Geo Factsheet

www.curriculum-press.co.uk Number 276

Sustainable Water Solutions In Transitional Economies

Water in India - The problem

India's main water sources are rainfall and snow melt from Himalayan glaciers. 80 % of the flow of Indian rivers occurs during the 4-5 months of the SW monsoon. The outlook for the glaciers is not good if present ablation rates (the rate at which they melt and retreat)continue. However, as the data in the table (Fig 1) shows there is a marked shortfall in average annual river runoff and utilisable flow, as well as there being a wide spatial variation . This is all the more apparent given that this data predates the recent drought years in which the flow will have fallen proportionately.

Table 1. A**verage annual runoff and utilisable flow of rivers for selected river basins (cubic kilometres)**

River	Average annual runoff	Estimated utilisable flow excluding groundwater
Indus	73.305	46
Ganga	501.643	250
Brahmaputra	537.067	24
Godavari	118.982	76.3
Krishna	67.79	58
Sabarmati	3.812	1.9235
Narmada	40.95	34.5

(Data from www.rainharvesting.org –source Anon1988 water resources of India , CWC publication No30/88 , central water Commission , government for India , New Delhi , pages 33 and 37)

This data implies that water stress and insecurity will increase in India incoming years as its population stands at 1.15 billion (2009) and has a growth rate of 1.6%. It is also a rapidly developing NIC. A recent report states that Indians consider freshwater shortages and water pollution to be the most serious of all environmental concerns. They do not feel that they can resolve these issues independently and actively seek further information. They hold government as being largely accountable for sustainable water provision and place little primary responsibility on either local inhabitants or NGOs.

Across India the access to improved drinking water can be shown below;

Figure 1. Percentage of Indian population with access to improved drinking water

	1990	2000	2006
urban	90	94	96
rural	65	77	86
total	71	82	89

Major cities have improving infrastructures, but those such as Mumbai receive only 4 hours of piped water per day

85 % rural water supply is from ground water sources and 2/3 of the grain productivity in irrigated areas is attributable to ground water irrigation schemes

Use patterns equate by sector with figures from many low and middle income countries. (Agriculture 82%, Industry 10%, Domestic Use 8%)

What then are the **causes of the growing pressures** on water resources in India?

Table 2. Causes of growing pressures on water resources in India

Economic	Social	Environmental
Changing economic structures, resulting from increased domestic and global demand on resources both primary and manufactured. Development as a NIC has led to increased demand.	Population growth which averages 1.6% per year	Climate change - India has experienced frequent severe drought conditions in recent years notably 2001-2002
Agrarian sector - demands for irrigation water etc are considerable in India due to high rural population and also the impact of the Green Revolution	Improving lifestyles -it is estimated that it takes 140litres of water to create a cup of coffee or 8000 to generate a pair of shoes	glacial water sources will reduce due to climate change - - reduced input from the Himalayas
Growth of the tourism sector -. (A tourist can use 880 litres per day as opposed to 250 litres by a local). In one 2 km stretch of the coast of Goa (SW India) there are 50 swimming pools	Urbanisation -access to water is more reliable in urban areas, and developing economies are those with the highest rates of urban growth. However India has relatively low urbanisation levels at around 32%	Wetlands are increasingly being developed and therefore lost as a water source. Groundwater supplies are currently 'overdeveloped'
Local water systems (ponds ,tanks etc), wetlands, forests , floodplains are all diminishing in area under increased developmental pressures	Already disputes have occurred concerning use of rivers with Pakistan and Bangladesn	Growing industrialisation has led to increased pollution of many sources of supply eg Ganges

Stakeholders and solutions

General issues

SIWI (the Stockholm International Water institute) seeking **sustainable solutions** hosted a World water Week (August 2009) at which 130 countries and 175 organisations convened to discuss water supply issues.(www.worldwaterweek.org). Governments, both local and national, must play a part and NGOs are active at all scales – witness the 2009 advertising campaign by Christian Aid with the slogan ' No rain doesn't have to mean No food'

AFPRO as a secular socio-technical development organization wrote a report in 2006 -2007 which stressed the importance of water in the Millennium development goals

- '**Goal 7 …..**Ensuring Environmental Sustainability…….
- **Goal 9** ……speaks of Integrating the principles of sustainable development into country policies and programs and reversing the loss of environmental resources.
- **Goal 10** fixes an aim of halving by 2015 the proportion of people without sustainable access to safe drinking water and sanitation '

The World Water Council set up in 1996 is an International intergovernmental and NGO network dealing with **water** policy topics and issues at a high level, including transboundary issues. It noted that the right to water "entitles everyone to sufficient, safe and acceptable, physically accessible and affordable water for personal and domestic'. The International Decade for Action "Water for Life" aims to encourage and support efforts to meet such internationally agreed targets, placing special emphasis on the role of women in these efforts. There are rights and duties both for users and authorities who manage the supplies.I

Therefore the following can be regarded as **stakeholders** in the provision of this 'right';

Solutions to water insecurity in India?

Efforts to control and manage water flow vary from small scale local technologies such as the Persian wheel, to macro scale techno centric solutions such as mega dams. Himanshu Thakkar Sandrp (S Asian network of Dams rivers and people – www.sandrp.in) stated in a press release of September 2007 that;

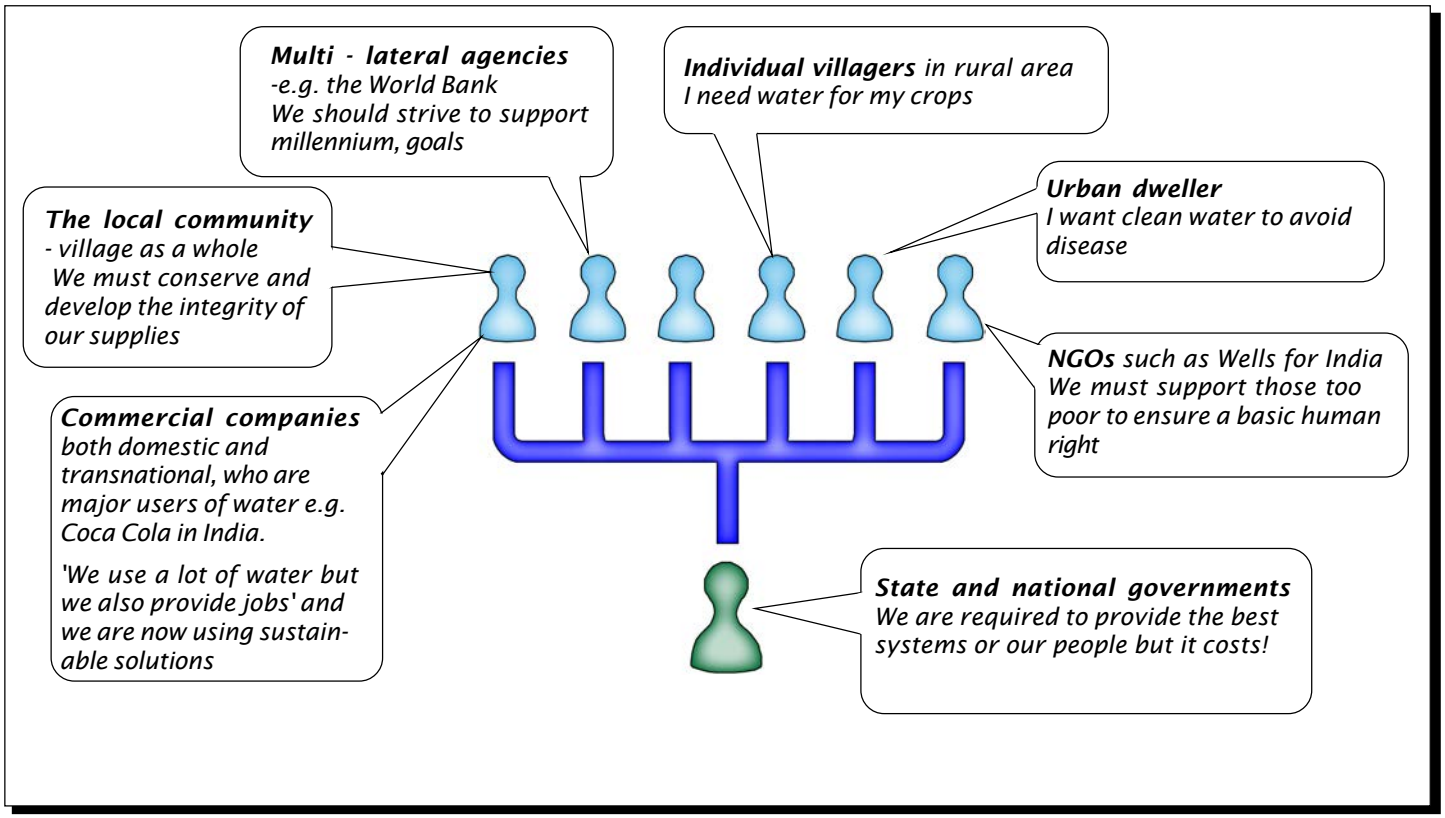
'**The government has been trying to regulate the use of groundwater through a top-down unaccountable , non-participatory mechanism of Central groundwater authority……Only a bottom –up mechanism from the local community controlled units can regulate a decentralised resource such as water'.**

A **top- down schemes** would include mega dams, whose costs both long and short term, are considerable. The dams give rise to considerable conflict as they are imposed from above and usually give rise to the dislocation of community.

Dean Nelson reported from New Delhi to the Daily telegraph on August 27th 2009 about potential Water wars over a Kashmir dam project. Islamabad had secured Chinese support for a plan to dam the Indus River in the Kashmir area which is divided with India. The latter feel this violates a bilateral water treaty and fear it will lead to flooding in their territory. Until this year poor monsoons had led to drought conditions in Pakistan. Water flows will probably be re evaluated given the extensive flooding in the monsoon season of 2010. Other controversial schemes include the Narmada and Farraka dams.

The role of small scale **Bottom up** solutions is best examined through **one specific region and the responses taken within its spatial context.**

Figure 2 Stakeholders

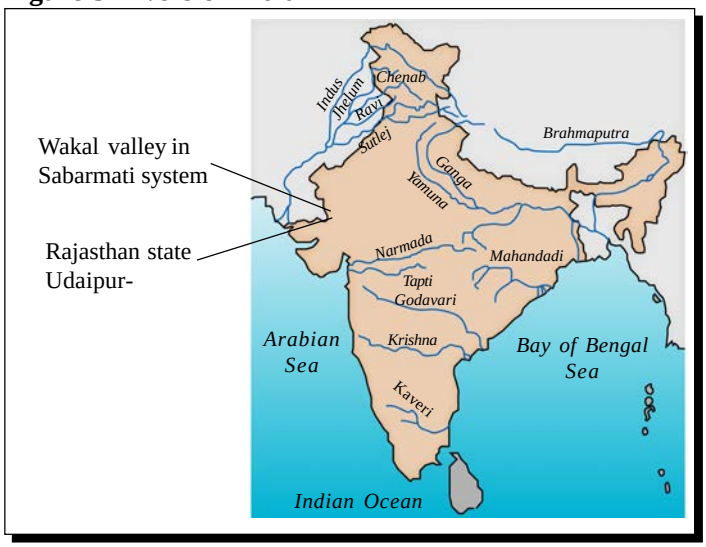


The issues of Rajasthan water supplies

- Rajasthan is one of the least developed regions of India and emphasises the dualism of India, with traditional rural areas and economically developed urban areas.
- This is the driest region of India accounting for 10% of its area and 5% of its population. Yet it has access to only 1% of the total surface water resources. (GOR 2005) Only 5% of schools hade water and sanitation by 2006 according to the Charity Wells for water.
- Rapid population growth and frequent drought mean the groundwater supplies are over – exploited. Water tables are therefore falling and this has a disproportionate effect on the poor.
- Evidence of poverty in many variables eg with 558 per 100,000 births this state has one of the highest infant mortality rates.
- The primary water source is groundwater which provides 90% of all drinking water. Of the last 50 years 82% of suppliers have seen below expected average replenishment. Only 32 of the 236 *blocks* (sub-districts) in Rajasthan are categorized as safe, with respect to their groundwater resources

This region includes the Thar desert whose annual rainfall is a mere 100mmm. The Aravali hills in south east Rajasthan are semi-arid with rainfall of 300-500mmm. High evaporation rates and high intensity rainfall can also lead to loss of potential groundwater replenishment.

Figure 3 Rivers of India



The solutions?

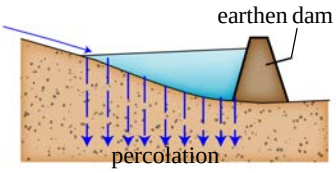
Low tech 'fixes'

Water use is managed in a **traditional manner** with **sustainable technologies** largely by rainwater harvesting (RWH) which is 'the collection and storage of rainwater in surface or sub- surface reservoirs, thereby reducing water losses to runoff and evaporation'

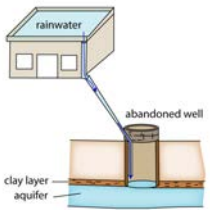
It occurs in 2 ways:

1. The direct capture and storage of rainwater for future human use by;
   - Taankas are particularly sustainable (3 m in diameter, 3-4 m deep most below land level.) They on average hold 20,000 litres. Filtering inlets on the side walls allows it to fill from the surrounding area and from rooftops, paving etc Once full provides water for family(5-6 average) until next monsoon.

- The Naadi /Johad - village ponds which retain water for crops and animals . Small wells in the bottom are opened when the Naadi is dry. These can be easily polluted.



- Rooftop rainwater harvesting – simple guttering allows w rain to be channelled into local storage containers. Similar to our water butts in our gardens



2 Manipulation of the landscape to slow and harness runoff by;

- Persian wheels whereby animal power draws water from shallow reservoirs

- land and soil bunds (creates simple terracing especially on sloping fields to trap water
- Stone dams (Trap water in soil to allow crop growth during monsoon – can be loose stone across seasonal river tributaries)

Deep wells are in many ways a higher technology solution, especially where tube wells are used, but they do allow for a safer supply as the water is less likely to be contaminated, and also is accessed from a more reliable deeper groundwater supply.

The issue is of cause over extraction as tube wells are not sustainable.

High Tech 'fixes'

More modern and technologically demanding solutions can still be small –scale and sustainable but are more controversial

- Anicuts – larger concrete dams where river widens
- Large scale water transfer intra- regional – there is a National river linking programme which would bring water from the Ganga basin to the Sabramati
- Large scale dams - The National Institute of Hydrology in India reports on several proposals in the Sabarmati basin http://www.nih.ernet.in/nih_rbis/india_information/SABARMATI_PROJECTS.htm

Small scale . low tech sustainable solutions – Rajasthan case- study

The Wakal Basin

The Wakal River, the main tributary of Sabarmati River, originates from the hills near Ghora village of Udaipur District. It flows about 112 km in the state of Rajasthan. It leaves the boundary near the village of Gau Pipli and enters Gujarat to the south.

The Wakal River Basin receives a modest amount of annual rainfall compared to the rest of the desert-dominated state of Rajasthan, (average 575mm). Almost all of this rainfall (96%) occurs in the 3-4 month monsoon window from late June through September. It is therefore prone to all the typical hydrological problems which affect Rajasthan

- ***GLOWS (global water for sustainability project)-Wakal River Basin Project***.
  This is a joint-project between World Vision India and Florida International University (FIU). World Vision India has been working in the Wakal River Basin for almost a decade, with the goal of improved watershed management. GLOWS advocates rainwater harvesting in this area because:
  - *RWH is a technology that can be applied in both urban and rural areas*
  - *Several RWH approaches have been used and many may be climate or eco-region specific*
  - *RWH can be implemented and managed at various levels – City , village and household*

- ***Wells for India*** *(a charity based in Winchester) has been working for some years focusing on water management as a key to reducing poverty. Its 5 year project in the Aravali hills covers 10 villages in the Wakal basin focussing on local tribal people. The intention is to reduce their vulnerability to the erratic precipitation pattern in the region. They have no employment source other than agriculture and no market access for cash crops. These problems are compounded by lack of accessible education and family planning.*

The work of such NGOs necessitates an ***Attitudinal fix****.*
This means that those with immediate access (or lack of it) to the water supply gain a full grasp of the practical implications of their actions . It gives the stakeholders ownership of the solutions – true bottom –up thinking.

347 villages west of Udaipur will see a presentation which focuses on 2 specific elements of water use
- *Over extraction by tube wells*
- *Desertification due to deforestation*

The drama is learnt by a group of local people and presented by them in each of the villages identified. Its graphic nature overrides literacy issues. The people are 'in tune' with the land and comprehend the implications as pointed out to them. The whole village turns out to watch

Figure 4 The process

A puppet show tells the story of families in a village - the wealthy family had a tube well which then used all of the groundwater in the area. The rest of the villagers suffered.

A compromise was reached and the villagers learnt to share the water and use it sustainably.

A second story tells of the arrival of a businessman in a village . They allow him to deforest a valley side by the village .

The river runs dry and the people leave the village in despair as their crops die. They are taught to replant and the 'devil' of desertification is driven away

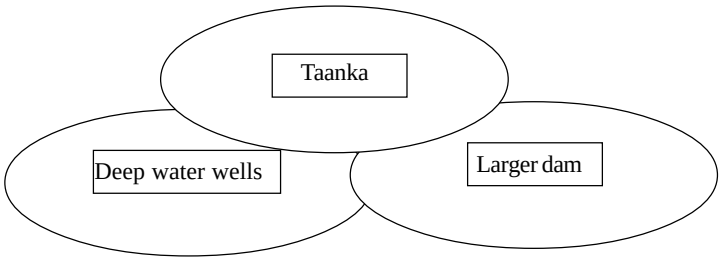
As Wells for India puts it in their report of 2008 on their project;
'Functional, community-based, gender-sensitive groups will be formed as these groups are best placed to manage their water resources. Community groups establish a sense of community ownership and responsibility for the project, which leads to sustainability '

Conclusion

This factsheet has given you the opportunity to look at water issues in India a transition economy with escalating demands. The exercises which follow allow you to evaluate the solutions for Rajasthan are of the poorest rural states of India, with widespread water scarcity.

Exercises for students

1. On rank scale 1-5 (one poor – 5 excellent) place each of the solutions covered, according to their sustainability and justify your decisions clearly
2. Re rank according to ability to redress the development gap i.e. Can they develop sustainable food production and improve their livelihood capacity?
   Is there conflict in your conclusions from theses 2 rankings?
3. Why is a mixture of technological and attitudinal fixes needed to address water insecurity?
4 (a) Sort the stakeholders shown in Figure 2 according to solution they would prefer from 3 given in Venn diagram



4/ (b) Where would you place the success of the three solutions in this diagram of criteria and why?

FUTURITY ie conserving water for future generations	ENVIRONMENT Ability to cause limited environmental damage
SOCIAL EQUITY ie helping all people equally including the poor	COMMUNITY INVOLVEMENT Bottom up involvement

Further Reading

About sustainable solutions for Rajasthan

- http://glows.fiu.edu/
- http://www.wellsforindia.org/
- http://www.sandrp.in/
- http://www.circleofblue.org/waternews/
- Rainwater Harvesting EVR 5332 –Integrated Solutions for Water in Environment and Development November 5, 2007John Stiefel –Research Assistant Global Water for Sustainability (GLOWS) Program Florida International University
- www.wateraid.org - More generally about the Water Crisis
- http://news.bbc.co.uk/hi/english/static/in_depth/world/2000/world_water_crisis/default.stm
- http://www.worldwatercouncil.org/index.php?id=1&L=0
- Atlas of Water Earthscan

Answers

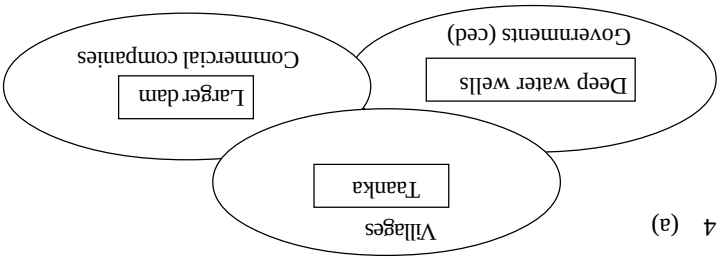
1. • Superdams
   • Wells including tube wells and Persian wheel
   • Rainwater harvesting ie Taankas, Naadi Johad, rooftop collection
   • Landscape manipulation ie stone dam, bunds

Example – rooftop rainwater harvest – scale 4 as – clean especially in urban areas, decrease urban flooding, simple to set up and use with recycled local materials, allows artificial recharge of groundwater too **but** does not deal with surface water quickly when rain intensive (so not 5 on scale).

2. Complete as for one but ranking would change t o3 on example given as although it would be sustainable it does not allow large scale food production and would not address issue fully in drought year. May allow household to become less dependent on aid but not catalyst for major developmental change.

3. Summary of argument – **technology** access dependent on:
   • Level of development and attendant ability to pay (dependence on aid, loan costs, etc) – cost benefit analysis
   • Political factors
   • Physical factors
   • Culture
   • Need to contract Top-down v Bottom-up approaches, especially with relationship to sustainability versus development (see first 2 exercises). But changing may need to change attitudes to alter pattern of water consumption. Examine use and attitudes of different stakeholders.

4 (a)



Stakeholders as in figure 5 – 2 inserted as examples

(b)

FUTURITY **Larger dam** ENVIRONMENT **Taanka**	SOCIAL EQUITY **Taanka** COMMUNITY INVOLVEMENT **Taanka**

Acknowledgements;

This Geo Factsheet was researched by Sue Chamberlain a Geography teacher at Kings School, Winchester, who visited Rajasthan in 2009.
Curriculum Press, Bank House, 105 King Street, Wellington, TF1 1NU
Geopress Factsheets may be copied free of charge by teaching staff or students, provided that their school is a registered subscriber.
No part of these Factsheets may be reproduced, stored in a retrieval system, or transmitted, in any other form or by any other means, without the prior permission of the publisher. ***ISSN 1351-5136***