral component of the ecosystem. It treats water both as a natural resource and a social and economic good.

The draft recommendations place heavy emphasis on more efficient use of both surface water and groundwater. Considerable gains could be made through better coordination and by adopting more water-thrifty crop patterns. The study also advocates Conjunctive Water Management -- where the use of surface water and groundwater resources is well coordinated, so that together they produce better results than either could on its own.

To implement this framework, ADB is proposing a multi-pronged programme of action. It covers critical aspects such as sustainable agriculture, water conservation, water pollution, domestic water supply and sanitation. The solutions involve a mix of new technologies, skills, funds and institutional arrangements. The national level programme is intended for five years; for the three participating states for eight years.

The presentations were followed by discussion.

Group Work session

During this session, participants divided into three groups which worked simultaneously on specific tasks assigned to each group.. The tasks set for the groups were as follows:

Group I: How to Incorporate Climate Change Impact into Water Resource Adaptation Planning?
The report presents a number of recommendations towards incorporating climate change including:

- strengthen and coordination of India's climate change capacities; IITM, CWC and State WRDs to work together (page 15 point 3)

- incorporation of climate change into planning is referred to in various parts of the report (page 15 point 4) and the need for specialist inputs into the planning (page 15 point 5)
- the specific vulnerabilities and proposed adaptation planning in the sub-basins should be referred to; Sutlej (page 53) , Kshipra (page 81), and Cauvery (page 124)

TASK: The group should review these proposals and make comment and additional suggestions to best incorporate climate change into water resources. A key issue is that climate projections will never be perfect, so the challenge is how to plan under uncertainty.

Group II: How Do The Centre and States Jointly Develop Mechanisms for Integrated Water Resources Management (IWRM)?
The report and the National Water Mission propose Integrated Water Resources Management (IWRM) to address climate change and adaptation measures. The report presents proposals for IWRM including presentation of planning process for climate change adaptation (page 11), sub-basin strategic planning (page 13) and a template for IWRM. It is proposed that sub-basin plans should be integrated into River Basin Plans (page 20).

TASK: The group should review the proposals and comment on the viabilities and possible areas to further strengthen the institutional mechanisms for IWRM. The importance of conjunctive management groundwater and surface water requires some institutional mechanisms at the village level; bear in mind that there are no water user associations (WUA) in many of the groundwater areas.

The group should also review various proposals and prepare suggestions to the best institutional arrangements to develop IWRM and develop participative planning at the different levels.

Group III: How to Incorporate Conjunctive Water Use Strategies for Increased Water Use Efficiency?
The studies in the three sub-basins show the key role of groundwater to support climate variabilities and adaptation: Sutlej page 56 para 147 (i); Kshipra page 88 para 282 (i); and Cauvery page 130 para 464 (ii).

A short modelling exercise using a water balance model was carried out in the Sutlej (page 41) which shows the key need to incorporate conjunctive use efficiencies and the critical role of agriculture including: the needs to address evaporative losses through shorter duration crop varieties, and the use of agricultural technologies such as mulching, directed seeded rice, etc. A proposal of how to address water use efficiencies incorporating conjunctive use is presented in page 25.

TASK: The group should review the findings in the report and identify workable strategies to incorporate conjunctive water use strategies into water use efficiency assessments and sub-basin planning.

Concluding Session
The three groups presented their work to plenary. These notes are based on their PowerPoint presentations:
Group I: How to Incorporate Climate Change Impact into Water Resource Adaptation Planning?

- The concern is not limited to planning of new projects, but also includes operation of existing projects.
- The inputs required can not be limited to a few agencies, such as IITM, and CWC. Also, it is necessary to make the decision making multi-disciplinary. A central agency should lead a group of agencies from Centre, State, Civil Society, Academic Institutions, . . . To make recommendations that should be uniformly applicable to all the agro climatic regions states in that basin.
- A number of GCM/ RCM/ Local models are available. The results of all of these may be studied to find the general commonalities, which can be used in the decision making.
- The main challenge is to take these discussions out of the seminar hall and bring them into decision making. To start with, the conglomerate suggested above may make ad-hoc recommendations, (like plan barrages for X years design flood instead of 100 years, where X is > 100), to be refined as we gain more experience.

- Incorporating impacts of climate change in planning is all about making decision under highly uncertain conditions. The decision science, which is part of Operation Research Techniques, may be used in assisting such decisions under uncertainty.

Group II: How Do The Centre and States Jointly Develop Mechanisms for Integrated Water Resources Management (IWRM)?

- All stakeholders have a role to play and shall be included.
- MoWR shall play a nodal role on all the water related issues at the national level co-ordinating all the connected Ministries/Departments. For this, MoWR may be empowered with all powers including constitutional/legal backup.
- The process to bring water under concurrent list shall be initiated without any further delay.
- Development of participatory data information system at every level needs to be done.
- Basin level approach as envisaged in national water policy for water resources assessment, planning, development, management and monitoring is very much essential.
- Under IWRDM set up for state, health and energy dept. Needs to be added.
- WALMI/Academic institutions shall be added in the state IWRDM setup.
- RBO as a highest body with a RBO Secretariat to assist as given in the ADB report is recommended.
- Pilot RBO for intra-state river may be implemented initially.

Group III: How to Incorporate Conjunctive Water Use Strategies for Increased Water Use Efficiency?

- Efficiency improvements should be considered at three levels- farmers field, scheme level and at basin level
- Lining of conveyance network should be based on factors like excessive seepages, water logging and salinity, water availability to tail end farmers and not necessarily for saving of water
- Capacity development/awareness programme through technical trips
- Documentation of available best practices in WM and their dissemination
- Water budgeting/auditing/benchmarking
- Fragmented lands are the hindrance for adopting scientific WM practices
- Best practices of groundwater management need to be followed, e.g. AP groundwater management by community (FAO Project)
- Artificial recharge to augment GW recharge in a big way to conserve rainfall
- Regulation of electricity- no free power, it should be charged, use of IT like use of smart cards (e.g. Bangladesh, China). Best practice – like Gujarat Jyothirgram scheme

Verbatim text of video message sent by Professor M S Swaminathan played at the Final National Workshop in New Delhi, 27 June 2011

The Asian development Bank needs our both congratulations and gratitude for sponsoring a very important study connected with water security of India. It is clear that water security is going to be an important casualty of climate change in the future. It is likely that we will face more serious droughts. The higher mean temperature will increase evaporation losses, and evermore, the need to produce more and more food from less and less land – per capita land availability is shrinking – water security is fundamental to not only to food security and livelihood security and health security and above all, the whole field of human health, human well-being. All of them will be important.

We need water for domestic purposes, for agriculture which almost consumes 70 to 80 per cent of the water in different parts of India, and for industrial uses. The National Action Plan looks at the point of water security in its totality -- looking at aspects of enhancing water availability. Those steps which can ensure a demand management apart from supply augmentation. It is very important that we manage the demand by improving the efficiency of use of water -- whether it is for domestic purpose, or for industrial purposes where recycling must be compulsory, or for agriculture purposes where we should aim to get more income and food per drop of water.

So the demand management, supply augmentation by all methods of rainwater harvesting, and mobilising all the water sources – whether it is river water, whether it is groundwater or whether it is rainwater, and also water coming from melting of snows, and finally, sea water. India has a long shoreline and many islands belonging to the Andaman and Nicobar group of islands, the

Lakshadweep group of islands. Therefore, seawater -- which constitutes 97 per cent of the world's water supply -- also receives more attention.

So the National Water Mission, which is a very important part of the National Action Plan for adaptation to climate change, is a very important mission in the country affecting the lives and livelihoods of nearly everyone -- every child, woman and man not only for today, but for tomorrow.

I am happy that this particular study, promoted by the Asian Development Bank, has taken very important basins. For example, the whole of coastal zone, there is the Chambal Basin, Sutlej Basin. These are important river basins. And, in fact, the National Water Policy of the Government of India calls for a basin approach – a water basin approach – to manage water. And I am glad that the study has taken it, including the coastal zone because nearly 25 per cent of India's population lives within 40 kilometres from the shoreline. And hence their own future – both in terms of occupation and income, and also management of future calamities including more frequent tsunamis and coastal storms – they are important. This is where the mangrove bio-shield becomes a very important aspect of coastal defences against storms and tsunamis.

I do hope this particular study which has been undertaken will provide with deep insights on how to manage the water resources carefully. Management means conservation, sustainable use and equitable sharing of benefits. All these three components of management will be important in the future even more than today. And how do we harness our water resources and utilise them in an effective and equitable manner will be one of the outcomes of this National Water Mission?

And I hope the study, and the action plan which will be based on the studies, will help us to strengthen our water security system.

III. SUMMARY OF MEETINGS WITH CLIMATE CHANGE RESEARCH INSTITUTES

A. Background

To assess the current status of climate change research in India a series of meetings were held with the main researchers and key climate change institutes in India. The meetinsg were attended by the consultants international climate change specialist and other specialists at some of the meetings.

B. Meeting Summary

1. 11th November 2010 Meeting with TERI HQ Delhi

Participants: Dr Arabinda Mishra (CC team leader), Ashok Jaitly (director water resources), Dr Vidyunmala Veldore (modeller), 2 further TERI staff (Dr K Sreelakshmi (water), Dr Shresth Tayal (glaciers); AY, RW, IR, BE

Objective(s): Overview of CC modelling & adaptation projects done at TERI, information exchange, particular on High-Noon, CC Maharashtra, State Adaptation Action Plans

Details:

The team leader Adrian Young presented overview of TA 7417 project; TERI staff talked in some details about CC Maharashtra project, downscaling (with PRECIS, to 25km res) is done for a 17-member ensemble (prob QUMP), using A1B scenario for 2030, 2050 and 2080. This part is happening at UK Met Office. Then TERI will analyse the data, in particular exploring extremes in model output, which will feed into vulnerability analysis.

Some discussion on best-practice how to merge data upwards from state level, if modelling is done differently between states then continuity & coherence are doubtful. A "best approach" should be suggested by ADB team where it relates to water issues. It was also observed that states currently don't have the capacity for storage of data.

There are now "climate cells" at state level (needs to be established if all / most / some) and Gujarat has a Dept for CC.

TERI staff also talked about some India-wide study to cost CC adaptation measures – they arrived at a cost of USD 1 billion per year (this is significantly less than findings from other studies, e.g. by Worldbank). However, most of focus is on demand site options, if storage options (for water) are included, cost would be higher.

The meeting concluded on some technical topics, including project to observe glaciers with isotope studies (which can distinguish between different melt sources – snow or ice). They also classified Himalayan glaciers according to 9 micro-climatic settings (more details once results have been presented at AGU in Dec 2010). TERI and ADPC are hoping to get funding for a downscaling project over Nepal.

TERI also doing SWAT modelling for number of regions; they are running their own PRECIS model; using hydrodynamic code (grid-based) to look at coastal issues (in connection with sea level rise), this could be useful for Cauvery delta (part of ADB study). Follow-up: Teams will keep each other in the loop on the projects discussed.

Update (17 Feb 2011): Ashok Jaitly invited ADB team to participate at TERI's India Water Forum, 13-15 April 2011

Resources given: Book: "*Costing Adaptation*", Leaflet: *TERI Regional Knowledge Hub*

2. Date: 12 Nov 2010 Location: Centre for Atmospheric Sciences (CAS), IIT Delhi

Participants: Prof Sushil Kumar Dash (Head); BE

Objective(s): Discussion about climate-relevant research at CAS; information exchange

Details: Professor Dash is using IMD gridded observational (obs) data (temperature and precipitation) to produce maps of extremes, recently presented at a WCRP-UNESCO workshop on extremes in Paris.

He is involved / associated in the CORDEX (**CO**ordinated **R**egional climate **D**ownscaling **EX**periment) project, using RegCM3, a regional climate model from ICTP (Abdus Salam **I**nternational **C**entre for **T**heoretical **P**hysics, Trieste, Italy). Encouraging that several RCMs are in use, apart from PRECIS, RegCM and REMO.

He mentioned another project which is starting up and looking at climate impacts at the regional scale – ICLEI (International Council for Local Environmental Initiatives / Climate Resilient Cities) – four Indian cities will be investigated, it may be worth making them aware of the ADB project so they can integrate findings.

Finally he mentioned that INCCA (Indian Network on Climate Change Assessment) has a meeting in Delhi on Tue, 16 Nov (MoEF organiser: Subodh Sharma). One ADB team member, Prof Gosain attended.

Follow-up: Have sent the inception report for TA 7417, possible future collaboration; he sent 3 of his papers on climate extremes relevant to India.

Update (07 Feb 2011): Sent factsheet ADB TA 7417, he will send a new paper in a month's time.

Resources:

- URL http://www.extremeworkshop.org/
- URL http://wcrp.ipsl.jussieu.fr/RCD_CORDEX.html
- URLhttp://www.iclei-europe.org/ (details not yet uploaded)
  URL http://www.iclei.org/index.php?id=1020 (for South Asia project team)
- URL http://users.ictp.it/~pubregcm/RegCM3/

3. Date: 19 Nov 2010 Location: ESCI Campus, Hyderabad

Participants: Shalini Sharma (Head, Centre for CC), Arvind Poothia (Director General), G.D. Ojha (Head, Water Resources Development Division)

Objective(s): To discuss research & teaching activities carried out at ESCI

Details: Bernd Eggen presented on the ESCI course ("Climate Modelling Programme") – both the outline of TA 7417 and a module on regional climate models. Shalini Sharma has good track record of organising & running courses relevant to climate change and water issues - ESCI are established in capacity building, R&D and consultancy (28 yrs), they train approx. 6000 professionals annually, meet many people every year and keep themselves updated about subject requirements. ESCI are offering advanced training programmes, and they claim "*one may not find any other Institute in India doing capacity building on such climate change related areas*". Shalini Sharma is also a DAAD fellow (DAAD - German Academic Exchange Service), which is quite a prestigious position.

ESCI is already associated with Solar Mission and Strategic Knowledge Dissemination under National Action Plan for Climate Change. They would like to be able to associate with ADB TAs to work together and contribute to ADB's aims. While strong on training & capacity building, research activities are less prominent.

Afternoon meeting with Arvind Poothia (director), exploring areas where there could be common ground, they may be a good partner for training module; they already ran "Climate Change and Water Use and Management -Water Mission in National Action Plan for Climate Change (NAPCC)" 16-18 June 2010. He also introduced BE to G.D. Ojha, who has good connections to groundwater departments in Bhopal and works on the WB's Hydrology project. He also investigates construction / inventory of recharge structures.

ESCI collaborating e.g. with GTZ, running joint workshops.

Follow-up: Keeping each other in the loop, exploring possibility, when appropriate, whether to involve ESCI in rolling out of training & capacity building (left very tentative for now).

Update (10 Feb 2011): Sent factsheet ADB TA 7417, she is organising "International Conclave on Climate Change", Hyderabad, 12-14 Oct 2011 – would like support from ADB

Resources: Centre for Climate Change – URL http://www.escihyd.org/centerforclimetchainges.php

4. 21 Nov 2010 Location: Centre for Climate Change and Adaptation Research (CCC&AR), Anna University Campus, Chennai

Participants: Dr. A. Ramachandran (CCC&AR – Director), Dr. N.K. Ambujam (Centre for Water Resources – Director), Prof. R. Ramesh (Institute for Ocean Management – Director); many from ADB team and local officials

Objective(s): Information Exchange

Details: Director explained that CCC&AR first such institute for this kind of research in India, with an emphasis to bring solutions down to "kataster" level (small land parcels).

He mentioned some hydrodynamical studies which were done (on Cauvery delta) in the 70s & 80s, more recently mapping of mangroves and ecosystem studies carried out.

He mentioned involvement in the state action plan, and this is supported by external evidence: "*A detailed study on the impact of climate change in Tamil Nadu which will throw light on remedial measures to combat this issue has been taken up by the Centre for Climate Change and Adaptation Research, Anna University, Chennai.*" (from a TN state governmental site).

CCC&AR is planning to acquire their own SGI supercomputer and develop their in-house climate model, according to the director. Apparently there is some collaboration with UK Met Office Hadley Centre.

They are also working a lot with GTZ (German organisation - German Society for Technical Cooperation), on a state-wide study, ready by mid 2011. CCC&AR is involved in the water mission relevant parts.

He also mentioned a project with the DHAN foundation (Development of Humane Action), which is a study on the Cauvery river and looks at the CCA by farmers. So far the DHAN web site lacks further information – maybe the project is too new.

He was keen for ADB to get involved / support CCC&AR in a whole basin study for the Cauvery or even bigger project.

Prof. Ramesh explained about the on-going effort to map the elevation and regional SLR for the whole of the Indian coastline, this is part of a new survey of India.

Meeting with the research students, and Malini Ponnusamy, who had organised the visit from Anna University's site, was cut short due to time constraints.

Follow-up:

- Sharing of results, especially of enhanced zonal mapping and GIS relevant data sets
- Getting further details on all the projects mentioned / clarification on status of relevant projects.

Update (09 Feb 2011): Email exchange regarding State Action Plan for Climate Change Tamil Nadu (which Malini Ponnusamy and colleagues are involved with), and on some other climate impact issues. BE kept asking about the above follow-up, so far no information provided.

Resources:

- URL http://www.annauniv.edu/CCAR/ (and links from this site)
- URL http://www.annauniv.edu/iom/staff_profile/Director.html (list of research projects, publications etc)
- URL http://www.annauniv.edu/WaterResource/index.php

5. Date: 22 Nov 2010 Location: IIT Chennai

Participants: Prof B. S. Murty, Prof K Srinivasan, Prof Balaji Narasimhan + whole project team

Objective(s): Fact finding on current research – mainly computational hydraulics, saltwater intrusion and stochastically analysing flood frequencies

6. Date: 25 Nov 2010 Central Water & Power Research Station (CWPRS), Pune

Participants: M D Kudale (joint director), RW, BE, Idris Poonawala (guide in Pune & former employee at CWPRS)

Objective(s): Finding out if CWPRS is doing research relevant to ADB project

Details: Extensive campus with impressive physical models based in hangars, delegation looked at one such model in particular, representing Mumbai and harbour areas. Apart from flooding, flood zone mapping and sea level rise, they are also investigating sedimentation issues. The amount of research going on was impressive (though climate change issues rather tangential.

Follow-up: Keep CWPRS in the loop

Resources:URL http://www.cwprs.gov.in/

7. 25 Nov 2010 : IMD, Pune

Participants: Dr Mazumdar, Dr Sivananda Pai, RW, BE, Idris Poonawala

Objective(s): Information exchange and establishing better contacts for obtaining IMD data.

Details: IMD mainly concerned with long-range weather forecasting (i.e. seasonal forecasting). The IMD gridded data has been used in some 300 papers, delegation was given a key paper which shows that while over India there is so far no trend in Monsoon rainfall, there are statistically significant trends in some states for either more or less rainfall. So far dynamical models don't have good forecast skills, hence statistical forecast methods have been used. Promising new approach is to take SST in Indian Ocean into account at higher spatial / temporal variation.

Imminent release of report "Climate Profile of India", available now at URL http://www.imd.gov.in/doc/climate_profile.pdf (some 130 pp).

Update (02 Feb 2011): Contact to IMD Chennai branch regarding "Indian Northeast Monsoon - Recent Advances and Evolving Concepts" event on 24-25 Feb 2011. Received reply on 24 Feb 2011 to re-contact in a few days to get presentations etc. Now received

Follow-up: Exchange of information and data was discussed.

Resources:

- IMD (general) – URL http://www.imd.gov.in/
- INEMREC – 2011, see URL http://www.imdchennai.gov.in/nem.pdf
- URL http://www.imdchennai.gov.in/inemrec.htm

8. 25 Nov 2010 : IITM, Pune

Participants: Krishna Kumar (modelling team leader), J. Sanjay (modeller, BE knows him from Met Office), 3 further senior colleagues of the team; BE, RW, Idris Poonawala

Objective(s): Information exchange, learning more about modelling & other research efforts at IITM, possibility of data sharing

Details: Introduction of ADB project, then learning a lot about the modelling efforts at IITM, including downscaling of QUMP, CMIP5 and decadal projections, using a variety of RCMs. Unfortunately for NATCOM only one of the QUMP results was taken forward, despite IITM requesting all 3 should be used (to give a better idea of uncertainties).

For Indian monsoon, best estimates are for 10% increase in total, and also an increase in variability by some 10%. Cyclones in Bay of Bengal also becoming 10% more intense, while not much change in frequency and location (this is quite different from projections in the Atlantic basin, where frequency is projected to decrease, which intensity of strongest storm also to increase).

When converting station data to grid, Krishna Kumar reckons up to 80% loss of observed point intensities through extrapolation onto grid.

Discussion of shortcomings in the current generation of climate models, a cold bias of 3-4 degC is being found, especially in rapid changing orography situations (relevant to Sutlej basin).

MJO (Madden-Julian Oscillation) is also not described well, owing to limited model resolution. MJO is the largest element of the intraseasonal variability in the tropical atmosphere. It is a travelling pattern, a large-scale coupling between atmospheric circulation and tropical deep convection, giving rise to anomalous rainfall events.

He then introduced delegation to Dr Rao's group (including Dr C Gnanaseelan), which works on seasonal monsoon forecasting. New approached with higher resolution dynamical models, 2010 was first year the system was tested.

Update (10 Feb 2011): Trying to get further info from Suryachandra Rao re seasonal monsoon forecasting status, so far no reply. Several contact& request emails to various people without reply.

Follow-up: Request of further information, keeping IITM in the loop; Krishna Kumar going on 1yr sabbatical in the US

Resources: URL http://www.tropmet.res.in/ - good sections on research and publications etc

9. 26 Nov 2010 Divecha Centre for Climate Change, CAOS & other departments, IISc, Bangalore

Participants: multiple meetings – a) Prof J. Srinivasan (head of DCCC); b) Prof N. H. Ravindranath & Prof Govindswamy Bala; c) Prof Anil V. Kulkarni; d) Prof Sekhar Muddu & Prof Nagesh Kumar, Prof V V Srinivas & Prof Rao (instead of Prof P. P. Mujumdar, who was away)

Objective(s): To find out what relevant CCA research projects are being carried out and which areas would lend themselves to future collaborations.

Details:

a) Prof Srinivasan introduced BE to results from a high-res GCM, run in collaboration with the Earth Simulator in Japan – it has approx. 20km grid resolution and shows much better quantitative and qualitative results for Monsoon over India than many other CMIP3 models. It shows e.g. rainfall decreasing over Kerala, which has already been observed. Prof Srinivasan also talked about the effect of aerosols on precipitation, which may delay drizzle and affect trend of heavy rainfall events. Another area under investigation concerns health issues through heat waves.

b) [Very rushed conversation, as they were off to another meeting, state action plan for Karnataka] – relevance of their research to ADB project seems low, though obviously their research has a high profile (e.g. IPCC)

c) Anil Kulkarni was very knowledgeable about glaciers and snow issues, he investigated hydroelectric power potential in sub-basins relevant to ADB project. Amount of power generated is affected by changes in regional temperature / rainfall. Was instrumental to Glacier Atlas (Sutlej in 1996 and Chenab in 2005). He shared several papers.

d) Since Prof Mujumdar was unobtainable, he introduced BE to three of his colleagues from the Department of Civil Engineering, with whom BE met. The Department of Civil Engineering has 100 research students (+ on MSc programme), 40 in water resources. Areas of active research / expertise include statistical downscaling, Bayesian concepts, extreme value analysis and adaptive strategies. There are projects concerning the Cauvery (upstream), the Krishna basin and the Mahanadi river (in Orissa). Major strength in modelling with home-grown surface models. Prof Mujumdar works on quantification of uncertainty. Further work into upscaling of soil moisture effects onto stream systems, and involvement in SMOS calibration. Also economic changes in upland sub-basins, where (agricultural) yields are sub-optimal, one issue was that data for linked modelling (including economics) was sparse.

Follow-up: Agreed to keep in loop and get further (p)reprints of relevant papers. Their main interest in ADB project is Cauvery river results.

Update (17 Jan 2011): Sent fact sheet for TA 7417 and respective status update

Resources:

- Divecha Centre for Climate Change, CAOS – URL http://www.dccc.iisc.ernet.in/
- URL http://civil.iisc.ernet.in/

10. 29 Nov 2010 IITB, Mumbai

Participants: 3 main meetings: a) Prof Anand Patwardhan (START); b) Prof M Sohoni, Prof Anand Rao, Prof Bakul Rao (CTARA = Centre for Technology Alternatives for Rural Areas); c) Prof Eldho (& Prof Subimal Ghosh) - Department of Civil Engineering

Objective(s): Finding out what research activities were within START and carried out at IITB

Details:

a) Prof Patwardhan in his capacity as START South Asia chair has good overview of ongoing climate science projects. He offered that START could help internationalise ADB project and could also help with dissemination of training.

b) Meeting with CTARA staff useful in general sense, as main efforts in local projects, with topics mainly being centred on drinking water, livelihood water and governance. BE briefly presented the TA 7417 project.

c) Brief chat with Prof Eldho, he mentioned a course that was planned for early 2011 on "Climate Change and Water Management", and gave BE some leaflets which were shared with CWC staff etc. Prof Ghosh was away at the time of the meeting.

Update (17 Jan 2011): Sent factsheet TA 7417, discussed participation (as guest lecturer) of myself or other project member on their course "Climate Change and Water Management", to be held during 28 Feb - 04 Mar.

Follow-up: Keeping in the loop about developments

Resources:

- URL http://start.org/networks/south-asia
- URL http://www.ctara.iitb.ac.in/
- URL http://www.civil.iitb.ac.in/~eldho/preview/pages/research-areas.htm
- URL http://www.civil.iitb.ac.in/~subimal/
- http://www.civil.iitb.ac.in/

:

11. 03 Dec 2010 CWC

Participants: Dr Pillai (Director of Dam Safety); BE

Objective(s): Information exchange, also to find out if CC impacts are currently considered in any aspects of planning / commissioning / operation of dams

Details: Very interesting conversation, but currently CC not an issue for dams, as uncertainties from other factors much larger. Currently new bill (Dam Safety Bill) before Parliament, should be passed within next half year – apparently Dr Pillai instrumental in drawing up the bill – he promised to send me draft copy. The bill will introduce two inspections for each dam structure annually, pre- & post-Monsoon, and comprehensive dam inspection every 10 years by professional dam engineers. The bill also contains institutional mechanisms, including the three tiers of dam owner, state level officials and central level officials). The bill also stipulates for creation of an emergency action plan and for a technical risk analysis, which may also contain climate change impacts in risk register.

He told about the DRIP (Dam Rehabilitation and Improvement Project) project – "*MoWR with assistance from World Bank, is in the process of taking up the DRIP, which is a six-year project starting around 1 Jan 2011. The project will be implemented in 4 States, namely Kerala, Madhya Pradesh, Orissa, and Tamil Nadu. 223 large dams in the four participating states with substantial need for rehabilitation and improvements are included in the project. Development of appropriate*

institutional mechanisms for the safe operation and maintenance of all large dams would also be taken up in these states. In addition, strengthening of the institutional setup for national level dam safety surveillance and guidance will be taken up in CWC (under MoWR). The project implementation agencies for DRIP would be the owners of dam (i.e. Water Resources Departments (WRD) or State Electricity Boards (SEB)) in the five (four ?) participating States. The overall implementation of the project will be coordinated by CWC. The project development objectives of DRIP are: (i) to improve the safety and performance of selected existing dams and associated appurtenances in a sustainable manner, and (ii) to strengthen the dam safety institutional setup in participating states as well as at central level." [from CWC web page, abridged]

Also a checklist for each and every dam in India (some 5100 large dams) planned in project DHARMA (Dam Health and Rehabilitation Monitoring Application). In CWC's 2008/9 report it was stated that "*so far, two modules of DHARMA have been completed*".

Meeting then covered how dams are adaptive structures both for more and less water flow – when more, they can operate as "flood cushions", when less, as "storage reservoirs", so in either case "no regrets" solution (within limits).

When asked about other potential CC impacts, he mentioned GLO (glacial lake outburst), so far apparently not a problem, but could be difficult to fix because of remote locations of many of these structures. Another issue was temperature variations becoming more extreme, leading to repeated freeze thaw cycles in dams & embankment structures, which could damage such.

Follow-up: Keep in the loop, will send him details of UK CC & Dams/Reservoirs study, when completed (in early 2011), according to Defra/EA.

12. Date: 03 Dec 2010 CWC (Room 513 S) Bhopal Singh (Director of Hydrology South); BE

Objective(s): Quick exchange of information

Details: Secondary meeting, set up by Dr Pillai (Dams Safety). Bhopal Singh informed BE of appraisal of hydrology, currently data not sufficient (only 800 stations in Southern India), flow is reducing, but discharge network too small, will be partly addressed by HP2. BE asked him how many stations would be sufficient and he said 5000 would be good. He mentioned that this lack of data was leading to estimates and in some cases subjective assessments. HP2 will help categorise basins into three broad categories – "lots of data", "some data", "no data".

He's also looking at some flood issues, via empirical approach. He mentioned Krishna basin where in 2009 normal flow (13lk cu/s) had been exceeded by nearly 100% (25lk cu/s).

Follow-up: Keep in the loop via Ashok Karya

13. 03 Dec 2010 IIT Delhi – Professor Gosain's office

Participants: ADB Project Team

Objective(s): Updates from field visits and regional meetings while international consultants still in India, discussions of work plans / key activities (doc from 01 Dec circulated) and outputs with timeframes.

Details: Adrian Young requires CC input towards interim report by 21 Jan (31 Jan also mentioned) – the interim reports needs to be finalised by 22 Feb 2011. Four outputs: 3 states & all India.

Sandhya Rao provided disk with CC data, for A1B, A2 and B2 scenarios, BL (baseline 1961-90) for Cauvery and Sutlej, extracted from full output of IITM downscaled (via PRECIS) MOHC (Met Office Hadley Centre) runs (not 100% sure which GCM was used here, at least 2 possibilities,

Bend Eggen to flesh out Robin Wardlaw's task list as it relates to CC issues, together with AG, then to AY. This relates to pp 5-6 of the circulated document. Key activities by AG & his team, with BE

providing support, initial analysis of observed gridded (e.g. IMD or APHRODITE) vs PRECIS BL precipitation data sets. This will aid bias correction prior to driving the SWAT models.

Some discussion on what CC data could be obtained from IITM (AG visiting there 14 Dec), as for A2 and B2 so far only end of century data available (plus BL). Further discussion about QUMP mini-ensemble, so far looks like AG's group only wants to take Q14 forward (this is a particular realisation out of the 17 models which seems to give best results over all of India). BE voiced concern that only taking one QUMP output forward is invalidating whole point of using QUMP approach – essentially no quantification of uncertainty possible. BE will investigate the rational and the relationship of the three downscaled QUMP outputs (Q0, Q1, Q14).

General approach on CCA – propose adaptation plans for current state, there will be several options, check which adaptation measures robust, first for present, then further checks for range of CC scenarios – the resulting/remaining adaptation strategies will offer robust resilience.

IV. COMMENTS ON INTERIM REPORT AND WORKSHOP

Comments	Response
SAER (Arnaud Cauchois, Senior Water Resources Management Specialist) **1. Groundwater**	
a. The underlying causes for underground water over exploitation are no clearly identified – the study tend to focus more on describing the symptoms than discussing the causes such as the nexus water use and rural electricity pricing; support price to water intensive crops, inefficiencies in surface water use. In the case of Cauvery Delta, recommendation is made to control the demand but there is no clear assessment of existing demand management measure, efficiency and challenges.	Agree, this needs to be expanded on and this has always been the aim as we head towards finalization of the reports.
b. Policy and strategy recommendation to reduce ground water resource requires solid understanding of the hydrological setting (source) and socio economic situations (uses dynamic). It is felt that these need to be more clearly articulated to support the recommendations for improvement proposed by the study.	In Sutlej, Punjab we are working on a sample distributory in order to get an understanding of the water balance using a simple model. The overall hydrological response of GW to different changes in cropping is also similarly being assessed. Follow up consultations will be held in this regard later this month.
c. In relation to point a and b, the recommendations to foster conjunctive use of water, reduce non beneficial water use by modifying cropping systems, supporting recharge, etc, with the overall goal to reduce ground water exploitation and return to sustainable management may not lead to the expected results unless some of the underlying issues are tackled and the proposed options are really adapted to the diversity of aquifer &uses dynamics.	Once we have determined or better understood the issues and technical options we will move towards discussing with communities and government workable initiatives to tackle the problem.
d. Point c means that the study does not really make strong recommendations for policy reforms /regulation of ground water and instead tend to focus on ways to reduce ground water use in agriculture or increase recharge, etc. Yet without regulation any savings in ground water may be automatically captured for more irrigation. We understand that regulation is a very hot topic particularly in Punjab, but we may be able to help a bit here trying to identify low hanging fruits reform to start with such as for instance extending the MSP to less water intensive crops.	Until we have defined the options it was not possible to be very specific. We will work on ideas with simple things stakeholders can do quickly and bringing in longer term changes i.e. MSP and regulation later (these will as you will note take time and will not happen overnight despite all the best intentions) The Government of Punjab have requested some very specific proposals so we will try to meet these in the first instance. We have a week of consultations planned in Punjab at the end of April which will also add to these discussions.
e. Emphasis from the state in possible recharge	Agreed we will try and firm up our proposals and better guidelines for AR and will strengthen AR

Comments	Response
options are rightly questioned and recommendation made to better assess efficiency and economic costs/benefits valid. It is felt however that this statement needs to be supported with a better explanation of what would be required to assess efficiency/economic benefits and particularly the complexity associated with these assessments particularly with the necessity to assess precisely the Potential Zones for Recharges. The characteristics of unsaturated zone and movement of moisture fluxes control the amount of recharge in a region. Land cover/Land use types also play an important role in ascertaining the recharge to the aquifer. All natural surfaces contribute in recharging groundwater to varying degrees. Lithology, geomorphology and soil characteristics play an important role in stimulating the recharge. The factors that govern the recharge in rocks are its intrinsic properties (fracturing, faulting and jointing, tectonic ruptures and solutioning cavities among karstic regions). However in alluvial regions, soil texture is the basic property controlling recharge. It is, therefore, imperative to effectively delineate PRZs. Landforms are the result of geological, tectonic, lithologic, geomorphic, pedological and sedimentological processes. The interactions of these processes produce a specific kind of landforms that have properties of recharge to the aquifer. Hence identification and characterising different kinds of landforms assist in establishing the PRZs.	into our perspective.
2. Modifying crops/cropping systems towards less water intensive options is a valid option. However, it cannot be done without a full understanding of the farming systems diversity and the interconnections between cropping systems, livestock systems and strategic needs of the household for each type. Crop systems are fully integrated in the farmers strategy and depend on land, finance, labors availability.	For Punjab We are trying to look at rice options which are likely to be more acceptable ie shorter period rice, direct seeding etc. Punjab farmers are very much into cash crops and for the moment rice and wheat are the best in terms of price and security Agreed changing cropping is not easy without changes in MSP.
3. Glacier retreat. Statement is made in the report that glaciers of Himalayas are retreating in a range of 10 to 35 m per year. Although, in average glaciers in Himalayas are retreating, latest studies are showing very large spatial variability in retreat– See particularly latest article of Dirk Scherler, Bodo Bookhagen and Manfred R. Strecker in nature geoscience dated 23 January 2011. How confident are we that the feeder glaciers of saltuj are all retreating? Do we have confirmation when looking at river flows?	There is no trend demonstrated in river flows. This is complex as increased glacier melt is being offset by increased evaporation that is affecting snow melt. Remote sensing studies in the Spiti river in the upper Sutlej (Berthier et. al.) show loss of glacier volume over the last 10 years. Thankyou for sharing the Schereler paper on debris – makes for interesting reading.

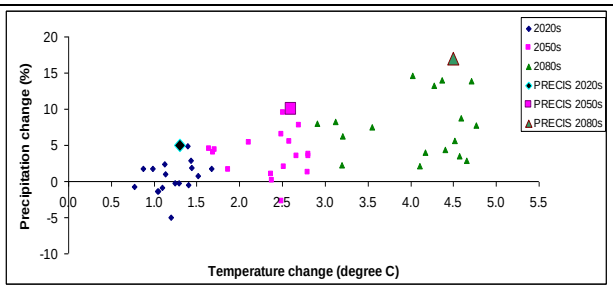
Comments	Response
4. Basin profiles do not really provide clear information on all water users. The information is centered on irrigation and drinking water uses but remain silent on other potential users such as Industries, environment, power generation. Similarly it remains silent on demand projections from all sectors and how these may be affected in the context of climate change. Having an understanding of the water balance projections over the coming decades in the basins under business a usual scenario and with climate change impact is seen as crucial for adaptation planning.	Overall data is inadequate to make definitive conclusions on this but we will aim to bring in as much information for the Final Report.
5. Surface irrigation system. These systems are not described in details in the summary but are much likely based on proportional flow division with very low provision per ha (0.2-0.3l/ha) as found in many system of south Asia. These design might have been adapted at a time were the objective was to share the scarcity and ensure minimum food security…it was supporting subsistence agriculture. Bad system management and deferred maintenance have even made this worst. But the design cannot support integration to market (and rice cropping. Hence, the development of ground water. This issue is somehow acknowledged particularly in the case of Punjab. However, there is no specific recommendation in the action plan to look at scheme design modernization options to try to improve surface water management in addition to the proposed conjunctive water use. The cautious approach towards lining is valid. More could also be said in the efficiency of lining and quick degradation of this efficiency in many cases as well as maintenance challenges that appear with ageing lining.	We will attempt to expand this; however it is thought that there actually is not so much scope for surface water improvement. Lining as mentioned in the comment may be of less value in conjunctive use. We are looking at trying to reduce the period water is made available, presently it is at about 330 days per year. Changing the system to an "on demand" system is difficult but there would appear to be some potential to try to better allow water to be better allocated to meet demand. GW is also poorly managed again due to poor power supplies. Based on our experience water pumps are generally always switched on.
6. Climate change projections and impact. With the exception of sea level rise for cauvery and glacier melt for the saltuj, we are somehow we are forced to admit that climate change projections are finally of limited use for planning adaptation due to the difficulty to predict rainfall changes. This leads to the proposed no regret approach. The legitimate question is then whether this was not already known prior to the TA and if so what justifies spending more money on similar exercise until the rainfall models can provide more reliable predictions. This is may be something that needs further discussion internally.	The limitations of projections were known from the start and mindful of this, agreement was made on the validity of the approach adopted from the outset. Hence it is of little value to question this now. To some extent the projections have been applied in the planning, less so to the rainfall. The approach we are advocating is to upgrade and refine the planning on a five year basis to incorporate improved projections and this exercise provides the first attempt. Further to this it should be pointed out that if the study had done **no** projections, then we would be very weak. In our opinion, also echoed by other stakeholders in the process (GoI; participating states and IIT's etc) the projections have provided important insight. Overall we must all understand that climate change at the moment is very much about

Comments	Response
7. Economics impact: from the interim report we do not get any understanding of what is at stake from and economic point of view if the proposed plans are not implemented and climate change predictions materialize to the worst. Would it be possible to get a clearer idea on the economic aspects in the final report?	**planning under uncertainty**. We are looking at mechanisms for the Indian Met Dept and the linked Indian Institute of Tropical Meteorology to prepare climate projections for all India based on the best and gradually improved information which can be used (selectively) by states and other planners.
8. Recommended framework plan and road map. These remain still very bulky and would benefit in further refining and ways to operationalize these. Among others we would need to get a sense of prioritization or logical modus operandi of the many recommendations - I think it would also be useful to provide a bit more details on preparatory activities (e.g. modelling studies scope and key elements).	We have prepared summary reports for each basin which were distributed at the interim workshop. We agree the basin reports are "long and bulky" and would work towards better refining of the priorities and strategic plan as we move towards closure of this work.

RSDD (Charles Rodgers, Senior Environment Specialist, Climate Change Adaptation), Environment and Safeguards Division	
Agriculture: Although there is a good discussion of issues linking water and agricultural productivity, in particular conjunctive use of surface and groundwater in irrigation, the distorting impacts of power (and implicitly water) subsidies, and so on, one thing that appears to be missing in these reports is a discussion of how climate change is likely to alter not only the crop water use regimes, but the overall suitability for certain types of cropping. For example, much of the discussion is focused on paddy rice cultivation and its impacts on groundwater use and related. However, it is likely that in many regions within India, rice cultivation may become impossible or highly risky due to temperature stress as critical temperature thresholds are transgressed more frequently. As an illustration, the 2009 ADB/IFRI study of climate change impacts on Asian agriculture projects production decreases of between 10% and 20% by 2050 due to combined physiologic and economic impacts of climate change under three scenarios. While it may be neither necessary nor useful to go into these issues in great detail, the potential for major reconfiguration of the Indian agricultural economy due to altered growing conditions should at least be acknowledged (I note that you do take this up later in the Conclusions section)	Agree with this-we are relatively light on the impacts on agriculture. However in all the recommendations we do have an agricultural component. An important finding in all the 3 sub-basins is for the water and agriculture to work together on cc. We will try and add something on critical temperatures for different crops, and how these relate to maximum temperature projections.
More specific comments: in Section C, *Surface and Groundwater Conjunctive Balance* (Par. 11) the importance of properly modeling the hydrologic crop-surface-groundwater balance is noted. I strongly concur that acquiring this capacity is a priority, and I would add, with emphasis, that in addition to being able to model the impacts of various efficient irrigation technologies (which in the long run will surely come into wide use for economic considerations if no other) such a modeling capacity is required in order to simulate the impacts of climate change itself, particularly on soil and crop evaporation and transpiration, on groundwater recharge, and on crop physiology, as described above. At preset very little is known about climate change impacts on groundwater balances, and it would be useful to establish such a capacity in this region.	This will be a recommendation-the main thrust of MOWR and the water resource agencies is surface water.
Par. 18 p. 5 describes Agricultural Options, and it is noted that both removing or redesigning the electricity subsidy and removing the MSP on	Will try to source more info -the ADB IRRI material will be very useful in this regard. We would be grateful if this information might be shared with us.

rice are currently politically infeasible, however desirable from the standpoint of improving water resources management. There is accumulating evidence that rice can be grown using alternative cultivation methods that both save water and maintain, or even increase yields. Two such methods are alternate wet-dry cultivation, and aerobic (direct-seeded) rice. ADB has provided TA funding to IRRI to demonstrate the effectiveness of these approaches in field-scale pilots. From memory, water savings were in the range of 10% - 20% relative to paddy (wet) rice cultivation, and yields were equivalent, or even slightly improved in some regions. It is my understanding that many Punjab rice soils have low clay content and hence high percolation rates, making these areas unsuitable for paddy (wet) rice cultivation if water conservation is a consideration (but recognizing that in areas of groundwater overdraft, this percolation is not necessarily a loss, or entirely undesirable). Recommend exploring AWD and aerobic rice in these settings – this might also be palatable since farmers can still presumably take advantage of the MSP for rice.	
Demand Side Management (P. 13, Par. 44): Acknowledging the current difficulties in attempting to regulate either groundwater abstraction or reduce or remove electricity subsidies, it should be noted that at some point these policies (subsidies of electricity in particular) become climate change mitigation issues. Given that the majority of the (subsidized) electricity in India is currently generated in coal-fired thermal plants, and given that such subsidies lead to inefficient and over-use of electricity, at some point India will have to re-visit these policies in the interest of meeting GHG reduction targets.	Agreed we will try and bring in 'minimising pumping' as one of the parameters into the decision making process. The consultant hydrologist on the team has done some preliminary financial estimates of the additional costs from pumping under the “do-nothing” scenario.
Payments for Environmental Services (PES) to improve groundwater management: The discussion of PES to promote water management goals in Punjab (P. 16, pars 57-59) is useful and interesting, although with a strong caveat: the use of PES has the effect of solidifying the idea that farmers “own” as much groundwater as they can pump, and hence must be compensated for refraining from doing so. Unless federal or State water law actually recognizes this ownership, it may be more effective (and less likely to establish an adverse precedent) to take the view that such payments should be pure policy-driven incentives. A good model is the U.S. Conservation Reserve Program (CRP) that was implemented in the 1980 and onward both to reduce the U.S. ag surplus and to take erosion-prone land out of	The easement act appears to give farmers rights to pump as they want. The bidding process sounds a possibility which we will further investigate.

cultivation. The idea was to let farmers bid on how much they would accept (per acre) to sign a contact constraining them to remove their land from cultivation, and the lowest bids were accepted first, thus minimizing the overall cost of a given acreage reduction (or maximizing the amount of land that could be placed in reserve for a given amount of money). Those who made the lowest bids were in general those farmers whose land was the least profitable to cultivate, so that the best land was kept in cultivation. In the same way, Punjab farmers could submit bids to be paid for ceasing to pump, and the lowest bids accepted, which would probably have the effect of reducing water use by the least efficient farmers (or those with the least productive land), which is the desired outcome.	
Specific comments/questions	
(1) Par. 91 p. 25: it is stated that "PRECIS simulations for future climate scenarios indicate an all-around warming…" Recommendation: since PRECIS inherits the global projections of the parent GCM (which in this case is HadCM3), it is more accurate to state that "GCM simulations for future climate…" or similar.	Yes, we agree that the driving GCM has most influence and will modify the text accordingly.
(2) It is indicated (on page 26, the last sentence of para 99) that, there have been three India PRECIS runs (presumably, forced by SRES A1B, A2 and B2, with LBCs derived from the HadCM3QUMP0), but the report only analyses scenarios from the A1B run. It would be helpful to either explain why only one set of scenarios are analyzed (is it because IITH only provided this set of outputs?); or look at all three sets of outputs, so that uncertainties with relation to different emissions scenarios could be represented.	We will present precipitation changes and temperature changes under the A2 and B2 scenarios, and compare them with A1B at 2080s in the final report. This will be done for each study basin.
(3) Table 7 p. 30 – row values for A2 and B2 emissions scenarios are missing – will they be provided later? It would be useful to see the contrast, which would be apparent by 2080.	The intention had been to include the A2 and B2 results. They will be included in the final report.
(4) "Precipitation Intensity" (last paragraph) – the reference is to Figures 9 and 10 – perhaps this should be 13 and 14? (same issue p. 34)	Yes, thank you, changes will be made. There was some mix up of Figure numbers. This will be corrected.
(5) Given the considerable divergence of GCM results, particularly with relation to variables such as precipitation and in complex geographic locations, it is worthwhile exploring the uncertainties in climate scenarios associated with climate models. Therefore, it would be helpful to look at the range of projections from other GCMs which perform well during the monsoon season (cf. para. 133 on	We agree that it is very desirable to do this. In much of the work this far, for the national communication, a lot of store has been placed on one scenario, without really putting the uncertainty into context. The following is from some work in China:

page 40 of the report). Particularly it would be helpful to get a sense of how projections from these other models compare with those from HadCM3 on which the RCM experiments and detailed analysis in the report are based.	 Changes in temperature and precipitation averaged for the whole of China by the 2020s, 2050s, and 2080s simulated by 17 GCMs from IPCC AR4 and PRECIS (all simulations under A2 scenario) Time constraints permitting the consultants will attempt something similar.
Suggestions for further work If the climate change scenarios and associated analyses were to inform concrete adaptation decisions and development planning in the basin, work on climate change scenarios needs to be further strengthened. To a large extent, this entails a better characterization of uncertainties in the scenarios and associated downstream hydrological analyses. Potential improvements could be made through: • Using outputs from a suite of RCM runs, driven by different GCMs and forced by different emissions scenarios; • Developing probabilistic scenarios using certain sampling techniques (e.g. Monte Carlo simulation etc.)	We agree entirely and will incorporate in the final report.
Mr. Kharya, GOI - Director Climate Change CWC Data gaps are required to be identified: o In NWM, review of data collection networks of various hydrological parameters have been recommended – a way forward for review may be suggested for each parameter. o Data gaps experienced while carrying out studies may be enumerated. o Data management has been covered in the report however the same may be further elaborated. . A typical process of the study since beginning	Agree will look at this in more detail Good will include this. The consultant Hydrologist and IIT are working on this. We are working on developing a standard and

– including selection of basin/sub-basin/area, setting up of groups in the States, meetings with state officials with purpose and outcome, meetings with farmers & locals and outcome, workshops and their purposes, setting up of scientific studies, selection of models etc. would be an interesting information to be put in the report which would be a sort of guiding principles for replicating the studies for other areas.	maybe more streamlined approach that could be used for upscaling.
· Specific studies, required to be carried out by the national research organizations be identified and institutional arrangement may be thought of for better knowledge management.	Yes we will do this- we understand NIH have been doing some work on this which we will get more information on during our visit later this month.
· Networking of the organizations dealing with "water" at Central level and at State level may be thought of better coordination at planning stage as well as implementation stage.	Agree with this point. I think It is very important and we can discuss more during the discussions in April /May.
· More detailed system studies may be worked out for improving water use efficiency at sub-basin level for different uses of water.	The water use efficiency will be developed-looking in more depth into the application of conjunctive efficiencies.
· More detailed strategic options be discussed for adaptation to sea water ingress in coastal areas.	Agreed will incorporate this.
· Capacity building component has to be addressed suitably.	Agreed
· Collected data may be utilized for trend analysis of various parameters and also appropriate models be identified for generating future projections with respect to water resources.	Some work on this is ongoing -will check on the progress
SAER (Kenichi Yokoyama, Principal Water Resources Management Specialist) My review of the interim reports is still limited, but would like to ask for the consideration on the following aspects at this stage.	
(i) I would suggest that the team revisit original Office Memorandum sent from MOWR to ADB through DEA in Sept 2009, which clearly stipulated the expectation of the GOI as to the specific value addition requested under the TA, and make the structure and content of the outputs in line with the expectation from the GOI.	Thankyou we will refer again to this memorandum. We will strengthen the parts on future capacity building but have to note the limitations of the team resources to actually implement capacity building. From the sub-basin studies we are finding the issues are quite complex and significantly wider than straight WUE.
In the above relation, it is also recommended to re-look at the reports of subcommittees on water use efficiency and IWRM basin planning, and provide maximum efforts to (a) duly cover key strategic directions identified in the subcommittee reports, and (b) provide sharply	Conjunctive efficiencies of SW and GW in all three sub-basins are relevant and WUE must consider the conjunctive efficiencies which are actually quite high and reduce the options for improving irrigation efficiencies. The direction is more towards reducing crop water demands and evaporative losses -we will bring this out further in the reports and

focused outputs to exemplify how the subcommittee recommendations are implemented on the ground in the strategic planning framework. (ii) We would also like to suggest that outputs should be clear as to the next steps that MOWR is recommended to take, which may include (a) plan of prioritized actions to prepare detailed basin plan on the basis of the planning framework; (b) quality IWRM basin planning framework with CC adaptation that all of us can say that they are exemplary framework that can be replicated across other basins; (c) a set of capacity development tools and programs that MOWR can implement with state governments; and (d) a set of clear and simple messages (and leaflets) to the general public as to "do-it-yourself-action by citizens" as anticipated in the Sept 2009 MOWR letter. (iii) In this relation, and in terms of IWRM planning, the draft outputs may desirably cover issues and strategic directions (at least at the level of the aforementioned committee reports) relevant subsectors, including water supply and sanitation, industrial water use, environmental regulations, and land and watershed management aspects, and basin level institutional setup and arrangements to pursue various basin agendas. (iv) In terms of water use efficiency, I agree with Arnaud that, while elaborate assessment of the present water distribution status has been provided in a qualitative manner for Sutlaj, more specific information would be desirable as to the operation of main and distributary canals, specifics about the coverage and content of warabandi, and TA team's overall assessment of the status of water use efficiency and basin wide implications, and scope of improvements and possible impacts on basin water balance. Similar assessments would be useful for Cauvery delta system.	discussions. We will look at the sub-committee reports. We need to stress the need for a move towards assessing conjunctive water use efficiencies which largely don't feature in the proposals/studies by CWC Agree his needs more work - we will be working on this with discussions and consultations with CWC and MOWR over the next few weeks. We agree the recommendations for all India remain too general. We will look again at 'do-it yourself actions by citizens' - these would need largely to be directed at existing issues as climate projections are not so well defined. It is not so easy to identify real do it yourself actions to address major issues of the sub-basins. We will work towards ensuring the message is more directed towards community-government cooperation-but will consult with the team and review the outputs of the Participatory Rural Appraisal which includes information relating to community perceptions and needs. We are working on this to better improve the quantification of demands and resources.

V. COMMENTS ON DRAFT FINAL REPORT AND OUTPUTS FROM FINAL WORKSHOPS

24. The draft final report was issued to MoWR, CWC, the three pilot states, ADB and other interested stakeholders in early June 2011. The report was discussed in depth at the three state workshops (Tamil Nadu Workshop, Trichy 13th June, Madhya Pradesh Workshop, Indore 16th June and Punjab Workshop Chandigarh 21 June) and the final workshop Delhi on 27th June. Feedback from the various organisations and the outputs of the workshops is shown in the Table 6 to Table 15 below.

Table 6 Central Water Commission

Comment	**Response**
1/ Mr. A.K.Kharya Director, CWC	
a. In the focal area 4: River Basin Planning & Management Table 6: Please examine necessity of proposed WRD portal. [connected issue –Concept of State WRIS would have to examined in detailed (page 53) as single data base is preferable or could computing concept may be discussed, however data pooling by respective areas of the State at their level or even at lower levels would be promoted/ encouraged as per pre-defined protocol to bring uniformity in data collection, dissemination, system modification/ likely up gradation, etc.]	We believe a parallel state level portal will be required. The state level portal will compile lower level and more detailed information relating to states, districts - water and canal systems.
b. Para 95: Decentralize management may be replaced with basin oriented approach for planning.	Agreed sentence adjusted.
c. Fig. 4: As proposed that RBO Secretariat would be initially supported by CWC regional office (Para 99) the figure may show RBO Secretariat & CWC as overlapping for more clarity.	Such overlapping in figures may create confusion. RBO has a separate set up and CWC would provide full support to RBO.
d. Please see that there in consistency in fig 2 – Sub Basin Planning and Mainstreaming Processes; fig 3 – Approach to Sub Basin Framework Planning; fig 4 – processes and Organization for Basin Planning; and fig 7 - Proposed Arrangement for IWRM within the States and also with institutional changes has been suggested in the report for various purposes e.g. Focal are 4 discusses institutional arrangements at length.	Figures have been adjusted to maintain consistency.
e. In the focal area 10 : Restructuring of Central Water Commission and MoWR Subsidiary Organizations Para 151: CWC is an attached office to MoWR, and not a subordinate office of MoWR. Substantial autonomy for CWC was expected in this arrangement, which has not materialized.	Noted and taken care of in final report.
f. Para 152: Mere restructuring may not suffice.CWC also need to be empowered by statutory provisions.	Such provisions need a lot of brain storming. Have been now omitted in the final report. To be reconsidered at later stage.
g. Para 160: With the desired mandate and need for more specialized work (and even if CWC were to outsource some of the work), the CWC's organizational cadre (i.e. CWES cadre) needs to be strengthened further, and not made smaller. For seeking functional efficiency of lean organization, RBOs may be carved out of CWC; however these RBOs should be manned by CWES cadre for leveraging upon strength that come from a large organizational knowledge pool. Orienting CWC for basin level planning is necessary and accordingly it is required to be strengthened.	Noted text adjusted to stress the need for experienced staff including RWES in the RBOs.
h. Para 161: There will be an urgent need for CWC to play the role of a strong regulator, especially in view of large risks to the lives and property of people posed dams that are poorly investigated or designed or constructed for commercial gains. The need is also there for coordinating authority for smooth operationalisation of the hydropower project which planned and constructed in cascade manner.	In the proposal CWC needs to split its regulatory and development roles. A separate regulatory and compliance section is proposed.
i. Table 17, item 7 & 9: National Water Academy (Pune) is meant for water resources related trainings; and hence no need for a separate 'National Water Training Centre'. However, NWA should be strengthened and empowered on suggested lines.	Text corrected
j. Para 164: An apt approach will be "Gradual development of many functions of CWC as well as of State Water Resources Departments to RBOs. The RBOs will be primarily manned by CWES cadre officials with a certain mix of basin-state's representation on encaderement/ deputation basis."	Test adjusted
k. They proposed structure for the Central Water Commission on page 51 does not indicate then hierarchical system of the proposed restructured Central Water Commission like the Central Water Commission regional office have been shown much below in the hierarchy whereas the proposal is for those field organizations to be elevated and added by Director/Additional Secretary level officer. Therefore, they should come directly under Chairman, CWC. Since	The details of restructuring of CWC have been removed in the final report.

Comment	**Response**
there would be around 18-20 (13 field units, 5 wings at headquarters and one planning and policy unit) it would be prudent to create one more layer in the name of Vice- Chairman (3-4 numbers) would be of the rank of Special Secretary. A State IWRM unit cannot be directly in hierarchy of CWC regional offices. This may please be looked into.	
l. A serious aspect of flood management has not been addresses in the proposed structure which may be incorporated appropriately.	Noted-flood management role would link under the basin planning and management activities. Flood warning would be linked to the hydrology functions.
m. It is opined that the proposed National Centre Sustainable Water Resources Management and Research should be part of Central Water Commission.	Noted - the details would need to be discussed.
n. Institutional aspect of performance overview and water use efficiency may be reflected appropriately.	This work is already being performed in CWC by a separate organization Performance overview and Management Information (POMIO). This may be continued.
o. Finding/statements at Para 156 & Para 160 are contradictory.	Noted. At present also, CWC awards a large number of studies by outsourcing to Institutes and by privet sector.
p. To sum up – the aspect of restructuring of organization(s) itself is large issue in itself involving not only the catering the needs of external environment but also about the internal environment, its people, their orientations, skills, capacities and preferences. Recommendations like "Then integration of surface and ground water resources management is essential and CGWB should be merged as a core part of CWC.(Para 158)" are about to be resisted even though the first part of the statement is need of the external environment. Therefore, other doable recommendations may be suggested to meet the need.	Noted and changes have been made in the final text. The proposal are preliminary and would need to be supported by more discussion with all the relevant parties.
2. **Central Water Commission Other Comments 15/07/11**	
a. As the studies have not dealt with the issues pertaing to the associate states, it is felt that the same may be deleted from the reports	The studies did considerable work relating to the upper catchments in Sutlej including assessment of snow and glaciers. The SWAT modelling provided a lot of information on climate and hydrology of the upper Cauvery and the Sutlej. It was never envisaged that the study would address the issues of the associate states. However it is agreed that the reference to associated states would be deleted
b. Due acknowledgements for data supplying agencies like CWC, IMD, BBMB, State Govt's etc.may be made. List of all collected data parameters- Climatic, Meteological and Hydrological may be appended.	Agreed
c. (Page-21, para-2) "CWC is proposing the assignment of more senior ….." be replaced with "MoWR should upgrade CWC field offices, already functioning on basin scale, to one higher level (Member or Chief Commissioner) in a move towards a more decentralized management".	Agreed
d. Report mentions (Page-ii, para-6 and page-15 para-i) about regional cooperation for adaptation to clilmate change. It is to point out that the issue of Regional Cooperation has not been mentioned in the NWM and therefore becomes beyond the scope of the studies	Climate is a regional phenomena and there are many advantages for the establishment of regional climate centres rather than national centres. This is already happening in Africa Europe and the Americas. India would be in a very good position to support the smaller countries of the region with climate projection assessments. If IITM were to take on such a regional role then there would be good opportunities for accessing international funding and support. The proposal would obviously

Comment	Response
	need to be discussed. The scope of the study is to build on the NWM but should not be limited to the NWM,it is suggested that the proposals for a regional cooperation and a regional climate centre should remain.
e. Counterparts names should be corrected	Agreed

Table 7 Comments from Punjab State

Comment	Response
a. The spelling of River Sutlej be corrected as Sutlej in the Report	Agreed to change the spelling to Sutlej. In the Indus water Treaty 1960, Spelling is given as 'SUTLEJ'
b. Report mentions rice-wheat cultivation only whereas in the South-western Region of the State wheat-cotton rotation adopted which needs mention in the report	Agreed
c. About 2% increase in temperature by mid-century and increase in precipitation by 10-15%under climate Change, whereas, it has been observed that since last 7 decades there is definite increase in average temperature of the State whereas the average rain fall has decreased by 50%. This projection in the Report needs to be re-considered by collecting the long term record of the State.	An analysis was made of historic annual and seasonal rainfall using IMD data for stations at Ferozepore, Jullandar and Ludhiana, to test for the existence of trend in the records. Approximately 30 years of data were available for each station. At Ferozepore there was an indication of a declining trend in annual and monsoon rainfall, but the significance level was greater than 10%, and this would not be considered conclusive. At Jullandar and Ludhiana there was an indication of an increasing trend in annual and monsoon rainfall. At Jullandar the significance level was greater than 10%, but at Ludhiana the upward trend in monsoon rainfall was significant at the 5% level. It has not been possible to investigate the reasons for different results at Ferozepore, but it was noted that there were more missing records at this location. At Ludhiana, a longer composite record was created using archived records from the GHCN[9] precipitation archive. This longer term record was used in analysis. The trend in annual precipitation amounts to an increase of 25% over a 99 year period. The projected future changes in precipitation under the PRECIS A1B scenario are in line with the trend observed historically at Jullandar and Ludhiana
d. Regarding formation of State Level Water Resources Committee, it is to inform that already 3 tier Committees for Water Resources Sector have been constituted by the Government i.e. state Level Technical Advisory Committee headed by Chief Engineer, Water Resources, Punjab State Water Resources Committee headed by Chief Secretary and Punjab State Water Resources Council headed by Hon'ble CM.	Noted.
e. Para 5, Ground Water needs to be modified for the latest data, which is still to be approved by CGWB. But almost cleared.	Noted.
f. Para 20 be modified for Ground Water Legislation as the success of Model Bill of GOI has not been reported by any State for agrarian sector. Also, Punjab's effort to conserve water by implementing "The Punjab State Preservation of Sub-Soil Water Act, 2009 needs to be properly mentioned in the	Noted. The Sub soil Water Act has been amply highlighted in the final draft report as it has shown very positive result for G.W systems in Punjab

[9] http://www.ncdc.noaa.gov/oa/climate/ghcn-daily/

Comment	Response
Report.	
g. In Para 28 MSP has been written as minimum Selling Price where as its standards expansion is Minimum Support Price.	Noted.
h. Para 35 contains no text which may be re-looked or Para numbers be amended accordingly.	Noted.
i. Para 60 needs to be amended as Water Resources & Environment Directorate is a part of Water Resources Organization of Punjab Irrigation Department.	Noted.
j. In Para 70, RBO has been recommended whereas Punjab is not favour of RBO.	Noted.
k. It is further requested that the various points discussed in the Workshop at Chandigarh be also considered before finalizing the Report.	The workshop points have been discussed & incorporated in the report. Please see the final Punjab workshop report.
l. Also, it is suggested that it will be better if in the Action Points, details and quantum of work involved for each activity in Lower Sutlej Sub Basin to counter the of Climate Change be mentioned in the Report	It is briefly mentioned in Table 23, -'Specific climate change vulnerability'. Further detail studies have been proposed in the 'Future Road Map' and 'Frame Work Plan'.

Table 8 Summary of Points Raised Punjab State Workshop 21st June 2011

Comment	Response
a. Climate Change trends for rainfall seem not to be consistent – TA Team requested to check this and ensure consistency within the report	These have now been adjusted
b. Rainfall day are already reduce in Punjab – this aspect needs to be correctly represented in the report.	These have now been adjusted
c. Need to reflect the switch to cotton in Punjab in certain areas which is now more pronounced. Need more debate on wheat versus cotton?	More research and study needed to be carried out to resolve these aspects.
d. Institutional arrangements – TA Team were requested to be mindful of existing institutions in the State (e.g. State level water committee; Water Res Committee; Water resources council) and only need help from ADB in revitalizing these institutions and not creating new ones.	In our report, Strengthening of the existing institutional system has been proposed. Water Regulator has been proposed in consonance with 13th Finance Commission
e. Refer to recently released GW Report for ground water data	New G.W. statistics' have been incorporated.
f. Punjab Water policy drafted not released – Report needs to be corrected in this regard.	Report adjusted.
g. Want /more critical/action areas to be looked at in the report	The action planning part has been expanded
h. Government of Punjab want guidance on the best technologies available	There are a number of technologies-the best and tested technologies need to be upscaled. There is however insufficient information to definitively recommend any one technology.
i. Study areas within southern Punjab where agricultural yield fall significantly lower than state averages	This needs further research.
j. Impacts of growing urbanization and land grabbing and real estate development needs attention – is there a shift away from agriculture in Punjab?	Urban development and agriculture need to coexist in a planned manner.
k. More need for laser leveling and Zero to liege	Up scaling to these technologies have been proposed for resources conservation
l. Canal water is not carry to farmers' field which is making G.W depletion.	More studies are to be undertaken for conjunctive use of water for each distributory. Canal Water Management need to be improved.
m. For micro irrigation support from Government is quite less	There is need for further study on micro irrigation and up scaling of micro irrigation is required.
n. Approach by ADB is not correct for diversification of rice/wheat to other crops. Small farmers with less land cannot do this	Further study is proposed on this aspect such as rotational diversification by closing one third of command areas in groups.Thsi maybe further studied.
o. Govt. officials not understanding then situation and not responsive to the farmers need.	It is proposed to carry out a training and awareness programme under IWRM.

Comment	Response
p. For water conservation government should modify its infrastructure and take effective measures.	Water conservation is most essentially required considering the need for resources conservation.
q. Rice is not a natural crop to the Punjab. With rice and wheat concept of farming g has changed from living style to new commercial enterprise. This needs to be change for restoring nature. For social welfare, first important thing is agriculture welfare. Millet, Bajra, Ragi, should be adopted for cultivation discarding rice/wheat.	Water conservation is most essentially required considering the need for resources conservation.
r. SRI is more water saving with enhances production. Why it is not being taken up. PAU is not doing any work on SRI.	There is need for further research for adaptation of SRI
s. Seeds suited to local climate should be promoted. Earlier we were having 40,000 varieties of rice which is now reduced to 20 varieties Only.	National Agriculture Mission is looking into the aspects related to seed and other inputs. There is need for more research on these which has been proposed in over study.
t. Agriculture is very important in our country. As the central government is presenting Railway budget in the parliament, similarly centre and state government should present annual budgets for Agriculture to the legislative houses considering the annual needs, climate conditions and market conditions.	
u. Such workshop should be repeated again and again for spreading more awareness. Most farmers have not received the study report of consultant so organize one more workshop to discuss this report.	In our report we have suggested eight year program for sustainable agriculture and water resources.

Table 9 Comment from Madhya Pradesh

Comments	Response
a. A detailed groundwater monitoring should take into account the features of the area or region, which are likely to have an impact on the water quantity and quality. Some of these features are: Type of aquifer Land use pattern Climatic zones Soil types Drainage basin	Noted - text has been adjusted
b. GROUND WATER ASPECTS: Intensive exploration and investigation is required for deeper aquifers, which are potential zones of groundwater is Kshipra basin. Arial distributions of this aquifer are unevenly occurred in hard-rock basaltic formation. Detail geophysical and geo-hydrological studies for exploration may be essential for the Kshipra basin catchment management together with development of artificial recharge.	CGWB and state G.W. Department have carried out detailed investigation / exploration for the deeper aquifers. This work has to be further explored.
c. WATER QUALITY ASPECTS : Surveys may also be taken up in the groundwater quality monitoring programme, will specific objectives, such as to find if the groundwater in an area contain naturally occurring fluoride, or pesticides as a result: of contamination from agricultural applications. Such surveys may be carried out for at least two years. The frequency of sampling may be 3 to 4 times a year. At the end of the survey, depending upon the result, few servey stations may be retained in the network us baseline, trend or trend-cum-surveillance stations.	Ground Water Monetary will be included in the frame work Plan components 3 – Water Quality Management and Pollution Control.
e. The intensive and detail scientific study is required on the following aspects. Study of change in the hydraulic regime of a water system due to excessive water abstraction, construction of developmental works etc.	The Ground Water & Surface Water interaction can be studied through the WEAP model.
f. Construction of artificial recharge structure to control the water quality specifically in the area where fluoride is found in deeper aquifer.	This aspect has to be further investigated and researched.

g. Contamination by fecal and organic matter: Fecal contamination is still the primary water quality issue for both surface and ground waters. Although this applies to both rural and urban areas, the situation is probably more critical inn fast-growing cities within the Kshipra basin. Fecal contamination is source of pathogenic organism responsible for water diseases. It affects the use of water for drinking water sources or bathing water, as well as ecological health of the river. The release of untreated domestic or industrial waste high in organic matter into rivers result in marked decline in quality of both the surface water and groundwater downstream of the effluent inputs.	Agreed
h. Salinisation :Increased mineral salt in ground water and rivers may arise from several sources: Groundwater mining through overexploitation Pollution by mining wastewaters Pollution by certain industrial wastewaters Irrigation runs -off.	Agreed
i. Contamination from Agrochemicals: Agricultural land use and cultivation practice have been shown to exert major influences on both surface water and groundwater quality. Of particular concern, is the leaching of fertilizer chemicals (e.g. nitrate) and pesticides from regular, intensive cultivation of crops. These cultivation practices affect surface waters and relatively shallow unconfined aquifers, both of which are used for potable supply.	Agreed
j. Management and research: Samples taken for special purposes, such as investigating and tracing pollution episodes, instigating anti-pollution measure or gathering information for research purposes. Samples will normally from part of a discrete survey, which has been dedicated to gathering the information required to address a particular problem. As such, no guidance is possible on the location of sampling points and frequency of sampling, as each survey must be planned individually.	It is proposed to carry out extensive survey and research as shown in the 'Road map' and 'Frame work plan'.
k. The report is informative emphasizing Shipra water conservation and development to address ongoing development, environmental and potential climate issue of the Shipra sub basin. For implementation of the programme, IWRM (Integrated Water Resources Management) approach is recommended with a focus to address sustainable development of water resources. An IWRM institutional framework would be required to be established including the formation of a State Water Resources Committee, a Regulatory Authority and empowerment of the District Planning Committee and District Level Sector Agencies.	In the 'Frame work plan' the details of implementation program are included
l. Road map for programme includes Planning Process, Planning Organization, External support, Investment and Support Programme and studies, but it seem that new programme to address the climate change projection regarding increase in temperature, increase in rainfall by 10-15% has not been prepared. On the basis of above, it is concluded that the Report contains useful information regarding proposal for IWRM in Shipra basin but requires more detail studies & finalization of programme to address the effect climate change.	The strategy for water conservation through farm ponds and village ponds has been proposed for agriculture usages as well as ground water recharge.

Table 10 Summary of Points Raised Kshipra State Workshop 16th June 2011

Comments	**Response**
a. Excessive Water Abstraction, and ground water withdrawals are the root cause of all the Kshipra problem	In our study we come to the same conclusion
b. There is urgent need to take up small schemes for conservation of water	Water conservation and resources conservation are essentially required for

Comments	Response
	sustainable agriculture.
c. Leveled surface of the field are not suitable for G.W. recharge. With some depressions in the field and raised boundary , water wastage and soil erosion could be stopped. This helps in recharge.	
d. Administration and government are serious about Kshipra water resources but as there are proper dam sites, the best way is to carry out demand management.	We have suggested demand management of water particularly through micro-irrigation.
e. Ground water boring for pumping water has been becomes curse. The bore wells are deepening for water withdrawal. There is need to stop bore wells altogether for sustaining the land and river.	We have suggested for proper and sustainable ground water management.
f. River interlining is most important that flood water can be transferred from other basins. The water should be conserved as per Indian Tradition. The storage tanks may be made more bigger for storing flood water	Up scaling of farmer ponds and village ponds have been proposed in our report.
g. For reviving of Kshipra river, one has to consider and study the entire catchment and water budgeting should be performed.	We have proposed to carry out further works on these aspects on IWRM principles.
h. Organic farming should be adopted as this can save water and power	noted
i. There is lot of encroachment and both the banks of river Kshipra. These needs to be remove for restoration of river.	noted
j. Village group should be formed to safeguard the check dams and catchment areas.	noted
k. All the tube wells on both side of Kshipra river in the nearby areas should be forcibly removed so that ground water flow to Kshipra can become perennial.	noted
l. More and more of water conservation on works should take up under NREGS.	note
m. Only treated water should be allowed to flow into Kshipra river waste water nallahs should be stopped.	Improving effluent quality is part of the plan
n. Intensive program for constitution of private and public toilets should be taken up	Water sanitation and public health is one of the major components of our proposals.
o. Submersion of idols into the river during festivals should be stopped by public awareness or administrative steps.	

Table 11 Comment from Tamil Nadu

Comments	Response
a. For concrete solution for the problems in Cauvery Delta the following aspects are to be taken up for details study and executive of work. To calculate the maximum flood discharges in each of the above channels and design the channels accordingly with necessary land acquisition. To check the discharging capacity of all cross drainage works such as bridges, culverts and other structures and if found inadequate revised designs will be evolved. Provision of adequate banks on both sides of the channels to be made. Provision of retaining walls at vulnerable points along the channels to be made. Provision of grade walls to retain the bed level of the channels to be made. Reconstruction of the tail end regulators as per latest technical, design. Provision of in-lets at all necessary places to be made.	In the proposed 'Road Map' and 'frame work plan' detail studies and works have been 'highlighted Tail End Regulators with fresh Study & designs have been Proposed in the report. Agreed
b. The above suggested points are to be investigated and detailed project to be prepared taking into consideration of all the parameters with a holistic approach. When this project is	Agreed

implemented it will go a long way in the prevention of flood and water stagnation in the Cauvery Delta area and thereby reliving the people and crops from damages year after year.	
c. Tamil Nadu is keen to take up the modernization work in Cauvery Basin to improve drainage regulate tidal propagation in the canasta as well as to improve the water quality in this coastal zone affected due to sea level raise and salinity during erratic monsoon.	Agreed

Table 12 Summary of Points Raised Tamil Nadu State Workshop 13th June 2011

Comments	Response
1/ Dept of Agriculture Consideration should given to address catchment management over the whole catchment to help alleviate floods	Agreed-this will be taken up in the FR. The requirement will be integrate the sub-basin plans into an overall basin plan
2/ Water Resource department No specific comments on the report was made and opined that the study has addressed all the problems and issues in conformity with the discussions held during the field visits and subsequent interactions	Noted.
3/ Farmers a. Agriculture needs to be improved for sustaining agricultural production in addition to improvements in market infrastructure	Agreed. However, the study team has observed that in Tamil Nadu, the agricultural policy, schemes and provisions thereof provides an enabling environment to sustain agricultural production and improvement in market infrastructure.
b. To establish ONE "sale point" for every 3000 acres cultivated.	Agreed and the proposal shall be examined and appropriately addressed
c. Post harvest technology is the need of the hour and recommendation should include establishment of cold storage plants was stressed	Agreed and the proposal shall be examined
d. The recommendation to cover the protection of catchment and forest to restore the ecological balance	Noted
e. No reference to energy issues. Given the energy cost, there is a need to harness the solar energy for water lifting/ pumping activities. Suggestion was made to the study team to take advantage of the tides of sea water rise to generate electricity for energy based pumping/lifting activities	Noted. Recommendations, if any, made by the study team contrary to the fear and concerns expressed by the affected party shall be re-examined
f. To a proposal on private investments in agriculture, a voice of dissent was observed and many opined that in the absence of government playing an active and support role, the partnership between Farmer & private enterprises/companies will negate the interest of farms and farm families and in support of their voice of dissent, cited example of private company disappearing half – a –way through the process and leaving the farmer in great financial stress of repayment of loan borrowed by the company from a commercial bank. The farmers strongly argued for Government to absorb such financial risks in any such Farmer-Private company partnership.	
g. The study recommendations needs to look into the problems of low return on their investment in agriculture and thus resorting to distress selling of their produce in addition to real estate agencies buying the fertile land taken over by the real estate agencies	Noted. Recommendations, if any, made by the study team contrary to the fear and concerns expressed by the affected party shall be re-examined.
h. The study recommendations needs to look into the problems of low return on their investment in agriculture and thus resorting to distress selling of their produce in addition to real estate agencies buying the fertile land taken over by the real estate agencies	The policies, schemes and provisions thereof agricultural policy, provisions and schemes thereof in TN are providing an enabling environment for sustainable agricultural production, increased productivity and minimize the problem of poor .return on investment in agriculture. The provisions and

Comments	Response
	schemes among others include a) Quality Control on Fertilizers b) Soil Fertility Management c) Soil Testing Facilities d) A Micro Nutrient Production Centre e) Integrated Pest Management technology through Farmers' Field Schools f) Agricultural Extension Centers at block level f) Establishment of Agri Council to play a major role in providing quality inputs, technologies, post harvest management, marketing and processing activities g) Integrated Office Complex h) Farmers Training Centres i) State Agricultural Management Institute (STAMIN) to provide training to farmers j) Crop Insurance k) National Agricultural Insurance Scheme l) Weather Based Crop Insurance Scheme m) Crop Yield Competition n) Precision Farming o) Organic Farming and Organic Manure Production p) Quality Seed Production q) Automatic Weather Stations r) Establishment of New Bio-fertilizer Production Units s) Tamil Nadu Women in Agri Business and Extension (TANWABE) t) other centrally sponsored projects lend support sustaining agricultural production in TN Agree. Real estate taking over fertile agricultural land does not augur well for the farmers and farming of India. This problems needs to be seen in the larger context of neo-liberal economic policy of the government of India. in promoting the formation of Special Economic Zone (SEZ) and unfortunately the geographical distribution of SEZs in India is such that that SEZs have been set up near the big cities, on fertile agricultural land. The need of the hour is to go back to the original philosophy of the CRZ Notification, take on board the contemporary challenges and rework its norms, provisions and regulatory measures. Trends in land and resource use and land tenure are also contributing to the loss of fertile land to non-agriculture purpose which requires special study to offer solutions and it is outside the purview of our current study.
Mixed group responses (Department Officials, NGO and Farmers)	
1. On Flood and Saline Management components of the strategic framework-the comments were directed at • Ground water Table • Leakage of Shutters • Encroachment • To attract the Rain or clouds • To attract the Rain or clouds. • Desilting (all aspects) • Maintain the theoretical Bed • Improve Ground water • Sea water intrusion • Drainage Problem • Reduce Sea water Intrusion • To improve the carrying capacity of Drains/Rivers (Percolation) • Aquaculture problems & • Flood inundation	The study team understanding is that an NGO namely EQUATIONS and Tamil Nadu Environment Council (TNEC) are engaged in documenting at first level issues that would eventually help in understanding issues of coastal access, conservation and management. In addition to this all the proposed measures by the participants of the workshop shall be examined to be appropriately addressed in the final report.

Comments	Response
2. On Sustainable Agricultural systems components of the strategic framework, the comments were directed at • Hindrance in the river and channels due to Ipomea, Iccornia • Poor drainage of water • Saving flood water • Labor scarcity • Salt deposits • Crop diversification • Flood water harvesting • Input sale point • Inundation of paddy crop • Encouragement to traditional paddy varieties & Marketing	All the proposed measures shall be examined to be appropriately addressed in the final report.
3. On Shoreline protection and management components of the strategic framework, the comments were directed at • The impact of intrusion of sea water along the coast line on drinking water facilities and irrigation lands • Diversion of excess flood water • Damages due to the prawn culture and pollution of GW due to mushrooming aquaculture. • Inadequate width of river • Blocking of estuary of rivers • Cleaning of encroachments in the river and drainage bed • Preservation of the beach beauty and flora and fauna. • Sea water intrusion due to over exploitation of GW & • Bed level of the drainage and the bed level sluices	The study team notes that Prof. M. S. Swaminathan Committee in its report has recommended a moratorium stipulated on all foreshore developmental activities. Accordingly, moratorium tourism was imposed on 21st August, 2009 and 3rd November, 2009. Based on a report submitted by Integrated Coastal and Marine Area Management (ICMAM) no development was permitted in the areas identified as "high eroding sites" and areas along ecological sensitive areas. All the proposed measures by the participants of the workshop shall be examined to be appropriately addressed in the final report
Follow-up meeting on 14th June 2011 No specific comments on the report was made during the wrap-up meeting but assured us of their comments after their perusal of the report.	

Table 13 Comments from Asian Development Bank

Comments	Response
ADB: Comments by Charles Rodgers (RSDD/RSES) August 7, 2011.	
a. *Note that in some cases comments are addressed in subsequent portions of the report	General-Charles Rodgers only saw the India Water Systems part (version 22 July)-some of his comments are better explained/covered in the sub basin sections in the main report
b. ES, Par. 2: "…IPCC and others has produced enough scientific knowledge and predictions for accelerated climate change at global and regional levels…" First, I would not characterize the state of global and regional knowledge as "enough", except perhaps to motivate action, since there is still considerable disagreement between models even at those scales. Also, recommend not to use "prediction" but rather "projection" throughout this document, in line with IPCC practice.	Agreed will incorporate these changes into the report
c. ES, page 2 par. 4: "The Fifth IPCC Assessment Report (AR5) … is expected to offer more accurate projections." I would avoid the use of "accurate" (here and elsewhere) in describing GCM projections. It would be more correct to say that the newer models (CMIP5) are likely to be more physically realistic (as more processes are represented), with many at finer spatial resolutions than the CMIP3 versions. However, some scientists (e.g., Trenberth 2011) caution that there may be *more* inter-model variability (uncertainty) as a result. Perhaps say "more credible projections".	Agreed will incorporate these changes into the report
d. ES page 3, par. 5: Here (and elsewhere) there is a proposal to conduct strategic planning and a range of supporting activities at the sub-basin level (presumably within States), and "later" at	The basin level planning will take time and some institutional initiatives to get these off the ground. Plans will need to be agreed and endorsed which

the basin level. In fact, sub-basin planning frameworks would be dependent on shared assumptions and boundary conditions from the full basin framework, so I would suggest that they should be developed in tandem. Restated, any water accounting framework at sub-basin level would have to reflect the larger basin-scale framework.	at present is a no go area at basin level. The less satisfactory compromise but workable approach is to develop sub basin plans and then gradually move these towards basin plans including the gradual enablement of basin organisations including stakeholder consultative forums and groups. Sub basin plans would work within the agreed boundary conditions -largely spelt out in the interstate agreements. Water availability and demand assessments would be carried out for the basin with and without climate change.
e. ES page 4 par. 7: It is noted that "Farmers are well aware of the water sustainability issues but find it economically difficult to change their farming systems." This is certainly true, but perhaps more thought could be given to the design of a system of incentives that would encourage and enable farmers to invest in more water-efficient farming systems. One such idea would be to "exchange" the current system of ongoing electricity subsidies for powered pumpsets (at a time when India faces chronic energy shortage) with one-time grant assistance to invest in water-saving technologies that would have the impact of greatly reducing both energy and water use in groundwater and conjunctive-use systems. At the very least this should be pursued as a research question. More generally, this report has emphasized institutional re-design and strengthening, focusing primarily on Federal and State-level institutions, without exploring policy changes at the farmer level. If, for example, farmers were assigned a water use right consistent with a reasonable level of water use efficiency, and were allowed to sell any unused entitlement back to the state (or e.g., the RBO) then a powerful incentive is created both for more effective management of water and for investments in advanced technology.	Agreed-In the Sub basin plans we are proposing an approach of balancing support for agricultural productivity together with farmer adoption of water conservation measures. I think we are very much on the same lines but will check the report especially the executive summaries to ensure these points are brought out.
f. ES page 5, par. 1: "Climate change projections estimate an increase in temperature of about 2 ^{O}C by mid-century." Here, there is a need to be careful about over-simplifying the results of modeling studies. The 2 ^{O}C estimate may be the mid-point of a distribution of model projections, and reflects assumptions concerning GHG emissions trajectories and so on. Perhaps use a more caveated statement.	Agreed. Climate Change projections indicate an increase in temperature by mid century. There is variability between projections, depending upon emissions scenarios assumed and models used. The PRECIS regional climate model, run with boundary conditions from the HadCM3 global climate model for three emissions scenarios indicates a temperature rise in the range of 1.7^{o}C to 2.0^{o}C. (RW)
g. ES page 5 par. 9, Institutional, Regulatory and Support Measures: There is no discussion here (and throughout the document) concerning the power subsidies or the lack of groundwater regulation (refer to comments above). Are these policy issues "off the table"? It is clear that they are politically loaded issues, and not easy to discuss, but at some point the need for society to adapt to an increasingly difficult water resources situation will make such concerns moot.	Agreed-these are very much part of the proposals and spelt out in each of the sub basin proposals. It is sensitive but agree need to indicate much more clearly the need for regulation aspects and need for society to adapt (AY)
h. ES page 7, par. 5: "Under the PRECIS A1B scenario" It is more accurate to say "under the HadCM3 A1B scenario, downscaled with PRECIS" or similar. PRECIS depends on GCM boundary conditions.	Climate Change: Under the HadCM3 A1B scenario downscaled with PRECIS:
i. ES page 7, par. 8: "while the current projections are not sufficiently robust to make concrete planning decisions, they are considered sufficiently reliable to support strategies and the general direction of water resources development." I'm not sure that I agree entirely. To make such a statement, one would need to evaluate these projections in the context of the entire CMIP3 ensemble results, at least regarding e.g., annual and seasonal precipitation. I would recommend changing the language to something like ".. they can be taken as indicative of potential future climatic conditions, and used to evaluate strategies…" or	Agreed wording adjusted

similar.	
j. ES page 10, par. 2: "IPCC AR4 upper envelope projections indicate a 0.3 metre rise by mid-century." Very few researchers believe the IPCC AR4 SLR projections – most would say that they are almost certainly too low, since they ignore e.g., ice sheet dynamics in Greenland and Antarctica. (Note – it looks like this point is made later in the text).	Agreed. Sea Level Rise: In the short to medium term, IPCC AR4 upper envelope projections indicate a 0.3 metre rise by mid century. Many researchers now consider this estimate to be too low, however.
k. Summary of Abbreviations page 14: SWAP should be "Soil-Water-Atmosphere-Plant"	Will change
MAIN REPORT:	
a.. Page 6, par. 22: regarding the increase of 3.3 ^{O}C by end of 21st Century: again, be clear that this is (presumably) an ensemble mean or similar, rather than a robust consensus across models and SRES scenarios.	Will change to: The IPCC AR4 reported climate change projections for South Asia are derived mainly from an ensemble of GCMs (CMIP3), referred to as the MMD (multi-model-data) models. From the MMD models the reported change relative to the 1970s baseline was an increase in temperature under almost all the scenarios and above the global mean including: (RW)
b.. Par. 23: *many* CMIP models will be available at higher spatial resolution. And again, while this should improve process representation, the variability across models may not necessarily decrease as a result.	Agreed. Change para 15 to: These results have been widely circulated and disseminated. Towards the end of 2011, the next generation GCMs (part of CMIP5, will be used in preparation of the IPCC AR5) will become available at higher spatial resolution. This will improve process representation, but may not reduce inter-model variability. The consistency of precipitation projections may improve with respect to the direction of change. No major changes in temperature projections are expected. (RW)
c. Page 7, par. 28: "Issues and solutions are changing rapidly" One set of solutions that isn't changing rapidly is increased water use efficiency (or more properly, increased water productivity), and the argument is equally persuasive with or without climate change.	Agreed will adjust
d. Page 7, Table 3: While this may be implicit in one or more of the Aspects presented in Table 3, I think that an additional Focal Area for India Water Systems will be improved measurement and integration of data across scales, to improve catchment water balances and real-time management. I am referring to new remote sensing technologies that provide increasingly accurate estimates of e.g., real evapo-transpiration and soil moisture. These will become increasingly important in short-term water resources decision-making and may deserve mention here.	Since the version sent 22 July we have added a new focal Area 6 Incorporating Climate Change into Planning and Design. Under point 7 in the table, I suggest adding: The potential use and incorporation of emerging data capture techniques, including for example remotely sensed precipitation and evapotranspiration should be explored.
e. Page 8, par. 35: Another good study is Krishnamurthy et al (2009), attached, which is in good agreement with Goswami.	The comments by Krishnamurthy have been added Studies by Krishnamurthy et. al generally support the findings of Goswami et al. Their study also made use of the IMD gridded daily rainfall dataset, but considered changes in the frequency of events above threshold percentiles of the daily rainfall distribution, and intensities, rather than fixed threshold values. There were many grid cells with no statistically significant trends, but the indication was of generally decreasing trends in frequency and intensity of extreme rainfall in the north and central parts of the Indian sub-continent, while coastal regions and the region immediately wet of Bangladesh have experienced increasing trends.

f. Page 9, par. 38: "The latter, known as Global Circulation Models (GCM), incorporate oceanic and atmospheric physics and dynamics and represent the general circulation of the planetary atmosphere and ocean." Not to split hairs, but GCMs coupled with ocean circulation models are usually referred to as AOGCM.	Agreed. The latter, known as Atmosphere Ocean Global Circulation Models (AOGCMs), incorporate oceanic and atmospheric physics and dynamics and represent the general circulation of the planetary atmosphere and ocean. Rest of this section we should change GCM to AOGCM. Also para 31:changed A RCM is a model of the atmosphere and land surface which has high horizontal resolution and consequently covers a limited area of the earth's surface. A RCM cannot exist without a 'parent' GCM or AOGCM to provide the necessary inputs.
g. Page 10, par. 38: "The downscaling can be of dynamic or statistical type. These models are referred to a Regional Climate Models (RCM)…" Again, not to split hairs, but Regional Climate Models typically aren't assumed to encompass statistical downscaling.	Agreed. End of para 30 to be changed as: The downscaling can be of dynamic or statistical type. Dynamic downscaling models are referred to as Regional Climate Models (RCM) and improve the quality of climatic prediction for specific local areas.
h. Page 11, Par. 47: "It is important to realize that if the boundary conditions of the underlying GCM are not skillful, then the downscaled results will remain relatively poor." This is a bit confusing as worded – better to say something like "… if the parent model providing the boundary conditions is not skillful in replicating important features of the regional climate, then down-scaled results will reflect this lack of skill." (or similar)	Agreed. Change para 33 to be changed: While it is possible to get finer details from techniques such as dynamical downscaling by using regional climate models (RCMs), it is important to realise that if the parent model providing the boundary conditions is not skilful in replicating important features of the regional climate, then down-scaled results will reflect this lack of skill.
i. Page 11, par. 48: "…surface air temperature rise by 2030's ranges from 1.7 ^{O}C to 2 ^{O}C as in the three simulations." Relative to what baseline? Best to state.	Agreed. Change 2nd sentence of para 40 to: Relative to the 1970s baseline period, the annual mean surface air temperature rise by 2030s ranges from 1.7°C to 2°C as in the three simulations.
j. Page12, Figure 1: Observed and Projected Climatology: Please consider making this a full-page graphic, as it is hard (for me at least) to get a good impression of regional skill given its present size.	Agreed can make it bigger but quality is poor. Figure has been improved
k. Page 12, par. 52: On what basis was the Q14 scenario chosen for use in the three sub-basins' analysis?	The Q14 scenario was the only set of results made available to us. I think that IITM Pune may still have been working on the other two.
l. Pages 14-15: Nice to se that you are working in the concept of a regional archive.	Thanks
m. Page 17, Table 5: under (2) River Flow Trend Analysis, it is noted that the analysis be based on naturalized flows. This would imply relatively complete, time-indexed data on withdrawals, consumptive use and return flows. Will this be a part of the proposed basin framework? It definitely should be.	It should be based on naturalised flows it would have little meaning. It is likely that in some sub-basins it may not be possible to put together sufficient data with which to naturalise flows, but it should be an objective. Naturalisation can be approached either in the sense of removing water resources development influences, or incorporating the impacts of the current development level on historic records. The former is preferable for trend analysis, particularly where there is significant storage. We should aim for this to be part of basin framework planning.

n. Page 22, par. 91: "Many but not all of the water resources planning and management activities can be implemented within the sub-basin…." Not sure I fully agree – IWRM rests above all on accurate mass balances, which require a basin framework rather that a framework based on political boundaries. While I agree that, given the mandate of the States to manage water, planning and management will be state-level activities, I would still argue that a whole-basin perspective is ultimately required.	The allocations of water to the states are very much fixed by the state tribunals-the aim is to gradually move towards basin planning. Will adjust this paragraph to say sub basin planning is the interim approach (AY)
o. Page 26, par. 107 and Table 8: I have a question concerning sub-basin types – is a "no-groundwater basin" one that has no usable groundwater, or one in which little or no groundwater is being used, either because of (currently) adequate surface water or inadequate investment in pumps or other extraction technology? Each interpretation has very different implications so far as management and investment are concerned. The same issue arises in paragraph 108.	Agreed will clarify the difference
p. Page 26, par. 108: "Micro irrigation and piped irrigation would have minimal application due to the lack of incentive to invest in water savings." Please see my earlier remark – perhaps there should be more discussion on the current lack of incentives for farmers to invest in water-efficient technologies and practices; and what alternatives exist to address this lack.	Agreed-the various points noted. Moving towards water charging will be slow and take time and we are proposing initially a mix of incentives/subsidies in return for taking up water savings-will bring these points out more in the various parts of the report.
q. Page 28, par. 110: "…farmer uptake requires significant support and possibly some element of regulation." As above, what are required above all are *incentives*.	Agreed we are proposing a move from blanket subsidies to more targeted incentives to meet conservation. However until some form of volumetric charging system can be established the only incentive possible are more subsidies-will expand this point
r. Page 28, par. 111: regarding the CWC's project-level estimates of irrigation efficiency – is there any way to relate these to sub-basin or basin efficiencies? Otherwise, it's hard to know how to interpret such numbers.	No there is no comparative basin /sub basin efficiency assessments-will point this out in para 111.
s. Page 31, par. 127: Not sure what is meant by "long-term changes in the land movement.." – is this a reference to land *subsidence*?	Wording adjusted
t. Page 31, par. 127: "Projected temperature increases are considered to have a high level of certainty…" I'm not sure that this statement should be worded this way. The IPCC has developed specific language to deal with uncertainty and likelihood. In their terminology, "virtually certain" refers to an event that has greater than 99% probability of occurrence. In this case, what exactly has a high probability of occurrence? Temperature increases, or specific temperature increases? Perhaps better to use language like "temperatures are projected to increase at a high level of confidence.." or similar. What *is* relatively certain is the direction of change. Magnitude less so.	At top of page 35: *Projected temperature increases:* there is a higher level of confidence in temperature projections than in projections of other climatic parameters. An allowance for increased temperature should be factored into planning, and specifically crop planning.
u. Page 32, Table 10: Is runoff in the Kshipra really anticipated to increase by 83% in response to a 15% increase in precipitation, accounting for increases in potential evapo-transpiration? Seems high somehow.	Agreed seems very high. According to SWAT, 83% of the increased precipitation appears as runoff. The actual increase in runoff is 65%. There is a decrease in simulated evapotranspiration. Change to 65% in table. Change title to Precipitation and Runoff Changes.
v. Page 33, Table 11, Climate Change Decision Matrix for India Water Systems: While this is a useful framework and table, I am curious as to how the specific levels of confidence have been established. For example, Sea Level Rise is assigned a high level of confidence in estimates, but snow and glacier melt a low level (please refer to my earlier comment – is the high confidence in the direction of change, or in a specific magnitude of change? If the former I agree, if the latter I'm not so certain). However, the same underlying process is behind both, and if you accept that SLR will occur at a high level of confidence, then you must accept that glaciers will ablate at a similar level of	. "Confidence level of estimates" have been subdivided

confidence. If the confidence level refers to specific levels of change (e.g., 30 cm SLR by 2050 or similar) then I agree that one would be hard pressed to come up with comparable estimates of e.g., ice mass loss by 2050 or similar. But I think that there is a problem with the use of these confidence levels, even if only intended as indicative, without (1) providing a source or reference for these estimates, and (2) clarifying what they refer to – directions or specific values.	
w.Page 42, Proposed IWRM Institutions: For future reference, it would be useful to explore the utility of the Indonesian "PERUM Jasa Tirta" concept to Indian basins. Jasa Tirta is a public corporation ((PERUM) that manages and allocates bulk water at river basin scale, and that must cover its recurring (but not capital i.e., infrastructure) costs through water tariffs and service fees. It serves both management and regulatory functions, but is ultimately subservient to (and a member of) the State Water Resources Steering Committee (or Indonesian equivalent). An interesting and promising model that addresses many of the desired IWRM functions.	Agreed will add this possibility-there is a lot of sensitivity of private sector even public corporations. I think we have to initially set the basin institutions based on government systems-the use of government corporation could come later-initially within the sub basins-will add some text to this .(It is observed that the Indonesian Perums which are equivalent to the Indian Nigams are not without their problems .

Table 14 Other Comments

Comments	Response
1/Mr.Chetan Pandit Chief Engineer National Water Academy,CWC	
a. I fully agree with everything written in the chapter and have no modifications to suggest.	Noted
b. Having said that, let us go a little further. You might have read in the papers about the agitation by farmer in Malval areas objecting to supply water from Pavana dam to industrial township of Pimri-Chinchwad near Pune. In Tuesday the agitating farmers blocked traffic on Mumbai-Pune express way for about 6 hours; the agitation turned violent; police had to open fire; and four protesters were "hilled" Now read Para 24 (ii) on page 6 in above context. It says. "The idea of multi-stakeholders consultation is that stakeholders must be aware of the fact that their needs for use a finite resource may conflict with other users' needs and through participative discussion stakeholders will express their concerns and issue and through collective dialogue move towards addressing issue and finding solutions." Very good. Now , suppose you are appointed as a one- man committee to apply this in Pavana dam conflict, can you tell us your action plan how to proceed? Exhaustive discussion have been already held with the farmers over last several year [yes, years]. What more and what different will you do?	Multi-stakeholders consultation generally paves the way for good negotiated settlement. There is no definite formula or action plan for such consultation. It will mostly depend upon the wisdom and skill of the mediator. Knowledge of overall water balance in the sub basin is also pre requisite for the mediator. The key to multi stakeholder consultations is to initiate consultations in the very early stages of the planning processes.
c. Then Para further says "Multi- stakeholders, facilitated by a neutral party, is a proven methodology in such resources conflict situations." If it is proven methodology, then there ought to be many example/case studies where it was "proven". Can you put a few such examples in the Annexure? Also, where does one find this "neutral party"? At level we couldn't find any in Narmada, Krishna-Godavari, Cauvery ….conflicts. At project level we could not find any in Sardar Sarover, Tehri, Syl, Delhi 24X7, Bhairo ghaati, Lopharinag Pala, conflicts. Pollavaram and Lower Subansiri are presently passing through conflict stage, and Renuka, Lakhwar Vyasi, Kishau, Kalpasar will soon join. How come not a single conflict has been resolved through this multi-stakeholders consultation facilitated by party and yet it is a proven methodology?	Disputes remain in the news for a long time. Settlements and agreements are short duration news or no news and are easily erased out of the public mind. There are about 130 agreements and settlements related to inter state water issues. These are in the records of CWC. In the river basin set ups like Tungabhadra Board, NCA and BBMB, a large numbers of issues are settled, in the board meetings. However, only some issues get prolonged.
d. This is a problem I have with the kind of chapter you have forwarded to me.3000 words, one can not disagree with any of it, and yet they actually mean nothing. Seen by itself, the chapter is a completed philosophy that addresses every aspect of capacity building. But if one tries to translate any of it's in to action, one it is nothing more than philosophy. Here are more examples. "Building upon the various information bases available at community level,	Making persistent sincere efforts based on sound philosophy and principals mostly leads to solutions. Skills and wisdom of the working team, off course, also play important part in any such effort to be successful and meaningful.

Comments	Response
codifying them where necessary." Now tell us what exactly do we do to "build upon" it at "community level", and "codify" it, and how to determine "where necessary"? i.e. which are the situation where codifying isn't necessary ?	
f. Implementing IWRM requires institutional reorientation, capacity development and building of stakeholder consensus through enhanced awareness and understands ding of its benefits in the short and long terms. A crucial first step in pursuing IWRM is conceptual clarity… The IWRM climate change strategy contains a significant amount of new material and ideas that will be unfamiliar to government trainers. As far aware, we are still trying to understand what exactly this IWRM is and how it is different from non-I WRM. As it that was not enough, we now have to decipher IWRM fused with the climate change strategy. I fully agree that "A crucial first step in pursuing IWRM is conceptual clarity" The only comment is, who (person/ institution) has this conceptual clarity, and can teach us?	The water resources planning and management so far has been mostly surface water projects oriented. It is important that we should shift to-wards holistic planning of the sub-basin or basin, considering overall water balance/ consumptions, considering rain water, surface water, ground water and evapo transpiration water into planning and management process. This will help to manage the water properly within the prevalent policy directives. Climate Change variations in water resources if any can also be accounted and managed through IWRM principals.
g. Water Resources Planning and Policy for Senor Manager from Centre and State graded as B. Then, who qualifies for "A" level training in the topic? And who are the trainers?	The Climate Change Analysis are being carried out by complex modeling and with a huge data requirement. In India, IITM is involved in such studies. In our opinion it is required to be understood at macro level by the senior managers. Understanding details including full technical aspects may not be necessary for them.
2/ Steve Parsons, Team Leader, Technical Assistance to Hydrology Project Phase Ii	
a. I note and endorse – the selection of "strategies for water resources data management" as a focal area. This is an area where Hydrology Project is actively engaged, sharing the objectives of this focal area that you identify. It seems very appropriate to make sure we keep in detailed touch in this area to develop synergy in the approach and interventions to support this area.	Agreed
b. The sub- basin planning frame work approach is also strongly supported by me. The DSS(Planning) being developed under our project uses sub-basins for the pilot areas, and seeks to develop tools that allow detailed estimates of water resources throughout the sub-basin, and to review impact of proposed planning decision on the distribution and likely future availability of water resources. We can certainly share experience in this area – from difficulties in getting adequate data-set to under-pin the DSS to the success in getting planners to effectively use such tool once they are available.	Agreed
c. For specialist inputs to sub basin planning, a key underlying factor is, of course good data. At the moment there are problems of data accuracy which will make climate trend analysis uncertain. We struggle to explain the importance of getting good quality hydrological data to senior managers – and in the past there has been uncertain funding of hydrological data collection – especially in the Sates. Help in getting the message across that good water management in the future has good hydrological data collected NOW as a pre-requested would benefit the Hydrology Project and its sustainability.	Draft Final Report highlights importance of good data collection and management; and networking of such efforts by various agencies.
d. Proposed IWRM institutions. I note your care in trying to separate any regulatory function from a State organization based within an irrigation Department. I fully agree this need to be done. I have observed there is a long- term need for States to properly identify Hydrologists as specialist and not a sub-set of Irrigation Engineers. There is lot of damage done to hygrometry by trying to staff hydrology functions with ordinary irrigation engineers and not recognizing a separate specialist cadre of hydrologists who would be focused on professional development and expertise that they can continue to use through their career and to coincide with their particular professional interest. Establishing more independent IWRM institutions would certainly help this process – and so greatly assists development of good quality hydrometric data sets.	Noted and agreed

Comments	Response
e. Your Strategies for Water Resources Data Management are largely consistent with what is intended under the Hydrology Project –and we can continue to communicate on the details of what we are trying to do how we are trying to do it. I feel it is important when considering data management to separate: Raw data (field observations, with basis checking for accuracy and error) Validated data (detailed field information after further quality control measured – the basis, full information) Data summaries (processed information - daily flow rates, annual maximum discharge series, mean monthly flows etc)	Agreed We have not gone for details of methodology for data observation, validation and processing. Under HP-II extensive efforts are required make procedures for data management.
f. Sutlej:HP 2 has two "purposes- driven studies" that may be of interested in the area: Integrated approach for snowmelt runoff studies and effect of anthropogenic activity in Beas Basin (BBMB) (Dr. Sanjay Jain, NIH) Groundwater dynamics of Bist Doab area, Punjab, using isotopes. (Dr. M S Rao, NIH)	Noted
g. Sutlej: The Real Times DSS work of DHI for the BBMB also will provide a good database on hydrology of the Sutlej Basin.	Noted. We have also held discussion with DHI at Chandigarh on the DSS work of Bhakra system.
h. Sutlej: The "local management of water resources" theme in your approach is consistent with a number of high level studies in India on ways to improve water resources management – and in my view is the only practical approach to rally change current practices. Under the Hydrology Project we are concerned with hydrological data needs – and we currently do not have clear ideas on what data are likely to be needed for this local management approach. So we would be happy to discuss this area further to see what can be done about making appropriate information available to support local water resources management in practice.	Noted
i. Kshipra: Much work is done by the Central Groundwater Board on groundwater assessment – there is a national programme of data compilation and analysis for a block-by-block evolution of how current water of groundwater use compares with estimated resources availability. While there are a number of weaknesses in the approach, the data compiled are usually able to provide important local insights for deciding water management strategies. Your Tables 30 reports the summary of this data, but I did not see your intention build on this database in your planned strategy.	We have highlighted the need for conjunctive use studies for ground water management. WEEP modal also considers surface water and Ground Water Interaction. There is urgent need for much work to be done on the Ground Water Management.
j. Kshipra:Much work goes into increasing rainwater harvesting / artificial recharge of groundwater, but little is reported the true impact of such work on the groundwater balance – and the surface water resources. While you propose studies of these issues, perhaps it also needs a more targeted approach to focus on effectiveness and efficiencies of the common schemes. And how these might be improved.	This is agreed. We have highlighted the need for investigating effectiveness of recharge structures / solutions including benefits cost ratio of such works.
k. Cauvery: Improving irrigation use efficiency tend to be a direct loss of ground water resources - so it might be important to take a wider-than normal consideration of the "true" efficiency of water use in this delta area - as you have twin problems of lack of surface water AND groundwater resources..	We have taken wider consideration on basin/sub-basin level water efficiency.
i. Cauvery: You (correctly in my view) identify water quality as the key in this area - management strategies to retain and use as much fresh water as possible while preventing ingress of water Data system to support a water quality-bases local management system could be a key constraint in practices, and there may need to b e specific investment in monitoring system to obtain the data needed for implementation of the projects proposed.	It has been considered a serious issue which needs further study and remedial works. There is no doubt about need further for good data and it needs investment. It is hoped that HPII is looking into these aspect

Table 15 Summary of Points Raised Final Workshop 27th June 2011

Comments	Response
a. Sub basin Planning has to address existing schemes not just new schemes	This is very much the plan and in fact the emphasis is on existing schemes
b. CWC and IITM do not have the resources to address climate	This can be reviewed-IITM has very good facilities

projections -other institutes should be involved.	and a decision is needed whether to concentrate or spread the climate research
c. Climate change has to move from ad hoc arrangements	Agreed-report proposes systematic planning for sub basins
d. Decision making under climate change has to be multdisciplinary	This very much the approached proposed under IWRM and endorsed by the study.
e.. Climate change adaptation should be linked to the agro climatic zones in a basin	A good point and should be researched-climate change may however affect boundaries of the agro climatic zones.
f. A number of GCM/ RCM/ Local models are available. The results of all of these may be studied to find the general commonalities, which can be used in the decision making	Yes future assessments should widen the number of climate models studied.
g.The main challenge is to bring climate change into decision making. for example reconsideration of design floods-like plan barrages for X years design flood instead of 100 years, where X is > 100), to be refined as we gain more experience.	The final report now includes proposals planning and design under climate change including building in climate resilience into water resources planning and design.
h. Incorporating impacts of climate change in planning is all about making decision under highly uncertain conditions. The decision science, which is part of Operation Research Techniques, may be used in assisting such decisions under uncertainty.	Agreed there is a need to develop operational research to develop quantitive methods for analysis to support climate change adaptation.
i. All stakeholders have a role to play and shall be included	Agreed
j. MoWR shall play a nodal role on all the water related issues at the national level co-ordinating all the connected Ministries/Departments. For this, MoWR may be empowered with all powers including constitutional/legal backup.	The All India plan incoprorates the key role for CWC and MoWR to support sub basin and basin planning and climate change adaptation.
k.Development of participatory data information system at every level needs to be done	Agreed
l. Basin level approach as envisaged in national water policy for water resources assessment, planning, development, management and monitoring is very much essential	Basin planning requires to be participative with dialogue between the states and stakeholders. Once the key institutional arrangements are in place basin planning should proceed. In the interim sub basin planning should be taken up as soon as possible.
m. Under IWRDM set up for state, health and energy dept. Needs to be added	Agreed; sub basin and basin planning needs to incorporate energy use.
n. WALMI/Academic institutions shall be added in the state IWRDM setup	Agreed
o. RBO as a highest body with a RBO Secretariat to assist as given in the ADB report is recommended.	Agreed
p. Efficiency improvements should be considered at three levels-farmers field, scheme level and at basin level.	Very definitely-at basin level it is necessary to address the conjunctive use.
q. Lining of conveyance network should be based on factors like excessive seepages, water logging and salinity, water availability to tail end farmers and not necessarily for saving of water.	Agreed-impacts of lining on groundwater need to be factored in.
r. Capacity development/awareness programme through technical trips	Agreed-capacity development aspects in the report have been strengthened.
s. Documentation of available best practices in WM and their dissemination	Agreed
t. Fragmented lands are the hindrance for adopting scientific WM practices	Agreed-sub basin and basin planning should incorporate this.
u. Regulation of electricity- no free power, it should be charged, use of IT like use of smart cards (e.g. Bangladesh, China). Best practice – like Gujarat Jyothirgram scheme	Agreed, power charging is a key issue and challenge for the planning processes.
v. Walmi should be added to the key agencies in the state organisation chart for IWRM	Agreed-walmi has been added to the final report
w. Pilot RBO for interstate basins to be established	Agreed -two pilot interstate RBO are proposed
x. The Andrah Pradesh model for GW management should be considered	Will study the AP model-the experience in the sub basins shows very location specific approaches are required
y. Artificial recharge is important and needs to be studied	Agreed-however indications are that artificial recharge alone will not be sufficient.
z.Use of smart cards for power should be considered	Agreed -this is a good possibility and should be studied.
1. ..Power should not be free the Jyotirgram structure in Gujarat should be studied	Agreed-we have referred to the Jyotirgram scheme in the report as a possible model
2 MoWR role to be strengthened interstate rivers to be on the	Agreed-the concurrent list has to be discussed

concurrent list	
3. Participatory data information systems to be considered	This will be considered
4.David Purkey studies in Andes relevant WEAP model can include glacier and snow assessments	The WEAP model would appear to be very appropriate for the India situation
.5.Mr Said Jains presentation on snow melt very relevant to Sutlej	Follow on studies on glaciers and snow in the Sutlej should link with the NIH work
6.Increase the function of the WUE	Noted
7 Coastal areas to consider desalination	Operational costs of desalination are extremely high. Water resources management and efficiencies should be considered first to allow surplus water to be allocated for potable and industrial water in the coastal areas.

VI. PARTICIPATORY RURAL APPRAISAL

A. Introduction

A participatory rural appraisal (PRA) was implemented in the three sub basins. The (PRA) was designed to obtain key information from farmers and other stakeholders on current issues, impacts on climate change and information on the way forward. The results of the PRA are described in the appendix of each sub basin. The questionnaires are described in this section.

B. PRA Sutlej

Two sets of questionnaires were used: (i) for Focused group discussion PRA and (ii) for household survey. For the questionnaire (ii) only top page had additional questions rest part was the same. The objectives were to; (i)analyse the stakeholder assessment of current issues; (ii)analyse the problems and causes of issues; (iii) to test the response to potential initiatives to address water issues; and (iii) identify possible initiatives that could be further investigated. The: PRA is to support the villagers through the process of analysis of the problems and help them identify appropriate response to the difficulties and opportunities

Project : TA-7417 (IND): Support for the National Action Plan on Climate Change
Sponsored by: ADB. Sirhand Irrigation System Punjab
Conducted by: Joyashree Roy and team of four[10] including local (Panjabi University of Patiala) students[11]

PRA must provide the following information

Village history: District:…….. .Village ……
Respondent Name.....
Occupation main.....secondary.....
Land area (ha) Land owner..... renter .....

WATER RESOURCE BASE OF THE VILLAGE

1. What are the main drinking water sources available for use by the community (springs, boreholes, wells, hand-pumps, canals, piped water from ……..)?

	Wet months	Dry Months	Issues-- MI-major issues, I Issues SI-some issues NI no issues--also describe		
	(P)-primary)/ (S)secondary source		Water Availability	Water quality	Other
Spring					
Borehole -hand pump					
Bore-hole electric pump					
Dug Well					
Piped supply-house connection					
Piped supply stand pipe					
Canal					

[10] One post Doc: Dr Duke Ghosh

[11] Three Students from department of economics at Ph. D (Rakesh Kumar) M.Phil Level (Manprit Singh , Vikramjit Singh).

Other					

2. What are the main sources of water for agriculture or other non-potable uses?

	Wet months Kharif			Dry Months Rabi		
	Source	Availability	Quality	Source	Availability	Quality
	Enter approx % of each type	Good, medium, poor, not available	Good Medium, poor	Enter approx % of each type	Good, medium, poor, not available	Good Medium poor
Canal Water						
Borehole - shallow <5m to water						
Borehole mediume 5-30m to water						
Borehole deep 30+metres to water						

3.Expand on issues above: including depth to water/ salinity/ health issues

4. What other water issues are there

	Impact	Describe
	Major/Medium/Low not an issue	
Flood		
Drainage		
Other		

CHANGES IN WATER SOURCES OVER THE LAST 10 YEARS

1. What changes have been observed over the last 10 years

	No change	Minor change	Significant Change	Describe the change (increase/decrease) and impacts on crops/damage to infrastructure etc
Temperature				
Total rainfall				
Extreme rainfall				
Hail stones				
Start date of the monsoon				
Drought				
Surface water availability				
Depth to Groundwater				
Groundwater availability				
Groundwater quality				
Flood				
Other				

2. Expand comment on the above issues and the changes impacts from the changes- i.e has it influenced the cropping patterns, livestock levels
3. Do the stakeholders feel climate change will affect their livelihood- is so in what way.
4. Where are the main areas of vulnerability to climate issues
5. What measures could the government take to reduce future vulnerability

WATER MANAGEMENT ISSUES

1. Issues of water management

Surface Water		
Equitability of allocation to the offtakes from the main canals.		
Equitability of the allocation to the individual fields equitable		
Water wastage in the main canal system		
Water wastage in the farmer canal systems		
Poor quality canals		
Other Issues		
Groundwater		
Lack of dependable electric power		
Lowering of groundwater due to overexploitation.		
Long term sustainability of groundwater		
Lack of charging for power is causing overexploitation		
Other		
Cropping		
Rice cropping is using to much groundwater		
Farmers are reluctant to move to non rice crops due to support price for rice		

2. Expand on any of the above points.....
3. Requirements for Regulation and control

	Agree	Disagree	Comment
	Strongly Agree/ Disagree. Agree, Mixed feeling, no opinion (SA, SD,A,D, MF,NO)		
For long term sustainability some type of regulations (control and restrictions) on groundwater is required			

Possible approaches to achieve this-			
Government to introduce charges for power used for tubewell water to control use and reduce demand			
Government to restrict area under rice cultivation			
Government to take on greater control and regulation of groundwater use.			
Greater Government controls to be introduced in tandem with programmes to support greater water use efficiencies and higher return cropping systems			
Government to restrict the number of wells			
Farmers and Community associations to take on greater control of surface and groundwater management			
Community associations could take on responsibilities to control and mange groundwater abstractions			
Government to change the price guarantees subsidies to promote non rice crops			

4. Possible Methods to Improve Water Efficiencies as a means to conserve water

Method	Assessment- VS-very supportive, S-supportive, M-mixed feelings DS-do not support A-against	Comment- describe how these could be developed
Improve the artificial recharge through community participation and incentives		
Promote the use of shorter duration rice varieties		
Promotion of high value lower consumptive crops to replace rice.		
Improve the surface water management and systems of water allocations.		
Expand the use of laser leveling to improve efficiencies		
Expand the use of field canal lining		
Develop strategies to improve the conjunctive use of surface and groundwater		
Develop the use of pipe irrigation		
To reduce water losses develop the use of sprinkler or drip irrigation		
Promote the use of SRI to reduce the water demand of the rice crop		
Introduce increased charges for surface water against increase in service delivery of water and support for improved irrigation systems.		
Introduce some level charges for electric power for tubewells in return for improve electricity availability and subsidies to reduce water losses.		
Seasonal weather forecasts to be provided		

for farmers		
Other -describe		

1. Summary of Sutlej PRA

General Socio Economic Issues

- Is there interest to move towards more sustainable cropping systems
- Are there labour shortages and how do you cope with that
- Are younger people staying in Agriculture
- Is there migration out of the area--what are the main reasons
- Would the farmers be interested in moving into large scale , high intensity mechanised farming systems through joint venture farming systems.
- How could a move away from rice cropping be achieved.
- Are farmers interested to develop/strengthen water user associations and take on more proactive role in sustainable management of the water resources
- How could the role of women in farming/water management be improved
- Are farmers interested in moving to new technologies to increase water efficiency -drip sprinkler etc
- What change in farming practices could be done to improve water use efficiency
- What is the perception of Farmers on ground water recharge. How should it be done in participatory manner.
- How could farmers apply improved weather rainfall forecasts to reduce the risks to cropping
- Are there conflicts/psychological stress among farmers within current water sharing system
- How are the conflicts resolved (role of government)
- Number of conflicts reported formally
- Any suggestion for alternative water sharing system
- Farmers investment (range and items) to ensure better access of farm land to water

Summary

- Farmers are aware that they are going to be 'the' beneficiaries of any better water resource management. Their primary concern is about income certainty. Farmers identify access to water as one of the three main determinants of their income security. Other two are market price stability and access to energy.
- Field survey through focused group discussion, stakeholder consultation, household survey and progressive farmer interview clearly reveal that **conjunctive use** of surface and ground water is in practice in Punjab. 10-30% of irrigation water demand by farmers is met by surface water flow and 70-90% by ground water extraction. This is reported by 48% of households in Bathinda, 70% in Sangrur and 100 % in Ludhiana.
- However, current conjunctive use is demand driven and mostly uncoordinated and partially managed. Surface water flow is fully managed and both supply and demand side are accounted for institutionally. Ground water is withdrawn at private initiative in an open access system i.e without any defined guidelines for extraction, use, recharge. Farmers use diverse technologies using electricity or diesel pumps to extract open access ground water resource. There is no record or accounting for ground water extraction. Ground water use is not officially/institutionally accounted for although resource position is monitored. Ground water resource availability and quality are accounted for formally by ground water boards.
- 100% of the consulted stakeholders are aware of adverse consequence of over exploitation of ground water. All stakeholders are fully aware that ground water availability is declining at a faster rate. From official statistics this fact is known to policy makers. For farmers they understand because every year they are going into deeper aquifers for water mining thereby incurring higher energy cost for water extraction.
- Need for formal management of conjunctive water use is well understood by 100% of respondents but voluntary action from farmers cannot be expected, neither administrators feel they can implement any restriction on ground water abstraction as that would mean depriving farmers of their water demand. Being asked if any statewide wide regulation on ground water usage can help, community felt it might but could not see political feasibility and practical implementation feasibility was in doubt as that would restrict agricultural activities there by adversely affecting farmers' income.

- Farmers across districts have very different opinion on ground water regulation or ground water management by government agencies. While 100% of the farmers interviewed supported the need for regulation on ground water irrespective of small or large farmer, in Sangrur small farmers supported more than large, while in Ludhiana regulation on ground water and especially by government did not find support at all. Higher the water stress higher is the support for ground water regulation.
- Community do not have a clear understanding on how ground water use can be regulated or managed if ground water can be openly accessed by any one given the availability of water extraction technologies. Moreover 100% of water demand is not met by surface water supply system in rice-wheat cycle based agricultural system.
- All stakeholders' responses depict a lock in dilemma in vicious cycle of 'ever increasing ground water extraction demand' emerging from 'high water demand' from 'rice-wheat cropping choice based agricultural system' and 'unavailability of sufficient surface water supply'.
- Providing a solution for conjunctive water use management is a major challenge for Punjab.
- The real challenge is how to regulate the existing informal water allocation market for ground water that happens bilaterally between rich and poor farmers. More careful and indepth study is needed to understand the dynamics.
- It needs to be explored if there is a potential for converting the current inefficient informal system by formal water extraction permit based water trading system where farmers will be players in the market to determine a price within a regulated water extraction limit. This is in perfect tandem with PES concept and avoids adverse impacts of increased government regulation, subsidy and water tax. Community's active role is recognized. This can provide right kind of control on ground water abstraction and ensure a support system through market price. This will not be very much in conflict with informal market system rather it will make the market efficient without worsening ground water extraction situation. The mechanism can be designed with further study.
- There is eagerness among multiple departments with cross cutting interest in water supply system to accept a clear mandate for an IWRM institute and its possible role and structure as coordinating institute among water using sectors including environment is a felt need.
- **Participatory Management** that exists is of two types: for canal water and surface water. Formal barabandi system for surface canal water allocation is top down command and control type system where community plays passive role. This is quantitatively equitable but do not follow efficiency principle as allocation is not productivity/crop related rather it is area related.
- Other extreme is community managed informal water market for ground water allocation. Rich farmer through affordability principle have access to ground water and sells the water to poor farmer.
- There is urgent need to improve efficiency in surface water allocation systems. Farmers in Bathinda district expressed that area based water allocation system do not address the crop wise difference in water demand.
- Ground water use information unless recorded and maintained officially by involving farmers no formal efficient management policy can be implemented be it for ground water regulation or conjunctive use. Community based institutions such as water users association or panchayat led institutions have major role to play in such situations. However, with additional training or capacity building participatory information system for ground water use pattern can be prepared.
- Such information can provide basis for calculating any 'control and support' system for farmers to regulate ground water use. Control can come after assessment of groundwater abstraction capacity in any district. It needs to be explored if in the new regime IWRM can take up this role for issuing ground water permit and managing the market. True community involvement can happen if farmers are be allowed to trade permits among themselves. Demand and supply will determine price for ground water use permit. This will effectively a reward or payment for ecosystem services created. This can replace unregulated regime for ground water abstraction and move away from subsidy system. It can be proposed that ground water extraction capacity may be assessed district wise based on scientific enquiry to determine permit quantity IWRM. IWRM can implement the control and support system.
- In more water stressed districts farmers are providing innovative solutions for water savings. Bathinda district farmers wanted crop zoning for the state, restrictions on paddy cultivation, scientific information for alternative crop and livelihood options, revisiting of barabandi system, water users association, channel lining, laser leveling, sprinkler and drip irrigation facilities, RO

based drinking water supply systems. Bathinda is more cotton producing district than Sangrur. Latter is paddy dominated only 5% is under cotton. Farmers wanted more canal lining, ground water recharge, direct subsidy to farmers, more government incentive to make agriculture remunerative, do not feel farmers can collectively solve water issues but feel small farmers need protection/support for water access as they pay high price to buy water, prefer pipe irrigation . The farmers feel irrigation technique change and some planning in harvesting time, market support for short duration basmati rice will help. The farmers want nonfarm part time job opportunity as agriculture provides enough free time. In Ludhiana the farmers are unwilling to move from paddy cultivation, wanted more market and infrastructure support for oil seed production, potato, pulses. They wanted more support for advanced technology for land preparation, direct seeding, soil moisture measurement, pollution control, flood control measures. They believe crop diversification and changing crop calendar can save much water demand. Some area specific restrictions on paddy cultivation by government was suggested. Government to control groundwater usage was supported but not distribution of groundwater by government.

- In all districts it is strongly felt that unless there is market support price for other crops like paddy and wheat crop diversification will not be done as latter will increase income insecurity. In Bathinda district famers were of the view that agriculture sector need to be managed in more organized way like industries.
- Despite small size of farms collective farming practice is not socially supported in a very individualistic society. Contract farming/Corporate farming practice is envisaged as future framing farming practice rather than collective farming due to migration of next generation, labour shortage and declining productivity.
- Society is male dominated and females' participation in agricultural activities are minimum due to mechanization also. This reduces economic empowerment and liberty.
- Given the current level of ground water usage pattern and cropping pattern community capacity is limited to adjust to climate changes.
- But farmers in all districts understand that climatic variability through temperature, rainfall pattern and monsoon start date change. Better weather forecast is demanded by 100% of sample households in sangrur, 71% in Bathinda and 50% in Ludhiana. 36% of sample households in Bathinda, 25% in Ludhiana and 20% in Sangrur believe changing precipitation is affecting ground water availability and quality. So ground water recharge is suggested.
- Suggestions are in favour of multiple changes together through changes in policy, irrigation infrastructure, change in agricultural practices, crop choice etc.
- For more than 90% of the households surveyed in each of the study sites, paddy and wheat are the primary crops cultivated. In Sangrur, a few of the farmers indicated that in the recent past, cotton was one of the primary crops but they have switched over to paddy and wheat because of the probability of severe crop loss in cotton. The survey indicates that without the incentive or crop insurance, it would be impossible to induce the farmers to undertake cotton/alternative crop cultivation. In Ludhiana, a few farmers indicated that although sugarcane is a viable cropping option in the area, they are reluctant to cultivate the crop because of insufficient marketing infrastructure. The Ludhiana farmers also indicated that oilseeds (like sunflower) had once been a major crop in the region. However, due to the high price volatility of the crop, the farmers have shifted to paddy and wheat cultivation.
- Strategic action plan need to have some statewide actions such as cropping pattern change, ground water allocation regulations, market support price, PES etc. supplemented by district level specificities to make actions inclusive. E.g., salinity issue is typical for Bathinda, while recharge demand is high in Sangrur and need for more technology innovation including seed variety, role of farmers in maintaining ownership over ground water is stronger in Ludhiana.
- Inclusion of stakeholder response district wise will make the actions implementable and less risky.
- Community empowerment through training and capacity building will make actions acceptable and projects less risky.

C. PRA Shipra

1. PRA Questionnaires[12]

25. The objectives of the questionnaires was to; (i) analyse the stakeholder assessment of current issues; (ii) analyse the problems and causes of issues and (iii) to test the response to potential initiatives to address water issues; and (iv) identify possible initiatives that could be further investigated. The PRA is to support the villagers through the process of analysis of the problems and help them identify appropriate response to the difficulties and opportunities

Project : TA-7417 (IND): Support for the National Action Plan on Climate Change
Sponsored by: ADB. Chambal Kshipra Basin
Conducted by:
PRA must provide the following information

Village history: District:…….. .Village ……
Respondent Name.....
Occupation main.....secondary.....
Land area (ha) Land owner..... renter .....

A/ WATER RESOURCE BASE OF THE VILLAGE

What are the main drinking water sources available for use by the community (springs, boreholes, wells, hand-pumps, canals, ponds, piped water from ……..)?

	Wet months	Dry Months	Issues-- MI-major issues, I Issues SI-some issues NI no issues--also describe		
	(P)-primary)/ (S)secondary source		Water Availability	Water quality	Other
Spring					
Borehole -hand pump					
Bore-hole electric pump					
Dug Well					
Piped supply-house connection					
Piped supply stand pipe					
Canal					
Other (pond)					

1. What are the main sources of water for agriculture or other non-potable uses?

	Wet months Kharif			Dry Months Rabi		
	Source	Availability	Quality	Source	Availability	Quality
	Enter approx % of each type	Good, medium, poor, not available	Good Medium, poor	Enter approx % of each type	Good, medium, poor, not available	Good Medium poor
Canal Water						
Borehole -						

[12] Two sets of questionnaires were used: (1) for Focused group discussion PRA and (2) for household survey. For the questionnaire (2) only top page had additional questions rest part was the same

shallow <5m to water						
Borehole mediume 5-30m to water						
Borehole deep 30+metres to water						

2. Expand on issues above: including depth to water/ over exploitation/salinity/ health issues

3. What other water issues are there

	Impact	Describe
	Major/Medium/Low not an issue	
Flood		
Drainage		
Other		

CHANGES IN WATER SOURCES OVER THE LAST 10 YEARS

4. What changes have been observed over the last 10 years

	No change	Minor change	Significant Change	Describe the change (increase/decrease) and impacts on crops/damage to infrastructure etc
Temperature				
Total rainfall				
Extreme rainfall				
Frost				
Start date of the monsoon				
Drought				
Surface water availability				
Depth to Groundwater				
Groundwater availability				
Groundwater quality				
Flood				
Other				

5. Expand comment on the above issues and the changes impacts from the changes- i.e has it influenced the cropping patterns, livestock levels
6. Do the stakeholders feel climate change will affect their livelihood- if so in what way.
7. Where are the main areas of vulnerability to climate issues
8. What measures could the government take to reduce future vulnerability

WATER MANAGEMENT ISSUES

9. Issues of water management

	Classify stakeholder perception of	Suggestions for

	issue - major/medium/low or not an issue. Describe	improvement
Surface Water		
Check dams on river KKshipra		
Farm tanks of varied sizes proportional to land holding		
Equitability in access to water for the individual fields		
Water quality		
Poor maintenance of tanks		
Other Issues		
Groundwater		
Lack of dependable electric power		
Lowering of groundwater due to overexploitation.		
Long term sustainability of groundwater		
Low charging for power is causing overexploitation		
Other		
Cropping		
Change in cropping pattern is using too much groundwater		
How keen are Farmers for paddy due to support price?		
Farmers want to go for horticulture for subsidy in irrigation system		

10. Expand on any of the above points.....

11. Requirements for Regulation and control

	Agree	Disagree	Comment
	Strongly Agree/ Disagree. Agree, Mixed feeling, no opinion (SA, SD,A,D, MF,NO)		
For long term sustainability some type of regulations (control and restrictions) on groundwater is required			
Possible approaches to achieve this-			
Government to introduce charges for power used for tubewell water to control use and reduce demand			
Governme nt to provide more subsidy for tank and micro irrigation			
Government to take on greater control and regulation of groundwater use.			
Greater Government controls to be introduced in tandem with programmes to support greater water use efficiencies and higher return cropping systems			
Government to restrict the number of wells			
Farmers and Community associations to take on greater control of surface and groundwater management			

Community associations could take on responsibilities to control and mange groundwater abstractions			
Government to change the price guarantees subsidies to promote non rice crops			

12. Possible Methods to Improve Water Efficiencies as a means to conserve water

Method	Assessment- VS-very supportive, S-supportive, M-mixed feelings DS-do not support A-against	Comment- describe how these could be developed
Improve the artificial recharge through community participation and incentives		
Promote the use of shorter duration horticulture/vegetables		
Promotion of high value cash crop		
Improve the surface water management through tanks		
Expand the use of laser leveling to improve efficiencies		
Expand the use of drip and sprinkler irrigation		
Develop strategies to improve the conjunctive use of surface and groundwater		
Develop the use of pipe irrigation		
Introduce increased support for improved irrigation systems.		
Introduce some level charges for electric power for tubewells in return for improve electricity availability and subsidies to reduce water losses.		
Creating Recharge points in Kshipra River		
Cleaning of Pollution of Kshipra River needed		
Seasonal weather forecasts to be provided for farmers		
Other -describe		

GENERAL SOCIO ECONOMIC ISSUES

- How has access to water resource changed over time: from surface to ground/any other?
- What is the level of indebtedness among farmers (any gender bias?)
- Are younger people staying in Agriculture
- Is there migration out of the area--what are the main reasons
- How is the access to local natural resources (e.g forest, grazing land, water tanks..) and who controls?
- How could a move towards efficient irrigation system be achieved.
- Are farmers interested to develop/strengthen water user associations/panipanchayat and take on more proactive role in sustainable management of the water resources
- How could the role of women in farming/water management be improved
- Are farmers interested in moving to new technologies to increase water efficiency -drip sprinkler etc
- What change in farming practices could be done to improve water use efficiency
- What is the perception of Farmers on ground water recharge. How should it be done in participatory manner.

- At present what is more important –crop insurance ( ), water access ( ), support price ( ), subsidy for micro irrigation ( ), subsidy for tank irrigation ( ), enhance Kshipra river flow through recharge ( ), Ground water recharge ( ), more community role in water management ( ), More govt. role in water management ( ), more revival of old/potential tanks ( )
- Are the priorities same in future too?
- Are there conflicts/psychological stress among farmers within current water access system
- Any suggestion on alternative method to enhance water availability
- Farmers investment (range and items) to ensure better access of farm land to water
- In agriculture also drip and sprinkler irrigation be promoted the same way it has been done in horticulture.
- How can Kshipra river water be elevated

26. The ADB field survey team visited three districts Dewas, Ujjain and Indore in the Kshipra river basin. The villages visited in these districts for household survey are Dewas – Chidawad, Ujjain – Khajuria Rehwari, Indore – Fali, Arnia, Silsoudia.

District	PRA date	Villages surveyed	HHs surveyed on following days	River	Distance from Kshipra (Km.)
Dewas	18.1	Chidawad	12	Tillar	20-25 km
Ujjain	19.1	Naugaon, Khajuria Rehwari	9	No river, Nala Kshipra	15 2
Indore	20.1	Fali, Arnia, Silsoudia , Sanwer	19	Khan Khan Nala	45 kms 50 kms 25 kms

2. Summary of Kshipra PRA

- Field survey through focused group discussion, stakeholder consultation, household survey and progressive farmer interview clearly reveal that **conjunctive use** of surface and ground water is in practice but with mixed institutional arrangements leading to inefficient management. Surface water flow through canal system can meet only 0%-50% of irrigation demand in wheat cultivation. In Chirawat even progressive farmer is dependent 100% on ground water. Water scarcity makes Naugaon village (mostly inhabited by OBC category of households) mostly single cropped zone. In Naugaon women's demand has been for drinking water security to save on their time and labour. They want participation in decision making process as well.
- Need for government regulation on ground water extraction was supported by all interviewed and was very much supported during PRA. In the absence of any formal ground water management system poor farmers buy water from rich farmers.
- Incentive for surface water harvesting, private recharge initiatives is seen by farmers as a major possible action for reducing ground water extraction and recognition of community initiatives at mainstream policy level. This demand is in line with (payment for eco-services) PES rather than subsidy.

- 78-84% households support ground water recharge mechanism through community participation as a strategy. Some progressive farmers are already adopting some methods of recharge but there is need for more technical input and design. However, there is a strong feeling that private initiatives be scaled up and incentivized as they are adding to water resource.

- Farmers identify access to water as one of the four main determinants of their income security. Other three are market price stability, access to cold storage facility, access to power.

- Pro-active farmers in Shipra basin have been historically adopting coping mechanisms to harvest rainwater at the private farm level. There is strong community support to stop any run off from the basin to Narmada and hold the water where it drops: be it on land or rooftops.

This is looked at as major intervention to address current as well as future water crisis. WRD department feel 40% run off can be harvested locally. Both at famer level and official level there is full support for innovative water conservation programmes. There are project plans with WRD department of small dams to hold water for Indore area. In Mohukhera also community wanted such small dams and has identified location but challenge is institutional. How to get forest department in water resource management. In Chirawat village demand is for more dams on tillar river.

- Currently diverse water conservation programmes are run by diverse departments: agriculture department, horticulture department, WRD, watershed management programme, farmers' individual initiatives. There is need for integration of efforts, targets, information compilation and monitoring through coordinated community mobilization.
- One additional advantage in Ujjain is that educated youths stay back in village so knowledge expansion and absorption happens faster. In water resource use monitoring existing extension service providers and educated/trained farmers can work with government for better management of water. Example of 'Radegaon' experiment was extended to show community –govt. joint effort. Young farmers are ready for getting exposure to newer/best practices. Progressive farmers and older generation farmers are ready to share knowledge if organized formally for scaling up of their experiences.
- Framers' strong perception of ground water recharge potential of farm ponds needs more scientific study. Policy makers and local geologists feel assessment of adaptive capacity augmentation through farm ponds needs continuous measurement and geological monitoring and record keeping on a long term basis.

- Perceived change in temperature and consequent rainfall is supported by all interviewed across all cross sections during PRA or household survey. While farmers in Ujjain and Dewas are more (100%) concerned about the declining surface water availability in Indore similar (100%) concern is for declining ground water table. Increased urbanization and competing demand for water is suggested as one source of concern by the community. While 100% of households in Dewas and Ujjain favour better surface water management as desirable strategy, in Indore it is for artificial ground water recharge and managing pollution in rivers are the most favoured strategies.
- Villagers have very strong opinion about deforestation that is causing local level rainfall pattern change. They want not only adaptive capacity enhancement but also support for afforestation programmes which they feel might changes erratic rainfall pattern.
- Changing climate is affecting high value cash crop as well: gram, potato, chilli, fruits papaya, vegetables. Untimely harvest time rain is damaging crops more than 40%.
- To create adaptive capacity for Madhhyapradesh in water resource management to reduce future vulnerability need is also for institutional reorganization and may be it will be needed to get forest department also as an active partner which is not the case now.
- Villagers during PRA expressed that best way to deliver adaptive action to reduce vulnerability to climate change risks might be by rejuvenation through desiltation of all kinds of traditional water storage facilities within the villages: farm ponds, government ponds (shasakiya Talab) , wells (kuaon), drainage channels (nallas), shipra river perennial flow revival, cleaning of pollution of tributaries like khan, artificial recharge of ground water through abandoned tubewells. This however they feel needs technical knowledge and equipments. Community involvement through sharing of silt, putting in labour/equipments to supplement government effort is offered by all the farmers interviewed. Local NGO s are working as a bridge to community and government for Shipra punarbharikarn (rejuvenation) programme.
- Securing water and sanitation systems to climate change risks are priority areas for the state.
- Active participation of community is very high in water resource management in the state. Payment for piped drinking water supply is managed in Mohukhera by community elected body of panipanchayat. Water quality testing is conducted by trained village level panchayats.
- Over the years community has taken leadership to innovate farm ponds to get private access to secure water supply. This has now become a practice and been mainstreamed in policy action. There exist 70-80% government subsidy for balaram talab (farm ponds) which can be created in 10% of the farmer's own land. Madhyapradesh model of government support for scaling up community efforts is a good method to deliver adaptive action.
- The demand is much higher than actual number of such ponds because of financial constraint. Only 16% farmers have balaram talab. There is annual target set by government for each block. 47-78% households feel farm ponds are very good water management strategy as

current access to water is not equitable. 50-100% households feel although there is equitable access to ground water because of its open access nature but farmers with financial constraints cannot access it. Poor farmers end up buying (payment by crop share) water from rich farmers.

- Local technical experts suggest more scientific approach in locating balaram talab in any farm land especially growing soyanbeans. Latter leads to increased run off by practice. Location of farm ponds at the outlet point of agricultural land can reduce silt outflow down stream and flooding.
- Promotion of high value cash crop to achieve water efficiency like horticulture, vegetables is supported by al farmers as the most desired strategy to enhance water efficiency across all districts. Farmers have reservation about sprinkler technology. This indicates the concern and suggested solution for income security. However, demand for cold storage and support price is in demand from farmers to further secure their income against market price fluctuations and possible incentive for more farmers to adopt new practices.
- Unlike Punjab demand for laser leveling is very low. Around 50% feel they can try if that helps.
- In Dewas 100% households surveyed support equally all three options: drip irrigation, conjunctive use of ground and surface water, piped irrigation as the strategy to enhance water use efficiency. In Indore 95% feel piped irrigation is needed, followed by conjunctive use (89%) and drip irrigation (84%). Ujjain prefers (100%) strongly about drip irrigation and piped irrigation followed by conjunctive use (56%).
- Among the households surveyed demand for subsidy support in irrigation system development is the highest in Ujjain (100%), followed by Dewas (92%) and Indore (74%). But very low support from households in all three districts are found for electricity charge revision to enhance supply (8-11%). Current experience of farmers with unreliable power (55-100%) supply and declining ground water table (47-83%) are the major reasons for such low response. Farmers believe there is over extraction of ground water (47-83%) as it is an imperative strategy to access water for crop protection. Choice for wheat cultivation to secure income easily has led to increased water demand. Farmers are more interested in efforts at government level towards cleaning of pollution of the rivers in Ujjain and Indore (100-89%) and there is high degree of enthusiasm (56-92%) to get better weather forecasts as that can help them in making crop calendar flexible. Indore and Ujjain are interested in creating recharge points in Shipra river for rejuvenation but at the same time understand judicious conjunctive use is needed.
- Farming household do not feel there is enough scope for changing cropping pattern given their soya-wheat–vegetable cycles. Continuing research by BISA on wheat and maize, of JAICA on soybean to get short duration variety are seen as positive steps by farmers. Need for research/information on applicability of drip irrigation for Soybean, cotton cultivation is being identified as a need by the community. Ujjain and Indore felt that with changing temperature mulching becomes a necessity to keep soil moisture content stable.
- Only 11-42% of households think there is some possibility as they grow very little paddy anyway (0-32%). There can be substitution of wheat by zero tillage oil seed (kusum)/pisiculture etc. But shift to horticulture with irrigation infrastructure subsidy is preferred by larger number (22-53%). While farming households (83%) in Dewas think future sustainability of water supply strategy is important it is somewhat different in Indore (42%) and Ujjain (0%). But they express funding need for strategic actions towards water quality management, management of nallas, series of dams creation etc. , desiltation.
- Experts feel monocropping pattern with soyabean crop disease risk is increasing and there is need for crop diversification. Soil is becoming zinc deficient.
- Desiltation activity need in this region cannot be met by NREGS fund as there is need for use of heavy equipments and mechanization.
- There is need for more communication between farmers and government to strengthen community action. NABARD model of Kissaan club , ITC model of contract farming through ICT enabled service delivery system can be scaled up. Crop insurance is not functioning well in the absence of adequate monitoring and record keeping. Farmers usually under report crop yield but in case crop failure compensation is less.
- Stakeholder consultation clearly showed lack of communication among water sector stakeholders. Lack of communication sometimes leads to inefficient solution. It could be identified that there is lack of understanding about each other's aspirations sometimes leading to conflict of interests. While administrators are interested in cost recovery, politicians favour benefit distribution without cost recovery. Mohukhera model shows progressive community

can bye pass such conflict by building a sustainable business model with support from beneficiaries and administration and some level of capacity building. This is preconditioned by change in work ethics among both community and administration. While latter need to emerge as facilitator rather than command and control type top down role. Community need to take more enterprise through training, capacity building and empowerment and handholding and infrastructure cost sharing initially to be able to manage local water resources.

- Assessment of responses from various stakeholders shows that most successful model of community participation (such as balaram talab) is individual farmer level participation rather than cooperative management solution where free rider problem increases the risk of failure in the longer run.
- Roadmap for implementation of strategic action can start from institutional arrangement for coordinating efforts towards inventory creation of all diverse water conservation attempts so far across institutions including private and public initiatives. Evaluation of water conservation potential of each type of intervention. Knowlegde transfer from scientific study to community about potential action with benefits and costs associated. Design of PES for private initiatives. Strengthening of agricultural produce market by revisiting market support price system going beyond simple food security to water security as well. Subsidy for water efficient irrigation systems can be revisited in the longer run in terms of water conservation potential and PES design.

D. PRA Cauvery Delta

1. PRA Questionnaire

27. The PRA is to support the villagers through the process of analysis of the problems and help them identify appropriate response to the difficulties and opportunities including: (i) analyse the stakeholder assessment of current issues; (ii) analyse the problems and causes of issues; (iii)analyse to test the response to potential initiatives to address water related issues; and (iv) identify possible initiatives that could be further investigated.

Project : TA-7417 (IND): Support for the National Action Plan on Climate Change
Sponsored by: ADB. cauvery Delta
Conducted by:

PRA must provide the following information

Village history: District:…….. .Village ……

Respondent Name.....

Occupation main.....secondary.....

Land area (ha) Land owner..... renter .....

WATER RESOURCE BASE OF THE VILLAGE

6. What are the main drinking water sources available for use by the community (springs, boreholes, wells, hand-pumps, canals, ponds, piped water from ……..)?

	Wet months	Dry Months	Issues-- MI-major issues, I Issues SI-some issues NI no issues--also describe		
	(P)-primary)/ (S)secondary source		Water Availability	Water quality-salinity /other	Other
River					
Borehole -hand pump					

Bore-hole electric pump					
Dug Well					
Piped supply-house connection					
Piped supply stand pipe					
Canal					
Other (pl specify)					

13. what are the main sources of water for agriculture/fishery or other non-potable uses?

	Wet months Kharif			Dry Months Rabi		
	Source	Availability	Quality	Source	Availability	Quality
	Enter approx % of each type	Good, medium, poor, not available	Good Medium, poor	Enter approx % of each type	Good, medium, poor, not available	Good Medium poor
Canal Water						
Rainfall						
Tank/ponds						
Borehole - shallow <5m to water						
Borehole medium 5-30m to water						
Borehole deep 30+metres to water						
Drainage course river meet at coast						

14. Expand on issues above: including depth to water/ over exploitation/salinity/ health issues/tail-end problem/sunburst/ sea mouth cosed
15. What other water issues are there

	Impact	Describe
	Major/Medium/Low not an issue	
Flood in agricultural land		
Drainage from land/river		
Salt water intrusion in agricultural land		
Sea/bar mouth closure		
Coastal flood/ Inundation		
Beach coming inside/unstable		
Salt level in fishing water		
Flood water flow to sea		
Tidal water		
Other		

CHANGES IN WATER SOURCES OVER THE LAST 10 YEARS

16. What changes have been observed over the last 10 years

	No change	Minor change	Significant Change	Describe the change (increase/decrease) and impacts on crops/damage to infrastructure etc
Temperature				
Total rainfall				
Extreme rainfall				
Sea level change				
Groundwater salinity				
Surface water salinity				
Start date of the monsoon				
Drought				
Surface water availability				
Depth to Groundwater				
Groundwater availability				
Groundwater quality				
Flood				
Other				

17. Expand comment on the above issues and the changes impacts from the changes - i.e has it influenced the cropping patterns, fishing pattern , livestock levels
18. Do the stakeholders feel climate change will affect their livelihood- if so in what way.
19. Where are the main areas of vulnerability to climate issues
20. What measures could the government take to reduce future vulnerability

WATER MANAGEMENT ISSUES

21. Issues of water management

	Classify stakeholder perception of issue - major/medium/low or not an issue. Describe	Suggestions for improvement
Surface Water		
River flow management through check dam/Tail end gates		
Farm tanks to store water of varied sizes proportional to land holding		
Equitability in access to water for the individual fields		
Water quality		
Poor maintenance of channels		
Salinity intrusion in drains and rivers		
Present water management		
Other Issues		
Groundwater		
Lack of dependable electric power		
Lowering of groundwater due to overexploitation.		
Long term sustainability of groundwater		

	Classify stakeholder perception of issue - major/medium/low or not an issue. Describe	Suggestions for improvement
Increased salinity of groundwater		
Ground water recharge by flood water		
Other		
Cropping		
Paddy needs too much water/groundwater		
How keen are Farmers for support price for crops?		
Farmers want to go for other crop varieties		
Farmers need to move out of agriculture for alternative livelihood (aquaculture?)		
Farmer interest in community shrimp aquaculture		
Flood Protection		
River Bank flood protection		
Coastal erosion protection		
Interstate river water sharing mechanism		
Tank flood protection		
Raising bund height		

22. Expand on any of the above points.....

23. Requirements for Regulation and control

	Agree	Disagree	Comment
	Strongly Agree/ Disagree. Agree, Mixed feeling, no opinion (SA, SD,A,D, MF,NO)		
For long term sustainability some type of regulations (control and restrictions) on groundwater is required			
Possible approaches to achieve this-			
Government to introduce charges for power used for tubewell water to control use and reduce demand			
Government to provide more subsidy for tank and micro irrigation			
Government to take on greater control and regulation of groundwater use.			
Greater Government controls to be introduced in tandem with programmes to support greater water use efficiencies and higher return cropping systems			
Government to restrict the number of wells			
Farmers and Community associations to take on greater control of surface and groundwater management			
Community associations could take on responsibilities to control and mange groundwater abstractions			
Government to change the price guarantees			

subsidies to promote non rice crops			

24. Possible Methods to Improve Water Efficiencies as a means to conserve water

	Method	Assessment- VS-very supportive, S-supportive, M-mixed feelings DS-do not support A-against	Comment- describe how these could be developed
13.1	Improve the artificial recharge through community participation and incentives		
13.2	Promote the use of shorter duration horticulture/vegetables		
13.3	Promotion of high value cash crop		
13.4	Improve the surface water management through tanks		
13.5	Expand the use of laser leveling to improve efficiencies		
13.6	Expand the use of drip and sprinkler irrigation		
13.7	Develop strategies to improve the conjunctive use of surface and groundwater		
13.8	Develop the use of pipe irrigation		
13.9	Introduce increased support for improved irrigation systems.		
13.10	Introduce some level charges for electric power for tubewells in return for improve electricity availability and subsidies to reduce water losses.		
13.11	Creating ground water Recharge points		
13.12	Flow management on Cauvery river		
13.13	Seasonal weather forecasts to be provided for farmers		
13.13	Other -describe		

GENERAL SOCIO ECONOMIC ISSUES

- How has access to water resource changed over time: from surface to ground/any other?
- What is the level of indebtedness among farmers (any gender bias?)
- Are younger people staying in Agriculture/fishery
- Is there migration out of the area--what are the main reasons
- How is the access to local natural resources (e.g forest, grazing land, water tanks..) and who controls?
- How could a move towards efficient irrigation system be achieved.
- Are farmers interested to develop/strengthen water user associations/panipanchayat and take on more proactive role in sustainable management of the water resources
- How could the role of women in farming/fishery/water management be improved
- Are farmers interested in moving to new technologies to increase water efficiency -drip sprinkler etc
- What change in farming/fishery practices could be done to improve water use efficiency
- What is the perception of Farmers on ground water recharge. How should it be done in participatory manner.
- At present what is more important –crop insurance ( ), water access ( ), support price ( ), subsidy for micro irrigation ( ), subsidy for tank irrigation ( ), enhance kauvery river flow ( ), Ground water recharge ( ), more community role in water management ( ), More govt. role in water management ( ), more revival of old/potential tanks ( )
- Are the priorities same in future too?

- Are there conflicts/psychological stress among farmers/fishing community within current water access system
- Any suggestion on alternative method to enhance water availability
- Farmers/fishing community investment (range and items) to ensure better access of farm land to water

2. Summary of Cauvery PRA

- Fishing and agricultural farming communities have varied challenges in Cauvery delta. Fishing community living within an area having a distance of less than 10 km from coast line, with their livelihood dependent on marine or inland fishery (very limited in surveyed households) has a different set of challenges than agricultural farming community living mostly beyond ten kms from coast line. However there are communities who practice both fishing and agricultural farming within ten km distance from coast line.
- Fishing communities surveyed in Thirumullaivasal village in Nagapattanam district of Sirgali block are from the Tsunami affected area. Major issue is drinking water. Tsunami has changed ecosystem by affecting the ground water quality. The ground water which is available at a depth of 6-8ft has become saline after Tsunami and is not usable. A total of 500 households in the village get piped surface water supply through 60 public standposts managed by Panchayat from an overhead storage tank two lakh liters. Demand from community has been to double the water storage capacity. Social conflicts are very common around water access.
- Fishing is a remunerative livelihood option which keeps almost 100% of the younger generation within the village even the educated youths. Both female and male share the economic activity actively. Male go to sea for fish catch and landed fish is fully managed by females. After tsunami, fish catch reduced drastically.
- Tsunami has led to intrusion of saline water in ground water. Sea water intrusion is a regular problem in Voimedu also. Community feels shutter regulator in the river can prevent the salt water intrusion.
- Women in fishing community control the post landing fishing activities like sorting, drying and marketing. There is no single male involved. Males go for fishing in sea. Female fish vending community are facing shrinking market for two reasons: for less landing after Tsunami and for barmouth closure which prevent boats from neighboring villages to enter. Mobile cold storage vans are in demand from female vendors to reduce middleman's role in marketing and associated indebtedness.
- Coastal Flood and inundation is major issue. Also sea water intrusion in canals.
- Women interviewed are in particular interested in access to better water quality . Not only for drinking purpose but also for nondrinking purpose which is now met from saline ground water. They are responsible for water security and health of the family.
- Drinking water management can be done through participation of villagers even if a user fee is charged but secures supply. In the longer run if Cauvery river water flow does not increase there may be need for desalinization to meet non drinking household demand for water as well.
- Barmouth closure problem is identified by 91% of fishing households as current major issue while sea shore coming inland is reported by 86% households followed by 77% households responding coastal inundation as major issue followed by tidal water intrusion (64%). Increasing salinity of fishing water is reported by 18% households only.
- Current water related challenges reported by agricultural community are different than fishing community. For the former major issue of concern is flooding of agricultural lands (83% households) ,followed by drainage water flow problem from land because of lower elevation of land (54%), similarly for flood water flow (46%). 42% feel erosion of beach is a major concern, salt water instrusion in agricultural field is of concern for 38% households. Coastal flood , inundation , sea water instrusion of concern for lesser number of agricultural households (29-31%).
- Access to water and multiple crop is basic demand. Younger generation are taking up agriculture as secondary occupation. With declining labour force they feel mechanisation will help. Currently samba is the major single paddy crop. Pulse is grown with no water supply. Soil quality is a major barrier for crop diversification especially nearer the coast (Voimedu). Cropping pattern is mostly paddy cultivation, single crop samba.

- Conjunctive water use is happening only in villages beyond 20 kms from coast line. More groundwater withdrawal is happening in the absence of canal water supply in village Anandhathandavapuram is in Nagapatinum district, Mailaduthurai block which is 25 kms away from sea coast.
- So far surface water management issue concerned among the agricultural households surveyed 58% are happy with current water management system. 88% households complain about poor canal maintenance conditions, 71% about tailend gate repairing need. 48% complain about water quality in land and 38% of saline water intrusion water of rivers and drainage channels. Only 17% favour storage tanks for rain water harvesting. Fishing communities' responses are different than agricultural community. For surface water 32% are happy with present water distribution system but also complain about poor channel maintenance, 23% give priority to salinity intrusion management in drainage channels, 18% feel water quality issue be attended an d5% feel through check dams river flow can be managed.
- For ground water management 77% support long term sustainability strategy, 73% are concerned about salinity in ground water, 65% think due to temperature rise ground water level is decreasing, 54% feel by flood water ground can be recharged, 44% see electricity supply as barrier for ground water access. So far ground water resources are concerned within fishing community 59% feel long term sustainability in ground water resource management be the chosen strategy, 55% feel increased salinity management be the strategy , 2&% feel ground water recharge by flood water and over exploitation of ground water be the strategy.
- 56% farmers realize paddy requires high water but do not see an alternative. 77% are keen on market support price, 29% farmers are ready to try alternative crop if told, 13% are ready for aquaculture and 12% ready to migrate for alternative livelihood.
- For flood protection agricultural households 65% feel unless interstate water distribution issue is resolved problem cannot be solved more so under climate change scenario as water release needs more control. 52% want river bank protection, 40% want raising of bund heights, 33% want coastal erosion protection while 19% want tanks for flood protection. About flood protection for fishing community coastal erosion protection is major intervention demand (77%), 50% want interstate water sharing be corrected, 18% prioritise river bank protection and %% want tanks and raising of river bunds.
- Perception about community participation and government control in water management varies across communities. While agricultural community feel community need to have major control of water resource management as 69% responds in favour, 60% feel government to impose greater control on ground water use. 52-54% feel government need to introduce power charges on ground water withdrawal, more government subsidy on micro irrigation facilities. 40% feel price guarantee on non paddy crop be introduced. While only 13% feel there needs to be control on boreholes, 38% think it is important for government to work on efficiency measures along with regulation and control.
- Very high perception exist in fishing community. 95% understand temperature and sea level is changing. 91% say rainfall is changing and salinity also is increasing, 86% think extreme rainfall is affecting productivity and ground water level is changing as well. Surface water salinity increase is reported by 73% households. 68 and 59% report about drought and flood.
- November-December flood due to untimely rain is affecting crop sometimes upto 75% loss. Water retention is most important and regulated flow. Drainage is a big problem. Barmouth opening can solve the problem. Closure is happening due to siltation and less flow in tail end
- Water use efficiency is less as less water can be lifted at slower rate due to damaged pumps and less availability of electricity.
- The people are willing to take up and interested in small pond based aquaculture but are aware that it needs govt license, training and government support. However, they know there is high risk of disease in aquaculture shrimp farming which is not there in marine shrimp catch which makes them more inclined for barmouth opening and marine fishing.
- Community feel that tail end regulator shutter repair can solve problem for fishing community and agricultural farmers and neighbouring villages too.
- They feel ponds can be created. Sea coast protection with excavated land can help creation of protection for sea water and flooding and trenches might work as rainwater harvesting points which can help in reducing salinity of ground water.
- Public lands may be used for aquaculture and not farm lands. There are tracts of unused lands now growing natural vegetation used for firewood

- Water availability is changing due to changed rain pattern in upper catchment of mettur dam in Karnataka. So the farmers have shifted at the advice of agriculture department the date of sowing Earlier sowing used to start by mid august now they do after august.
- Rainfall pattern is becoming erratic with heavy shower in one/two days. Cyclone damaged crop in 2008 and crop insurance was given for 60% damaged crop situation
- Suggestions are in favour of multiple changes together through changes in policy, irrigation infrastructure, change in agricultural practices, crop choice etc.
- Strategic action plan need to address issues pertaining to fishing communities separately than agricultural farming community. Strategically fishing community can be provided with solution for drinking water supply with long run aim for meeting good quality residential water supply. Supplementary training support for youths and females can address the issue of resilience through community empowerment through security of income. Youths with better fishing effort and barmouth opening can intensify the catch and females can increase market control. Free movement of boat along coast line, cold storage in mobile vans or in neighbouring village can enhance resilience.
- Some some statewide actions such as ground water allocation regulations, market support price, Payment of eco services delivered by farmers by avoiding over drawal of water may be incentivized by Payment for eco services (PES) etc. supplemented by district level specificities to make actions inclusive. e.g., salinity issue is specific for the delta nearer the coast.
- Inclusion of stakeholder response district wise will make the actions implementable and less risky.
- Community empowerment through training and capacity building will make actions acceptable and projects less risky.

Appendix 7 Terms of Reference

VII. APPENDIX 7 TERMS OF REFERENCE FOR THE STUDY

28. The TA will be implemented in three phases over 11 months from August 2010 to end June 2011, with phase I and II to be completed over the first 7 months. Phases I and II will carry out studies in the pilot sub-basins as well as at the centre to assess issues relating to IWRM and climate adaptation. Over the subsequent 4 months (phase III), the TA will assimilate the experiences at the basin level and other information to compile a preliminary IWRM road map for MOWR. All equipment for the TA will be processed according to *ADB's Procurement Guidelines (2007, as amended from time to time).* The proposed consultancy inputs are described in Table 1.

Table 1 Proposed Consultancy Inputs

	International	**National**
Team Leader/IWRM Specialist/Strategic Planner	6	
IWRM/Water Supply/Irrigation Specialist		6
Climate change Specialist	2	2
Hydrologist	1.5	3
Hydro-geologist	1.5	3
Data management GIS specialist	1	4
Awareness/communication specialist	1	
Social community Specialist		3
Water Management Institutions Specialist		4
Total	**13**	**25**

A. International Consultants

29. **Team Leader/IWRM Specialist/Strategic Planner** (International, 6 person-months). The team leader (TL), in consultation with ADB and the TA project director, will coordinate the TA activities with the agencies concerned and development partners. He/she will provide overall guidance and leadership for all of the TA activities and will guide the preparation of TA methodologies and work and staff schedules, monitor TA progress, prepare key TA reports, other outputs and lead the studies in the pilot sub-basins and preparation of strategic framework plans and road maps ensuring adequate levels of consultation at all levels. The consultant will be required to develop (i) robust strategic framework plans and road maps for IWRM climate change adaptation planning as it relates to the water sector, (ii) design and manage an effective and participatory process to develop the change or adaptation strategies, (iii) liaise effectively with a range of development partners and agencies, (iv) support the development and management of a public awareness campaign, (v) oversee training activities, (vi) facilitate workshops and consultative processes with all kinds of stakeholders and (vi) manage the overall project team and timely submission of outputs.

30. **Climate Change Specialist** (International, 2 person-months). Will carry out a comprehensive review of climate prediction research in India. The review will be supported by a small review panel of experts from the key Indian climate research institutes. The review will assess the progress and gaps of climate research with special reference to the needs of water resources planning mainly rainfall and temperature. The consultant will provide recommendations for the future research strategies for Indian climate change including assessment of resources, international linkages and information exchange. The climate change specialist in close coordination with the hydrologists will assess the viabilities, strategies and frameworks for the gradual development of basin level climate and hydrological simulations to support the water resources planning processes. The climate change scientist will prepare training modules and give some presentations as well as the preparation of the climate aspects and contributions to the strategic framework plans and the road maps.

31. **Hydrologist** (International, 1.5 person-months) The hydrologist will: (i) work in the pilot sub-basins to review and assess the key hydrological issues present and indicatively in the future; (ii) assess the adequacy of hydro-meteorological networks and quantity and quality of hydrological data and analyses (at state and central level) (iii) in coordination with the data management consultant

review the institutional framework for hydrological data management at state and central level and prepare recommendations for technical approaches including appropriate software; (iv) in close coordination with the climate scientists assess the viabilities, strategies and approaches for preparing simulation strategies at the basin level; (v) identify appropriate technical and institutional arrangements for effective basin modeling including simulations and (vi) prepare the hydrology contributions to the strategic framework plans and the road maps.

32. **Hydro-geologist** (International, 1.5 person-months) The hydro-geologist will: (i) work in the pilot sub-basins to review and assess the key groundwater issues at present and indicatively in the future; (ii) assess the quantity and quality of groundwater data and analyses (at state and central level, (iii) in coordination with the data management consultant review the institutional framework for hydro-geological data management at state and central level and prepare recommendations of the technical approaches including appropriate software; (iv) in close coordination with other specialist present assessment assess the viabilities, strategies and approaches for conservation of groundwater and improving the conjunctive use of surface and groundwater including artificial recharge; (v) assess the possible role of groundwater storage to support climate variations and present possible strategies for long term groundwater management; (vi) identify appropriate technical and institutional arrangements for effective basin modeling including simulations and (vii) prepare the hydrology contributions to the strategic framework plans and the road maps.

33. **Data management GIS specialist** (International, 1 person-month) The specialist will work closely with international and national other specialists to identify the needs for long term and sustainable data compilation and analyses, this will include: (i) assessment of present data and future requirements at the pilot sub-basin, the state and the central level; (ii) review of the capacities and resources for data collection and analysis; (iii) review on-going initiatives and he necessary mechanisms for standardization and data sharing between the sectors at different levels; (iv) review the possible role for the institutes and the private sector to support data management and analyses; (v) develop outline long term and sustainable data management strategies and (vi) to present preliminary proposals for appropriate software for data management and GIS; (v) to present and discuss the options with the project steering committee and other key organizations responsible for hydraulic and rainfall data.

34. **Awareness/communication Specialist** (International, 1 person-months) The consultant will be responsible for developing an education, information and awareness strategy to increase understanding of climate change adaptation risks and appropriate adaptation responses at the national, state and community levels. Awareness and information outputs will be developed based on the information and experiences in the sub projects. He/she will assist in the design of training modules and programs prepared by the specialists. The scope of work will include but will not be limited to these tasks: (i) using a participatory process and based on material to be supplied, design a hands-on training program on IWRM orientated climate adaptation; (ii) Assume overall responsibility for the development and production of appropriate media material including a short video, radio feature or leaflets; (iii) support the dissemination of material by MOWR to specific target audiences and (iv) support the planning and design of the workshops to make the maximum impact on participants to familiarize participants with various aspects of climate change adaptation and mitigation efforts.

B. National Consultants

35. **IWRM/Water Supply and Sanitation/Irrigation Specialist** (National, 6 person-months) The IWRM water supply and sanitation **(**WSS)/Irrigation specialist will: (i) assist the TL to maintain linkages with MOWR and other relevant line agencies, organize meetings, socioeconomic and technical surveys, stakeholder workshops; and help set up a mechanism for regular consultations, including the project steering committee;(ii) working in the pilot sub-basins would carry out assessments of the viabilities of various initiatives to implement IWRM, conserve water and improve service delivery; (iii) synthesize lessons learned from similar projects and summarize best practices for similar interventions in India and inter nationally; (iv) assess the engineering and other costs and benefits associated with new management and technical initiatives to improve efficiencies and compare these costs and benefits to the existing arrangements; (v) assist in the assessment of the institutional capacity of various agencies make recommendations for long term effective and sustainable management; (vi) in consultation with the other team member prepare simple matrixes of

different water initiatives and their indicative cost and benefit ratios and (vii) support the compilation and production of material to prepare the sub-project framework plans.

36. **Climate change Specialist** (National, 2 person-months). Working closely with the international specialist will carry out a comprehensive review of climate prediction research in India. The review will be supported by a small review panel of experts from the key climate research institutes. The review will assess the progress and gaps of climate research with special reference to the needs of water resources planning mainly rainfall and temperature. The consultant will provide recommendations for the future research strategies for Indian climate change including assessment of resources, international linkages and information exchange. The climate change specialist in close coordination with the hydrologists will assess the viabilities, strategies and frameworks for the gradual development of basin level climate and hydrological simulations to support the water resources planning processes. The climate change scientist will prepare training modules and give some presentations as well as the preparation of the climate aspects and contributions to the strategic framework plans and the road maps.

37. **Hydrologist** (National, 3 person-months). The hydrologist will: (i) work in the pilot sub-basins to review and assess the key hydrological issues present and indicatively in the future; (ii) prepare assessment of present levels of water availability and demand in the pilot basin, (iii) prepare estimates of flood flows and indicative flood risk assessments (iv) assess the quantity and quality of hydrological data and analyses (at state and central level) (v) in coordination with the data management consultant review the institutional framework for hydrological data management at state and central level and prepare recommendations for technical approaches including appropriate software; (vi) in close coordination with the climate scientists assess the viabilities, strategies and approaches for preparing simulation strategies at the basin level; (vii) identify appropriate technical and institutional arrangements for effective basin modeling including simulations and (viii) prepare the hydrology contributions to the strategic framework plans and the road maps

38. **Hydro-geologist** (National, 3 person-months). The hydro-geologist will (i) work in the pilot sub-basins to review and assess the key groundwater issues at present and indicatively in the future; (ii) assess the quantity and quality of groundwater data and analyses (at state and central level; (iii) assess ongoing and potential initiatives to support groundwater recharge; (iv) in close coordination with other specialist present assessment assess the viabilities, strategies and approaches for conservation of groundwater and improving the conjunctive use of surface and groundwater including artificial recharge; (v) assess the possible role of groundwater storage to support climate variations and present possible strategies for long term groundwater management; (vi) identify appropriate technical and institutional arrangements for effective basin modeling including simulations; (vii) prepare the hydrology contributions to the strategic framework plans and the road maps and (viii) prepare the hydrology contributions to the strategic framework plans and the road maps.

39. **Data management GIS specialist** (National, 4 person-months). The specialist will: (i) work closely with international and national other specialists to prepare including preparation of spatial GIS and other data to support the framework planning studies in the pilot sub-basins, mapping and data for the framework plans will be indicative and preliminary; (ii) to work with the states with pilot basins to assess the types, levels and accuracy of water related data held at the state level; (iii) compile simple inventories of the data and summaries of the metadata; (iv) to carry out a similar assessment for MOWR and CWC; (v) assess the present levels of data sharing by the states, centre and institutes and (vi) to work with the international data management specialist to develop long term and sustainable data management strategies at the state and national level as well as Government Institutes.

40. **Social community Specialist** (National, 3 person-months). The social/community specialist will work within the pilot sub-basins to assess how IWRM can effectively be supported at the community level. This would include a review of participatory management initiatives (including participatory irrigation management [PIM]). In liaison with the technical water experts carry out assessment of community capacities to adjust to climate changes, indicative areas of support and how these can be factored into the strategic framework planning and road maps. The community specialist would undertake community consultations on strategies to better regulate water use both surface and groundwater; work with the institutions specialist and prepare appropriate approaches. The specialist would support the requirements for cross cutting stakeholder participation at the community level

involving other specialists. The specialist would prepare the social/community contributions to the strategic framework plans and the road maps.

13. **Management and Institutions Specialist** (National, 4 person-months). The specialist will: (i) assess the government policy, regulatory, and legal documents related to water sector development and assess how these can be effectively be applied to establish IWRM with climate adaptation; (ii) assess the existing water management institutions and their functions related to system management, O&M, planning and implementation; (iii) analyzing the institutional setup at the state and central level, identify sector responsibilities, operational guidelines and identifying areas for institutional strengthening and improvement; (iv) support the TA team in identifying and defining practicable service delivery and system management alternatives and identifying those most suitable; (v) support the team's analysis of the OandM and institutional setup of the states and MOWR; (vi) advise on the opportunities and alternatives for enhancing water management; (vii) advise on an appropriate O&M framework based on best international practices; (viii) developing alternative irrigation service and management models through which independent entities could be engaged to manage, operate and maintain these schemes; (ix) developing detailed participatory implementation arrangements that could be applied to support IWRM planning and management. (x) assessing staff requirements at the sub-basin and states and prepare an indicative matrix for assessment of future needs; and (xi) support the preparation of the preliminary state level roadmaps (3 states where the pilot sub-basins are located) and an integrated road map for MOWR showing the potential approach to integrated and coordinated management-these road maps must incorporate maximum levels of participation at the state and centre

Appendix 8 Study Tour Report

TA 7417-IND: Support for the National Action Plan on Climate Change




Study Tour Report
Mekong Region, Vietnam and Lao PDR — 4-10 September 2011

September 2011

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FIGURES AND TABLES

VIII. INTRODUCTION

A. Introduction

41. A six day study tour to Mekong Region, Vietnam and Lao PDR was organised as a part of the *TA 7417-IND: Support for the National Action Plan on Climate Change* from 4-10 September 2011. A key feature of the TA was to increase awareness and provide training in water resources and climate change. To support this aim, a study tour to the Mekong River was planned and implemented; the Mekong basin although slightly different from the Indian water resources situation holds a wide range of development and climate change issues.

B. Visit Objectives

42. The broad objective of the study tour was to look at how water resource planning and management and adaptation is being addressed in the Mekong River Basin. The visit objectives aimed to examine key areas relating to climate change and river basin planning and management; including:

(i) **Water resources planning and management in the Mekong delta area Vietnam:** The Mekong Delta is one of the most intensively farmed systems in the world. Farmers have adapted their farming systems to maximise the production within the constraints of flooding, salinity and now face impacts of sea level rise. A two day visit was made to the Mekong Delta. The Southern Institute for Water Resource Planning (SIWRP) in Ho Chi Minh was visited and the institute provided background information and coordinated a visit to the Mekong Delta.

(ii) **Basin Planning within the six countries of the Mekong river basin:** The Mekong river basin holds a wide range of different water and agricultural issues. The Mekong River Commission (MRC) has over the last 50 years been undertaking a wide range of interventions to support the equitable and effective management of water resources in the four Mekong countries. Initiatives by the Mekong Commission especially relevant to the Indian context include the Mekong Water Sharing Agreement; adaptation for climate change; open information exchange between the riparian countries, the establishment of state of the art information systems including hydrological and groundwater data and modelling systems and hydropower planning. A one day visit to the MRC Headquarters in Vientiane, Lao PDR was made including a short visit to nearby aquaculture research station.

43. The study tour for six days (4-10 September 2011) included twelve mid to senior level Government staff from the Central and state governments. The state representatives included participating states of the ongoing ADB climate change studies[13] (Tamil Nadu, Punjab and Madhya Pradesh and Himachal Pradesh)

[13] TA 7417-IND: Support for the National Action Plan on Climate Change and the Integrated Water Resources Management Scoping Study for Sutlej River Basin, Himachal Pradesh: Improving Capacity for Climate Change Adaptation.

C. Program

44. The tour program is summarized in Table 1 below.

Table 16: Program

Day & Date	Activity
Sunday, 4 September	• 2330 Hours: Travel to Ho Chi Minh, Vietnam
Monday, 5 September	• 1400 Hours: Free day in Ho Chi Minh
Tuesday, 6 September	• 0730 Hours: Breakfast in hotel • 0830-1130 Hours*:* Meeting with SIWRP on - Mekong Delta Water Resources Planning and - Mekong River Basin Development Plan - Discussion • 1130-1330 Hours: Lunch • 1330-1700 Hours: Travel by road to Can Tho City, Mekong Delta • 1900 Hours: Dinner
Wednesday, 7 September	*Field trip – Can Tho City, Mekong Delta* • 0730-1200 Hours: Field trip to Tra Vinh Province (Sightseeing salinity control area and shrimp cultivation and rice production) • 1200-1300 Hours: Lunch • 1300 -1700 Hours: Field trip to Ben Tre Province (Sightseeing rice production and orchard area). • 1700-1900 Hours: Return to Ho Chi Minh
Thursday, 8 September	• 0900 Hours: Discussion with Director, SIWRP • 1500 Hours: Fly to Vientiane, Lao PDR
Friday, 9 September	• 0830-0930 Hours: Visit to ADB, Lao PDR Resident Mission – Courtesy call to CD, LRM *Briefing and Discussion — MRC Secretariat and Field Visit (Each Presentation included 10 minutes for discussions)* • 9000-1000 Hours: Visit and Presentation by ADB LRM • 1000-1015 Hours: Short statements from MRC/Indian delegation • 1015-1100 Hours: Introduction to MRC • 1100-1130 Hours: IWRM-based Basin Development Strategy • 1130-1200 Hours: Presentation from Indian delegation • 1200-1300 Hours: Lunch • 1300-1330 Hours: Presentation on Climate change adaptation in the Lower Mekong Basin • 1330-1400 Hours: Presentation on MRC procedures • 1430-1800 Hours: Field trip with Lao National Mekong Committee
Saturday, 10 September	• Return to India

D. Participants

45. The participants who followed the study tour are listed in Table 2 below. There were 12 participants from the Central and State Governments and two support persons from ADB.

Table 17: Study Tour Participants

Participant/Organisation	Address
Ms. Debjani Chakrabarti Additional Secretary Government of Orissa	Water Resources Department Rajib Bhawan, Bhubneswar 751001, Orissa
Mr. Vinod Kumar Tiwari Chief Environment Specialist HP Power Corporation Ltd. (HPPCL) Government of Himachal Pradesh,	Uttam Bhawan, Dogra Lodge, Near 103 Tunnel, Shimla 171004, Himachal Pradesh
Mr. Mukesh Kumar Sinha Senior Joint Commissioner (PP) Ministry of Water Resources	Shram Shakti Bhawan, Rafi Marg, New Delhi 110001
Mr. Naresh Kumar Mathur Chief Engineer Central Water Commission	Sewa Bhawan, R K Puram, Sector 1 New Delhi 110066
Mr. Rajinder Kumar Garg Chief Engineer Government of Punjab	Water Resource Department Sinchai Bhawan, Madhya Marg, Sector 18-B, Chandigarh, 160018, Punjab
Mr. Govindaraju K. T. Ramaswamy Chief Engineer & Director Government of Tamil Nadu	Institute of Water Studies, Water Resources Department, Taramani, Chennai 600113, Tamil Nadu
Mr. Ashok Kumar Kharya Director, Climate Change & IAD Central Water Commission	Sewa Bhawan, R K Puram, Sector 1 New Delhi 110066
Mr. Kuldip Singh Takshi Director Government of Punjab	Water Resources & Environment Directorate, Irrigation Department SCO.32-34 (Top Floor), Sector 17-C, Chandigarh 160017, Punjab
Mr. Som Parkash Bansal Superintending Engineer Government of Himachal Pradesh	Directorate of Energy Thakur Vatika, Khalini Shimla 171002, HP
Mr. Sanjay Kumar Singh Under Secretary (ADB-I) Government of India	Department of Economic Affairs Ministry of Finance North Block, New Delhi 110001
Mr. Manohar Dubey Deputy Secretary, PSM Government of Madhya Pradesh	Housing & Environment Department, Paryawaran Parishar, E-5, Arera Colony, Bhopal
Mr. Manoj Kumar Acharya Superintending Engineer Government of Madhya Pradesh	Water Resources Department Gayatri Chowraha, Near All India Radio, Guna, Madhya Pradesh

Participant/Organisation	Address
Dr. Vidhisha Samarasekara Senior Climate Change Specialist/ Tour Leader, ADB, India Resident Mission	4 San Martin, Chanakyapuri, New Delhi 110021
Mr. Adrian Young Consultant, TA Team Leader	Scotland, UK

E. Organizations Visited

46. The organisations visited and the key contact persons are summarised below.

1. **Southern Institute for Water Resources Planning**
271/3, An Duong Vuong Street, 5th District, Ho Chi Minh City, Viet Nam
Tel: (84-8) 3835 0850, 3835 4218
Fax: (84-8) 3835 1721
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Nguyen Ngoc Anh, Director, e-mail: anhn2t@yahoo.com/ siwarp@hcm.fpt.vn

Tran Minh Khoi, Deputy Director, Center for Water quality – Environment
e-mail: siwarp@hcm.fpt.vn

Nguyen Xuan Hien, Deputy Director, e-mail: nxhien@hcm.vnn.vn

2. **Mekong River Commission**
P B Box 610, 184, Fa Ngoum Road, Unit 18 ban Sithane, Neua, Sikhottabong
Vientiane 01000, Lao PDR
Tel: (856-21) 263 263
Fax: (856-21) 263 264
http://www.mrcmekong.org

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Klomjit Chandrapanya,Chief, International Cooperation and Communication Section
e-mail: klomjit@mrcmekong.org,

Tran Mai Kien Climate change Programme Officer
e-mail: kien@mrcmekong.org

Sourasay Phoumavong, Directorate of Environment Division,
e-mail: sourasay@mrcmekong.org

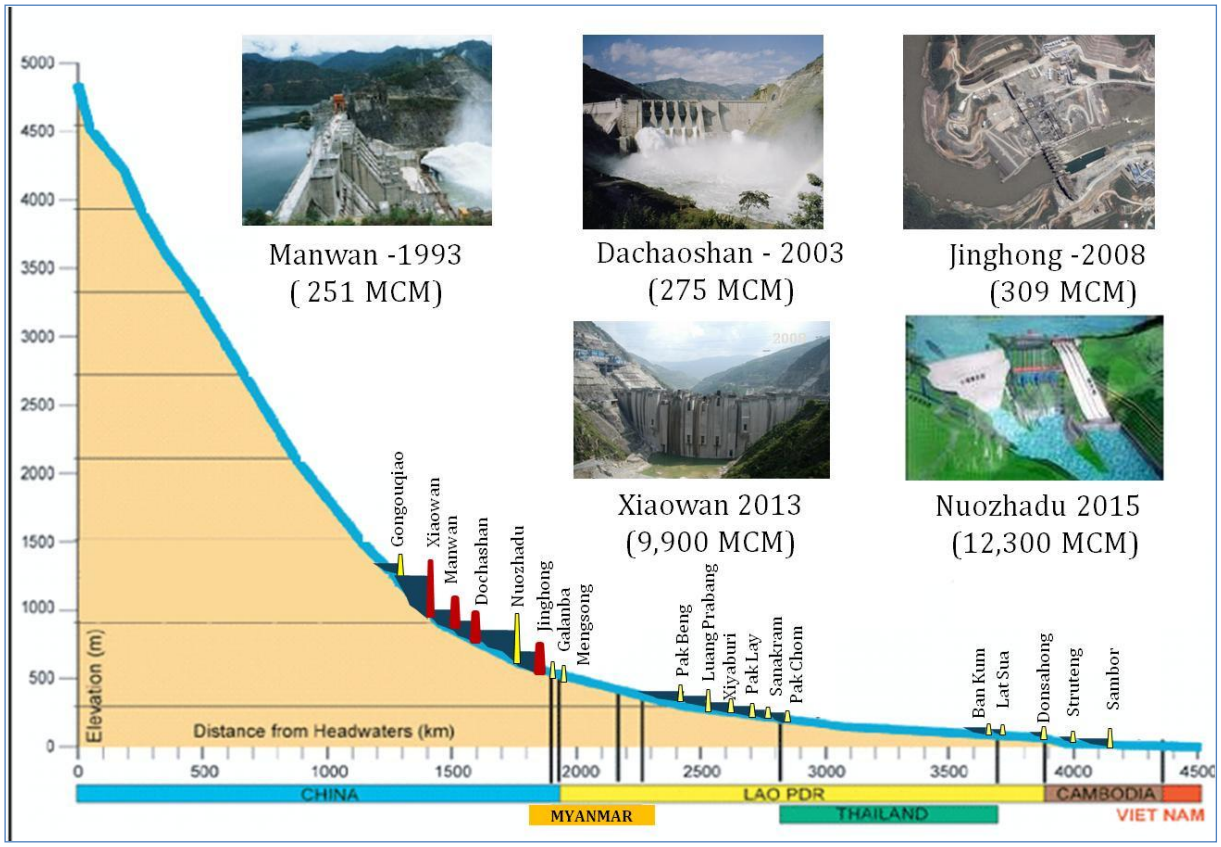
Cuong, Officer of the Secretariat in Phnom Penh
e-mail: cuong@mrcekong.org

3. **ADB Lao PDR Resident Mission**
Mr. Chong Chi Nai, Country Director

IX. MEKONG RIVER BASIN

47. The Mekong river basin ranks about number 12 in the world's largest rivers as shown in Table 3. The catchment area of 810,000km^2 is about 25% of the size of India. The Mekong River runs through six countries PRC, Myanmar, Laos, Thailand, Cambodia and Vietnam. The Mekong previously largely undeveloped now faces very large development challenges including construction of mainstream and tributary dams for hydropower as shown in Figure 1.

Figure 1: Construction of Mekong Main Stream Dams



48. The Mekong River basin is somewhat different to Indian rivers in that it is an open basin with water surplus. Despite this, development presents many challenges including coordination of development of ensure minimum impact of the riparian countries as well as environmental impacts.

49. Environmental impacts of water resources development are significant and include reduction of sediment to the lower Mekong Delta and impacts on the annual fish production which is about 400,000 tones and supplies about 80% of the protein to the Cambodian people. It is anticipated that fish production will be greatly reduced by the impact of hydropower dams.

50. Management of water resources development and coordinated planning to meet long term sustainability including adaptation to climate change are key requirements of the Mekong River basin

Table 18: World's Largest Rivers

	River	Length (km)	Drainage area (km^2)	Average discharge (m^3/s)	Outflow	Countries in the drainage basin
1	Nile – Kagera[n 1]	6650	3349000	5100	Mediterranean Sea	Ethiopia, Eritrea, Sudan, Uganda, Tanzania, Kenya, Rwanda, Burundi, Egypt, Democratic Republic of the Congo, South Sudan
2	Amazon – Ucayali – Apurím	6400	6915000	219000	Atlantic Ocean	Brazil, Peru, Bolivia, Colombia, Ecuador, Ven ezuela, Guyana
3	Yangtze (chang Jiang)	6300	1800000	31900	East China Sea	China
4	Mississippi – Missouri – Jeff	6275	2980000	16200	Gulf of Mexico	United States (98.5%), Canada (1.5%)
5	Yenisei – Angara – Selenge	5539	2580000	19600	Kara Sea	Russia (97%), Mongolia (2.9%)
6	Yellow River (Huang He)	5464	745000	2110	Bohai Sea	China
7	Ob – Irtysh	5410	2990000	12800	Gulf of Ob	Russia, Kazakhstan, China, Mongolia
8	Paraná - Río de la Plata	4880	2582672	18000	Río de la Plata	Brazil (46.7%), Argentina (27.7%), Paraguay (13.5%
9	Congo – Chambeshi	4700	3680000	41800	Atlantic Ocean	Democratic Republic of the Congo, Central African Republic, Angola, Republic of the Congo,Tanzania, Cameroon, Zambia, Burund
10	Amur – Argun	4444	1855000	11400	Sea of Okhotsk	Russia, China, Mongolia
11	Lena	4400	2490000	17100	Laptev Sea	Russia
12	Mekong (Lancang Jiang)	4350	810000	16000	South China Sea	Laos, Thailand,
13	Mackenzie – Peace – Finlay	4241	1790000	10300	Beaufort Sea	Canada
14	Niger	4200	2090000	9570	Gulf of Guinea	Nigeria (26.6%), Mali (25.6%), Niger (23.6%), Algeria (7.6%), Guinea (4.5%), Cameroon (4. 2%),Burkina Faso (3.9%), Côte
15	Murray – Darling	3,672[8]	1061000	767	Southern Ocean	Australia
16	Tocantins – Araguaia	3650	950000	13598	Atlantic Ocean, Ama	Brazil
17	Volga	3645	1380000	8080	Caspian Sea	Russia
18	Shatt al-Arab – Euphrates	3596	884000	856	Persian Gulf	Iraq (60.5%), Turkey (24.8%), Syria (14.7%)
19	Madeira – Mamoré – Grand	3380	1485200	31200	Amazon	Brazil, Bolivia, Peru
20	Purus	3211	63166	8400	Amazon	Brazil, Peru
21	Yukon	3185	850000	6210	Bering Sea	United States (59.8%), Canada (40.2%)
22	Indus	3180	960000	7160	Arabian Sea	Pakistan (93%), India, China
23	São Francisco	3,180*	610000	3300	Atlantic Ocean	Brazil
24	Syr Darya – Naryn	3078	219000	703	Aral Sea	Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikist
25	Salween	3060	324000	3,153[9]	Andaman Sea	China (52.4%), Myanmar (43.9%), Thailand
26	Saint Lawrence – Niagara –	3058	1030000	10100	Gulf of Saint Lawren	Canada (52.1%), United States (47.9%)
27	Rio Grande	3057	570000	82	Gulf of Mexico	United States (52.1%), Mexico (47.9%)
28	Lower Tunguska	2989	473000	3600	Yenisei	Russia
29	Brahmaputra – Tsangpo	2,948*	1730000	19,200[10]	Bay of Bengal	India (58.0%), China (19.7%), Nepal (9.0%), Bangladesh (6.6%), Disputed India/China (4.2%),Bhutan (2.4%)
30	Danube – Breg	2,888*	817000	7130	Black Sea	Romania (28.9%), Hungary (11.7%), Austria (10.3%), Serbia (10.3%), Germany (7.5%), Slov akia(5.8%), Bulgaria (5.2%), Croatia (4.5%),
31	Zambezi	2,693*	1330000	4880	Mozambique Channe	Zambia (41.6%), Angola (18.4%), Zimbabwe (15.6%), Mozambique (11.8%), Malawi (8.0%) ,Tanzania (2.0%), Namibia, Botswana
32	Vilyuy	2650	454000	1480	Lena	Russia
33	Araguaia	2627	358125	5510	Tocantins	Brazil
34	Ganges – Hooghly - Padma	2,620[11]	907000	12,037[12]	Bay of Bengal	India, Bangladesh

X. MEKONG DELTA VIETNAM

A. The Southern Institute for Water Resources Planning

51. The SIWRP was visited on 6 September. The institute is responsible for water resources planning for the Mekong Delta and the Dong Nai river basins. The SIWRP planning is a specialist water resources institute under the Ministry of Agriculture and Rural Development (MARD). In Vietnam water resources development is under MARD, but water resources assessment is under the Ministry of Natural Resources and Environment (MONRE). The SIWRP has been a key agency in the planning of water resources in the Mekong Delta. The organisation of the SIWRP is shown in Figure 2.

Figure 2: SIWRP Structure

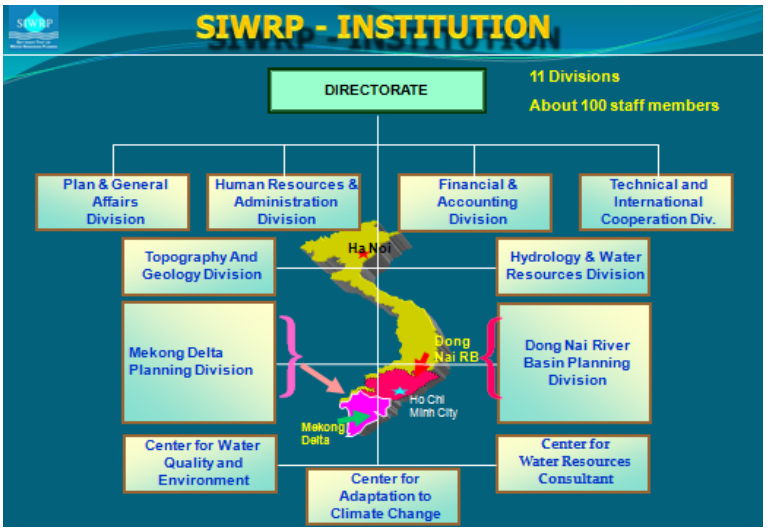


Figure 3: Discussions at the Southern Institute for Water Resources Planning Vietnam

B. The Mekong Delta

52. A field trip to the Mekong delta was made on 6-7 September: The group stayed overnight in Can Tho, which is the largest town in the Vietnam Mekong delta.

53. The water resources of the delta are complex with elevations of 0.3m to 2.0m average temperatures of about 26^0C and 1200-1400mm per year, with 90% of the rain falling May to November. The World Bank estimates that Vietnam would be one of the most vulnerable countries to climate change; the low lying Mekong Delta would be especially vulnerable.

1. Floods

54. There are major issues of flooding, (1.2 to 1.9million ha, with depths of 0.5m to 4.0 m over a period of 3-5 -flood). The strategy for flood management and mitigation is directed at Adaptation to Live with Flood. The strategy is full flood protection for populated areas, roads and infrastructure and partial flood protection in the deep flooded areas and full protection in the shallow flood protection. Flooding in the Mekong Delta is shown in Figure 4. The deep flooding in the Cambodian part of the delta was clearly seen from the plane travelling to Phnom Penh on 8 September.

2. Salinity

55. Salinity is a major issue with about 1.5million hectares affected by salinity as shown in Figure 5. The Government of Vietnam has developed water control structures and sea dyke systems. Adjusting the cropping pattern to avoid the salt water period is a key part of the strategy in the delta. In the parts of the coastal areas farmers grow brackishwater shrimp, other farmers rotate brackishwater shrimp in the dry season and rice in the wet season. Salinity issues in the delta will be made more critical by sea level rise and increased water use in the upstream parts of the Mekong. The development of hydropower dams will to some extent mitigate against this through increased dry season water releases. A salinity control structure was visited on 6 September as shown in Figure 6.

Figure 4: Flooding in the Mekong Delta

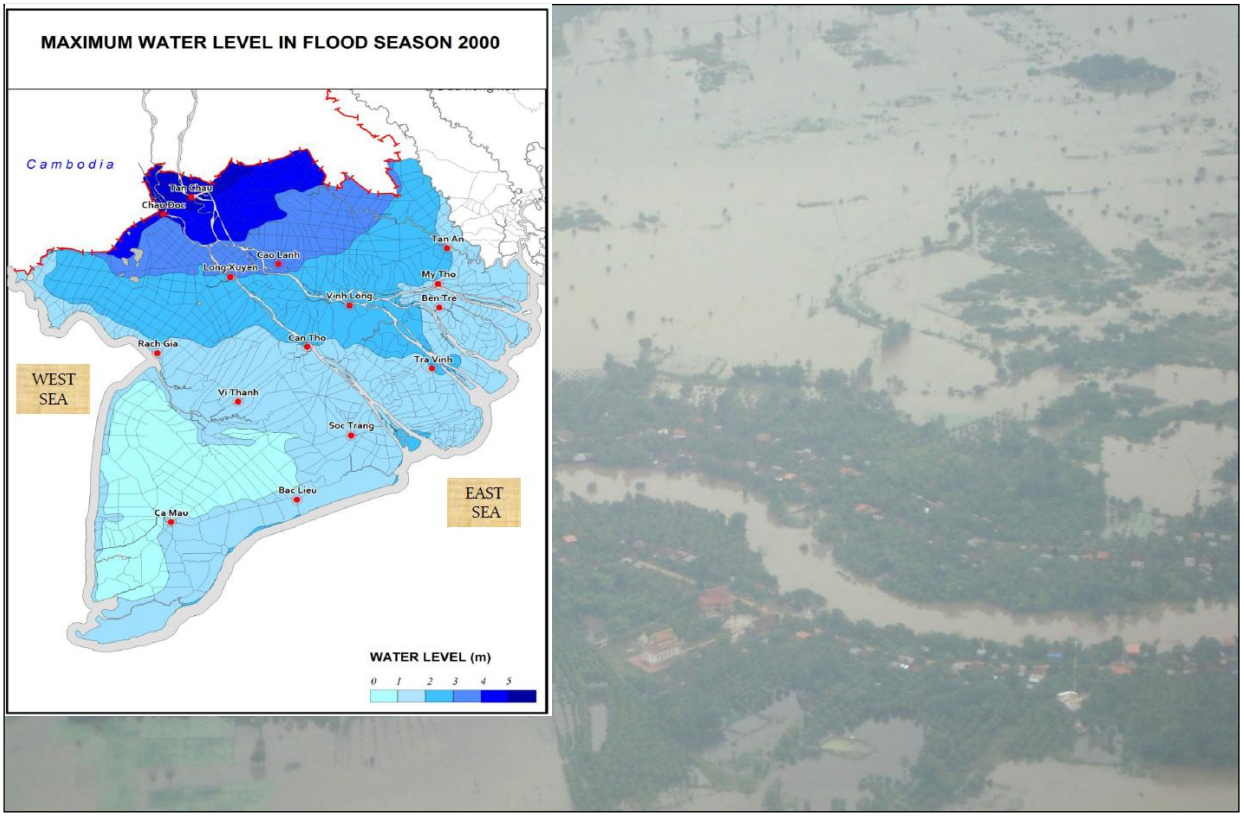


Figure 5: Salinity in the Mekong Delta

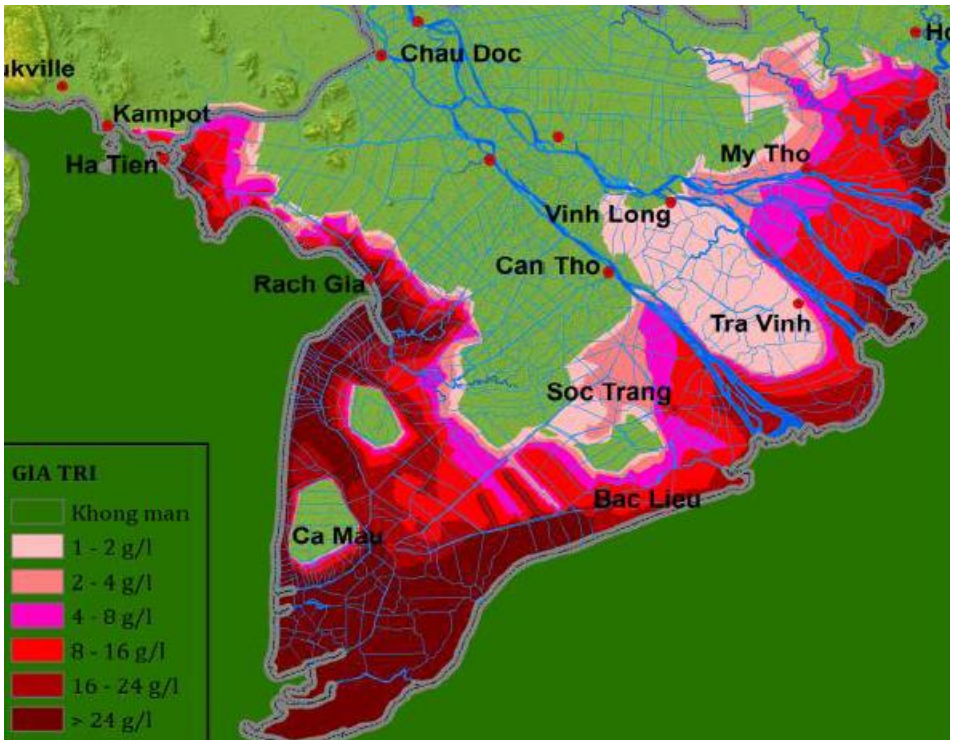


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Figure 6: Salinity Control Structure Mekong Delta

3. Crop Diversification and Fruit Production in the Mekong Delta

56. A visit was made to a fruit demonstration farm on 7 September. Over twenty years after the introduction of Doi Moi[14] (innovation) reforms in the mid-1980s, Vietnam's agricultural sector has undergone substantial changes. Growing integration in international markets, rapid economic growth and urbanization have had a significant impact on demand, especially for high-value food products such as fresh fruit and vegetables. The area under fruit tree cultivation in Vietnam has doubled in the past 10 years, from around 360,000ha in 1995 to more than 750,000ha in 2005, with an average annual growth of 8.5%. Total fruit harvest has also doubled within the same period, from 3 million tons in 1995 to more than 6 million tons in 2005. Changes in land use, from low value-added paddy to intensive gardening and commercial production of high-value fruit, have contributed substantially to the expansion of the fruit area in the country. In recent years, the poverty rate among fruit farmers in the rural Mekong Delta has declined. This is despite large fluctuations in the fruit export markets in the last decade. The role of farming is changing with non-farm activities increasing. What is likely to emerge are policies which will favour large scale commercial agriculture on the grounds that it is more efficient in terms of production. What has been seen in the Mekong Delta is one of the main drivers of rural development is the positive reciprocal relationship between urban centres and farming. There are two main aspects to this: first, the growth of urban incomes throughout Vietnam, resulting in high demand for fresh fruit, and second, the increase in employment opportunities in non-farm sectors, which allows farmers to diversify their income sources and invest in fruit production. The visit to the fruit farm is shown in Figure 7.

Figure 7: Visit to Fruit Farm Mekong Delta

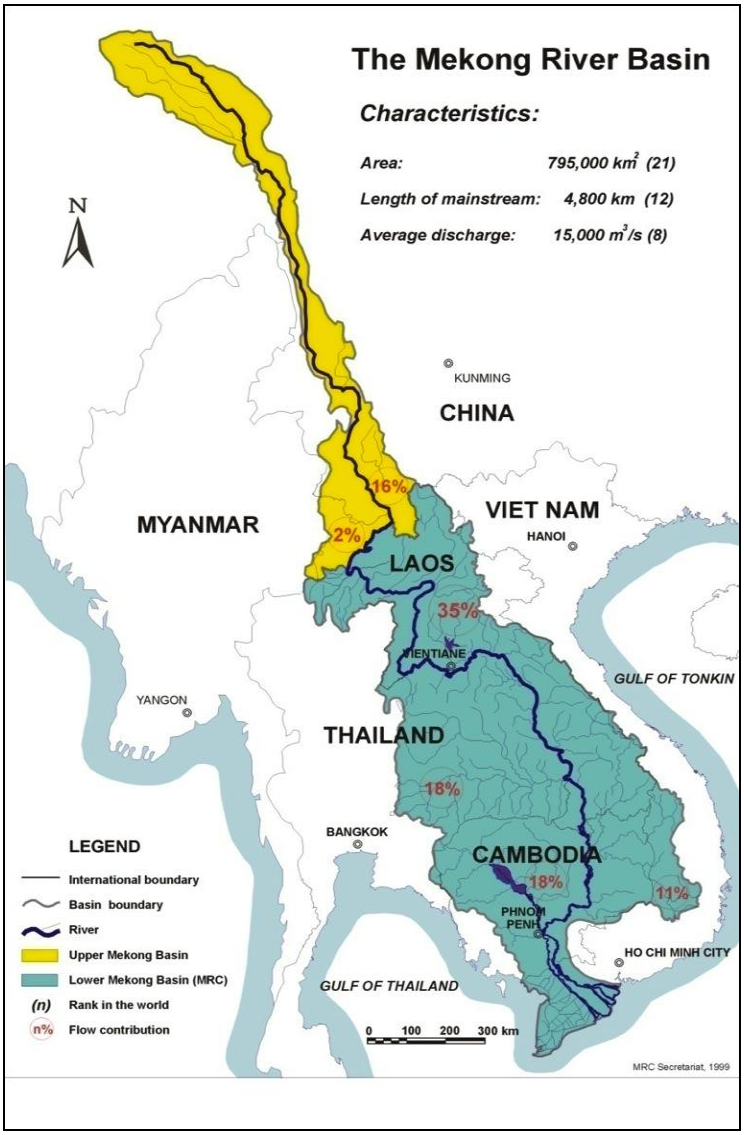
[14] In 1986 Vietnam launched a political and economic renewal campaign (Doi Moi) that introduced reforms intended to facilitate the transition from a centrally-planned economy to form of *market socialism* officially termed "*Socialist-oriented market economy."* Doi Moi combined *economic planning* with *free-market* incentives and encouraged the establishment of private businesses in the production of consumer goods and foreign investment, including foreign-owned enterprises. By the late 1990s, the success of the business and agricultural reforms ushered in under Doi Moi was evident. More than 30,000 private businesses had been created, and the economy was growing at an annual rate of more than 7%, and *poverty* was nearly halved.

57. In the last ten years farmers in the Mekong Delta use more and more of their land for fruit trees; in 2004 about 13% of the households productive land was for fruit trees; the average area per family was about 0.2ha. In the low lying lands a complex system of ridges and channels has been developed to raise the growing area above the floods and low trenches which are for irrigation and drainage. Irrigation as seen on the visit is trhough a low head pump with drip distribution.

XI. MEKONG RIVER COMMISSION

58. The MRC in Vientiane Laos was visited on 9 September. The commission made presentations relating to the operations of the MRC which was followed by discussions. The Mekong basin is split into the upper basin and the lower basin as shown in Figure 8.

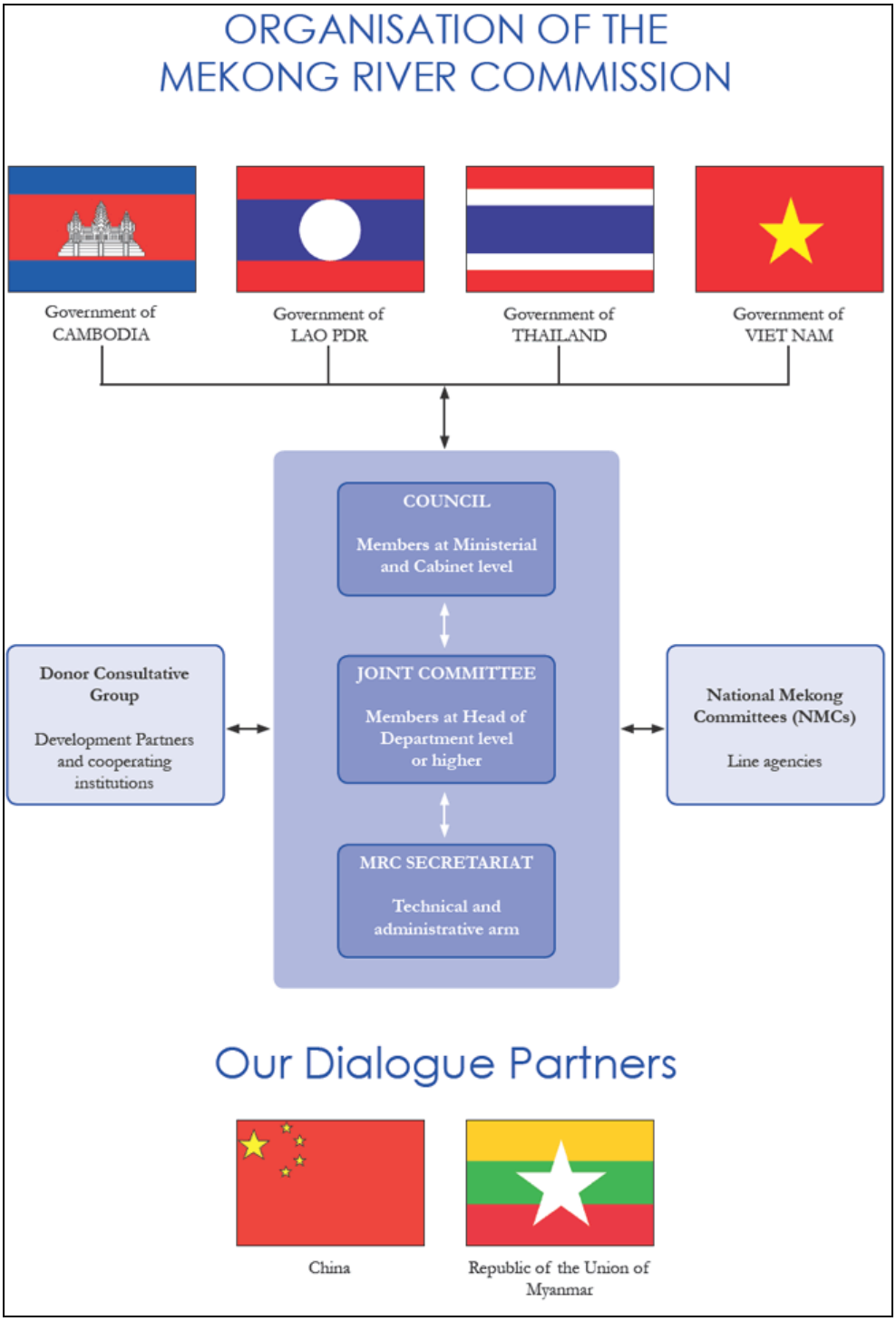
Figure 8: The Mekong River Basin



A. Structure of the MRC

59. The MRC consists of four member countries; Cambodia, Lao PDR, Thailand and Vietnam as well as two dialogue partners PRC and Republic of the Union of Myanmar. The organisation is shown in Figure 9.

Figure 9: Organisation of the MRC



B. The Mekong Commission Organisation and Procedures

60. The MRC is an intergovernmental river basin organization built on a foundation of nearly 50 years of knowledge and experience in the region. The MRC is an advisory body, not a supra-national governing body, the functions of the commission are based on commitment from the highest political level with decisions based on consensus. It is the only platform for regional dialogue on water resources management issues.

61. The MRC was formed on 5 April 1995, when Cambodia, Lao PDR, Thailand and Vietnam, signed the "*Agreement on the Cooperation for the Sustainable Development of the*

Mekong River Basin". The mandate of MRC is to coordinate and promote cooperation in all fields of sustainable development, utilisation, management and conservation of the water and related resources of the Mekong Basin to lift the population out of poverty. Even though the growth and export performance of the Lower Mekong Basin Countries over the past 15 years have been impressive and living standards have generally increased but areas of poverty remain, particularly in rural areas.

62. The Mekong Commission has developed agreed and approved procedures as below.

(i) Procedures on data, information exchange and sharing (2001)
(ii) Procedures on water use monitoring (2003)
(iii) Procedures for notification, prior consultation and agreement (2003)
(iv) Procedures for the maintenance of flows on the mainstream (2006)
(v) Procedures for water quality (2011)

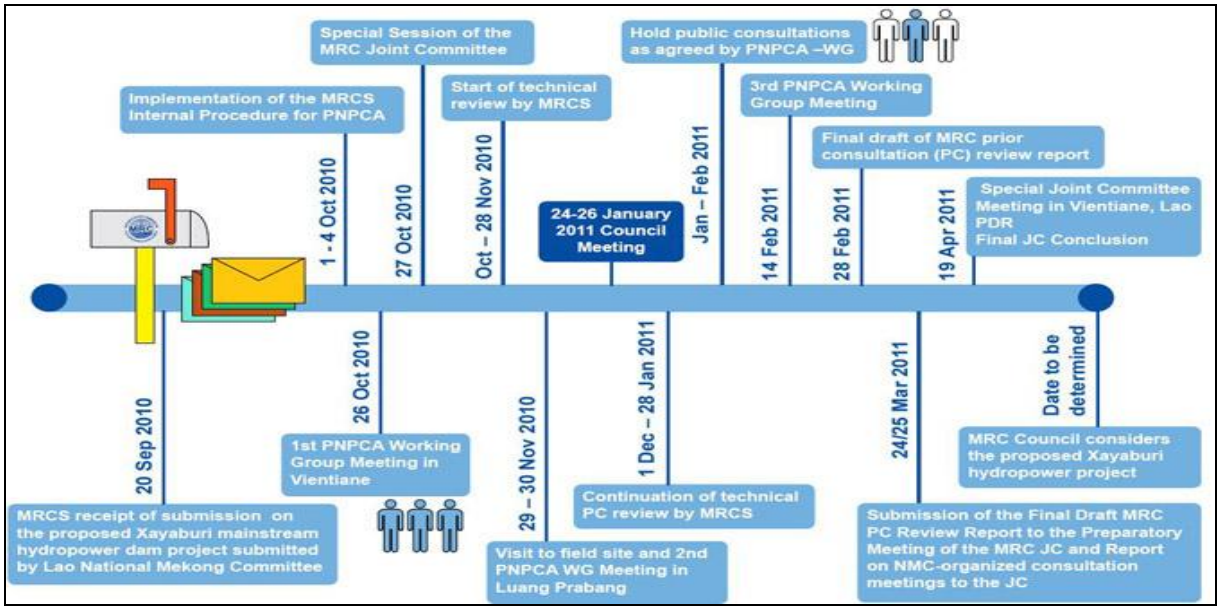
63. Of special relevance to India are the procedures for Data Information Exchange and Sharing:

(i) To operationalise the data and information exchange among the four Member Countries;
(ii) To make available, upon request, basic data and information for public access as determined by the NMCs concerned; and
(iii) To promote understanding and cooperation among the MRC Member Countries in a constructive and mutually beneficial manner to ensure the sustainable development of the Mekong River Basin.

C. Procedures for Notification, Prior Consultation and Agreement

64. The MRC and the member countries have developed procedures for member countries to notify and reach agreement on water resources development projects. An example for the proposed Xayaburi hydropower project is shown in Figure 10 below.

Figure 10: Example of Implementation of Notification, Prior Consultation and Agreement



D. Basin Development Planning

65. A Comprehensive basin plan was approved by the MRC Council in January 2011. The plan sets out how the four MRC member countries will share, utilize, manage and conserve the water and related resources of the Mekong to achieve the goals of the 1995 Mekong Agreement. The plan compared 12 specific development objectives within the economic, environmental and social spheres, a total of 42 assessment indicators identified and assessed within the framework. The Basin Development Plan objectives include:

(i) The MRC basin development plan balances the riparian countries' ambitious development plans by bringing together 'synergies' and 'trade-offs'.
(ii) Trade-offs in particular require much analytical work and negotiation between countries, or between sectors, to find the 'middle ground' or 'balancing point' which all key players and stakeholders are prepared to agree.
(iii) This requires strong IWRM understanding and capabilities across the basin, and across institutions, and time for consultation to develop preferred negotiating positions.
(iv) The potential sectoral and transboundary synergies and trade-offs have been studied through a cumulative impact assessment of basin-wide development scenarios.

66. The Mekong basin planning process is integrated and has evaluated wide range of aspects of water resources development. The impacts on fisheries from the development of water resources infrastructure is shown in Figure 11.

67. Bringing transboundary processes together; one of the main achievements of the basin development process has been to bring together transboundary cooperation between the Mekong riparian countries as shown in Figure 12.

68. MRC strategic plan 2011 to 2015 defines the goals and objectives of the MRC for the next five years to achieve the vision for the basin and the mission of the MRC. The strategic plan was approved by the MRC council in January 2011.

Figure 11: Impact on Fisheries of Water Resources Development

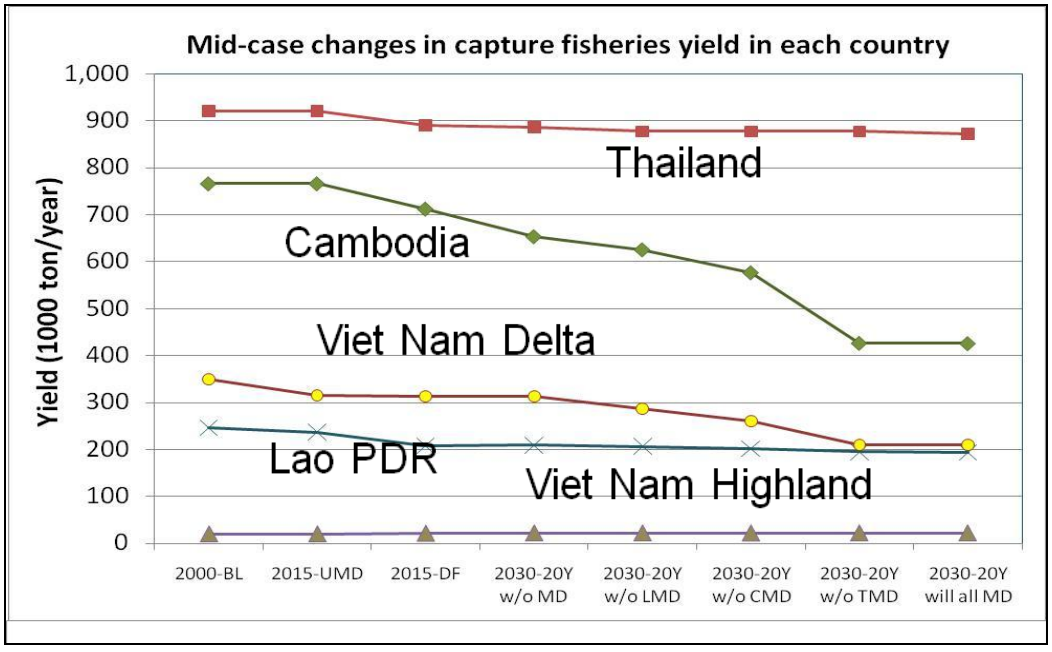


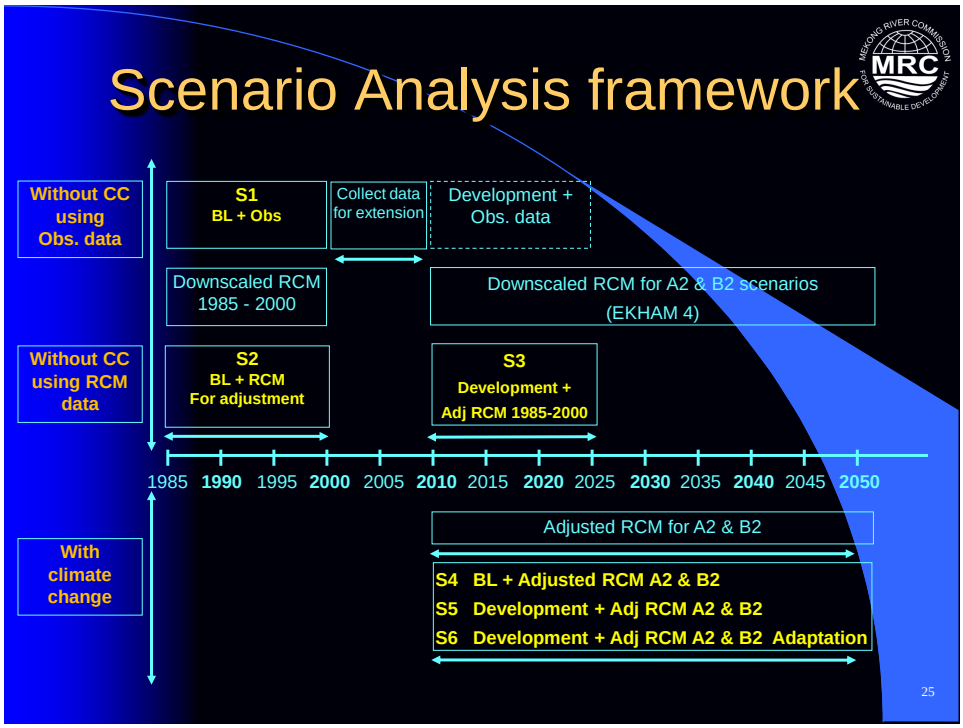
Figure 12: Basin Planning and Trans-boundary Cooperation

E. Mekong Climate Change Adaptation

69. The Mekong Commission is working with the four riparian countries to develop climate change adaptation strategies. The Mekong Climate Change Adaptation Initiative (CCAI) is a collaborative regional initiative of lower Mekong basin countries aiming to support the countries in adapting to the impacts and new challenges of climate change through improved planning, implementation and learning. CCAI Phasing includes a long-term initiative (with three 5-years phases, up to 2025), the CCAI would be linked with the cycle MRC's strategic planning process.

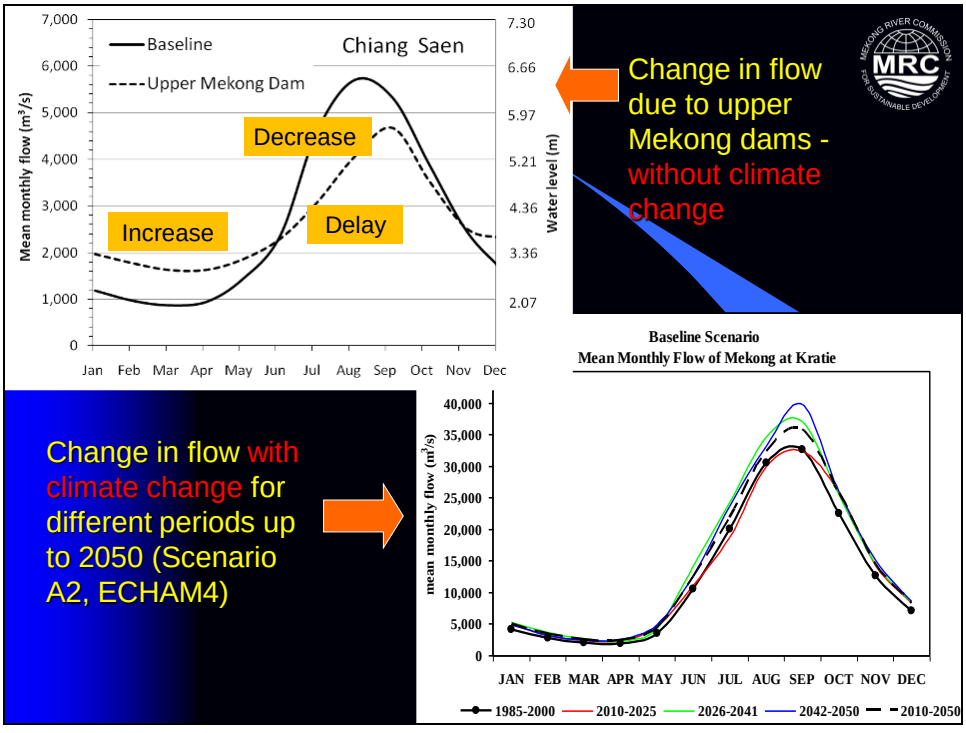
70. The broad climate change impacts have been assessed and include: (i) basin wide temperature increase of 0.79˚C, with greater increases in the northern part; (ii) average annual precipitation increase of 20 cm, (equivalent to 15.3%) predominantly in wet season; (iii) increase in total annual runoff of 21%, but strong water stress during dry season remains in some areas such as North-Eastern Thailand and Tonle Sap;(iv) increase in dry season precipitation in northern part and a decrease in dry season precipitation in southern part of the basin;(v) increase in flooding in all parts of the basin, with the greatest impact in downstream part of the Mekong mainstream and sea level rise and increased salinity in the delta area. The MRC has used a framework scenario to assess climate impacts as shown in Figure 13.

Figure 13: Framework for Scenario Analysis



71. Modelling to assess the impacts of climate change as well as development is one of the key activities of the climate change initiatives. Modelling includes flood assessment, salinity assessments, food security assessments, temperature and rainfall assessments. An example of the process is shown in Figure 14 below.

Figure 14: Change in Flow Regimes from Development and Climate Change



72. The MRC is supporting Local Demonstration Climate Change Activities four sites (1 in each country). Each demonstration site is designed to:

(i) Raise awareness and build capacity of climate change issue in the local level through adaptation planning process;
(ii) Implement the possible adaptation options to strengthen communities' resilience;
(iii) Synthesize the adaptation strategy/policy at the local level and integrate into national level; and
(iv) Provide lesson learned on climate change adaptation that could be replicated or upscaled.

73. Climate change activities appear quite similar to ongoing activities in India under the Indian Network for Climate Change Assessment (INCCA) programme as well as the ADB supported climate change TA. The use of local demonstration sites is an interesting concept and not so different from the pilot sub basins be studies under *TA 7417-IND: Support for the National Action Plan on Climate Change*.

F. Presentation on Water Resources and Climate Change in India

74. Mr. Mukesh Kumar Sinha, Senior Joint Commissioner, Ministry of Water Resources, Government of India made a presentation describing ongoing initiatives to address climate change in India. The presentation was concluded by some discussion. The MRC expressed interest to organise a study tour to India at some stage.

XII. ASIAN DEVELOPMENT BANK LAO PDR RESIDENT MISSION

75. A visit was made to the ADB Lao PDR Resident Mission on 9 September. Dr. Chong Chi Nai the Country Director made a presentation on the water resources in Lao. Lao is developing fast through hydropower and mining. ADB is supporting development in a number of ways including transport, education, urban development, agriculture and natural resources. Lao has 20,000MW hydropower development potential on the tributaries, development costs are quite reasonable typically at $1million/MW. There is no power grid in Lao and the country is still importing power; ADB is supporting the development of the power grid. Lao Government works to 5 year national plans and detailed projects are developed from the plan. ADB like other donors involve a high level of participation of the Government. Donor coordination is good. All consumers pay for power including for agriculture; tariffs are however graduated. ADB is supporting hydropower development through private sector partnerships. ADB and World Bank have recently supported the Ngam Theun 1070MW hydropower project, this is a river basin transfer project. ADB is also supporting a cascade of hydropower dams in the Nam Ngum river. A short film of integrated water management in the Nam Ngum basin was shown.

XIII. VISIT TO FISH FARM NEAR VIENTIANE

76. A visit to the Nam Ngum mutlpurpose dam was not possible due to the bad roads after recent floods. An alternative visit was made to the Lao Ministry of Agriculture and Forestry aquaculture research centre near Vientiane, the centre is a part of the Living Aquatic Resources Research Centre,

77. Fish is a major resource in the Mekong River and aquaculture is taking on an increasingly important role. Reduced natural fisheries due to water resource development will require aquaculture to play and increasing role. The Indian major carps were brought to Lao some years back to support aquaculture production, there is however concern of the ecological implications of these species escaping to the wild and sale of these fish is not permitted.

XIV. MEKONG RIVER DEVELOPMENT ISSUES

78. The characteristics of the Mekong river is very different from the Indian rivers, there are however many commonalities of the issues.

(i) There is a need for development; water is an important factor of development, with between 50% and 80% of the population in Lao PDR and Cambodia do not have access to safe drinking water/
(ii) There is a growing pressure on natural resources; there is an Increasing population pressure (100 million people in the lower Mekong basin by 2025) with More than 80% of the people live a subsistence life relying on water-related resources for food.
(iii) There will be negative impacts on the availability of clean water and fish, on the forest cover, and on natural resources in general.
(iv) Increased occurrence of extreme weather events and impacts of climate change; the region is prone to flooding and extreme weather events. Climate Change is expected to intensify existing risks.
(v) Flooding has both positive and negative impacts, requires adaptation.
(vi) Drought forecasting and adaptation will play an important role in future risk management.

79. During visits to the Mekong delta area concerns were raised that although the upstream dams are assessed to benefit downstream by storing water in the rainy season which can reduce flooding and releasing it when need to increase flow in the dry season. The downstream concerns were that the dams are for hydropower generation. The reality is the dams try to store as much water from the beginning of the rainy season so that they are often unable to store additional water during the peak of the flood season. Also in dry years they will not be keen to release water.

XV. MATRIX OF KEY POINTS

80. A matrix of the key points and relevance to India has been prepared based on feedback from the study tour participants. It was generally agreed that although the Mekong Basin has very different characteristics to the India Basins there are some good ideas and initiatives relevant to the India Water Systems.

Aspect	India Perspective
Very high degree of planning. The Mekong Commission has recently completed the Basin Development Plan. The Vietnam and Lao Governments prepare 5 and 3 year development plans at province and district level.	Sub-basin and basin planning is a key recommendation of the National Water Mission and proposed by the ADB Climate Change TA.
Living with floods rather than fighting floods.	Flood management is a core part of the basin planning process.
Very intensive use of water and cropping in the Mekong delta.	Integrated crop planning and demand management is a key recommendation of the ADB Climate Change TA.
Ensuring adequate environmental flows-high emphasis of ecological value of the river	Basin planning needs to incorporate adequate environmental flows. Impacts on

Aspect	India Perspective
including fisheries.	fisheries need to be considered.
Participative approach to planning and evolution and acceptance by member countries.	Basin planning involving a different states needs to develop participative approaches to develop scenarios and identify options for value added management and investments.
MRC has moved from knowledge based organisation to role to coordinated planning. Planning is based on developing synergies and tradeoffs between different sectors.	The NWM proposes IWRM and the development of RBOs as a core part of the adaptation to climate change. The Indian RBOs should gradually take on the functions of coordinated planning and supporting synergies for planning and management of water resources. A most impressive feature of MRC is that different countries are unitedly working towards achieving sustainable development of river basin and to ensure equitable sharing of benefits among all users. A similar approach might be adopted in India where inter-state water disputes are blocking some of the water resources opportunities water resources sectors.
Commercialization of farming systems drive for high value and export crops. Public and private sector and communities working together.	Support for marketing was a key issue raised by farmers during the participative rural appraisal under the NAPCC TA in the three sub basins.
Cooperative models are being developed in Vietnam which opens the way for mechanisation for small farmers	This can be tried in the northern region of Punjab State for the benefit of small and marginal farmers. However, the awareness for use of machinery like laser levels etc. on cooperative/rental basis is being created/adopted in the state.
Open data sharing between the four member countries as well as PRC and Myanmar has been achieved.	Open data sharing is a key proposal of the NWM and a key pre-requisite to basin planning.
MRC has prepared a strategic plan 2011 to 2015.	The NAPCC TA sets out strategic planning at sub basin and later at basin level as the core direction from which water resources management and development should evolve.
Lao PDR all consumers pay for power, there is no free provision of power although the tariffs are on graduated tariffs.	In India there is widespread provision of free power for agriculture which is leading to issues of sustainability. A system of graduated tariffs should be explored.

Aspect	India Perspective
Synergies of urban development and the diversification to high value crops such as fruit to meet the growing urban demand	Similar changes are ongoing in India-there is scope to promote the private sector marketing opportunities including export of high value crops.
International river cooperation is through the MRC.	For the basins extending to the beyond national boundaries, India is following the policy of bi-lateral dialogue and discussion for the management of water resources and other related issues. The application of a River Basin Organisation like the MRC may be less appropriate, some further study of various options would however be of value. For the basins within the country, many of the functions being performed by the MRC are already being performed by the central agencies. The main issues are of scale of operation, effective coordination, capacity building, upgrading technology and most importantly basin oriented approach for planning and management of water resources in present context and in the light of probable adverse impacts of climate change on it. In this regard some systems/protocols developed by the MRC would be useful in Indian context.
The huge network of inter connectivity of rivers/tributaries in the Mekong Delta through channels/canals to meet the agriculture needs**.**	This might be replicated in the State of Punjab for using monsoon run-off water to meet agriculture needs and also to help in augmenting continuously declining ground water resources of the State, which may even help in increasing the fertility of soils.

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84. The planning and administration of the visit was made through the ADB, India, Lao PDR and Vietnam Resident Missions and special thanks is given to the concerned staff involved, who made such special efforts that allowed the trip to proceed without problem.

Figure 15: Study Tour Participants outside the ADB Lao National Resident Mission

The National Water Mission (NWM) of the National Action Plan for Climate Change in 2008 produced a broad range of recommendations towards climate adaptation for the water resources and related sectors. Parts of the NWM are now being taken up; there are however major requirements for strategy and mechanisms to implement an integrated programme for climate change adaptation for water resources. Responding to this gap, the 'Support to the National Mission TA Study' has identified core actions at the central and state levels; building on the NWM recommendations as well as meeting requirements for sustainable water resources, the study has developed proposals towards a viable and workable set of initiatives and programmes for climate change adaptation.