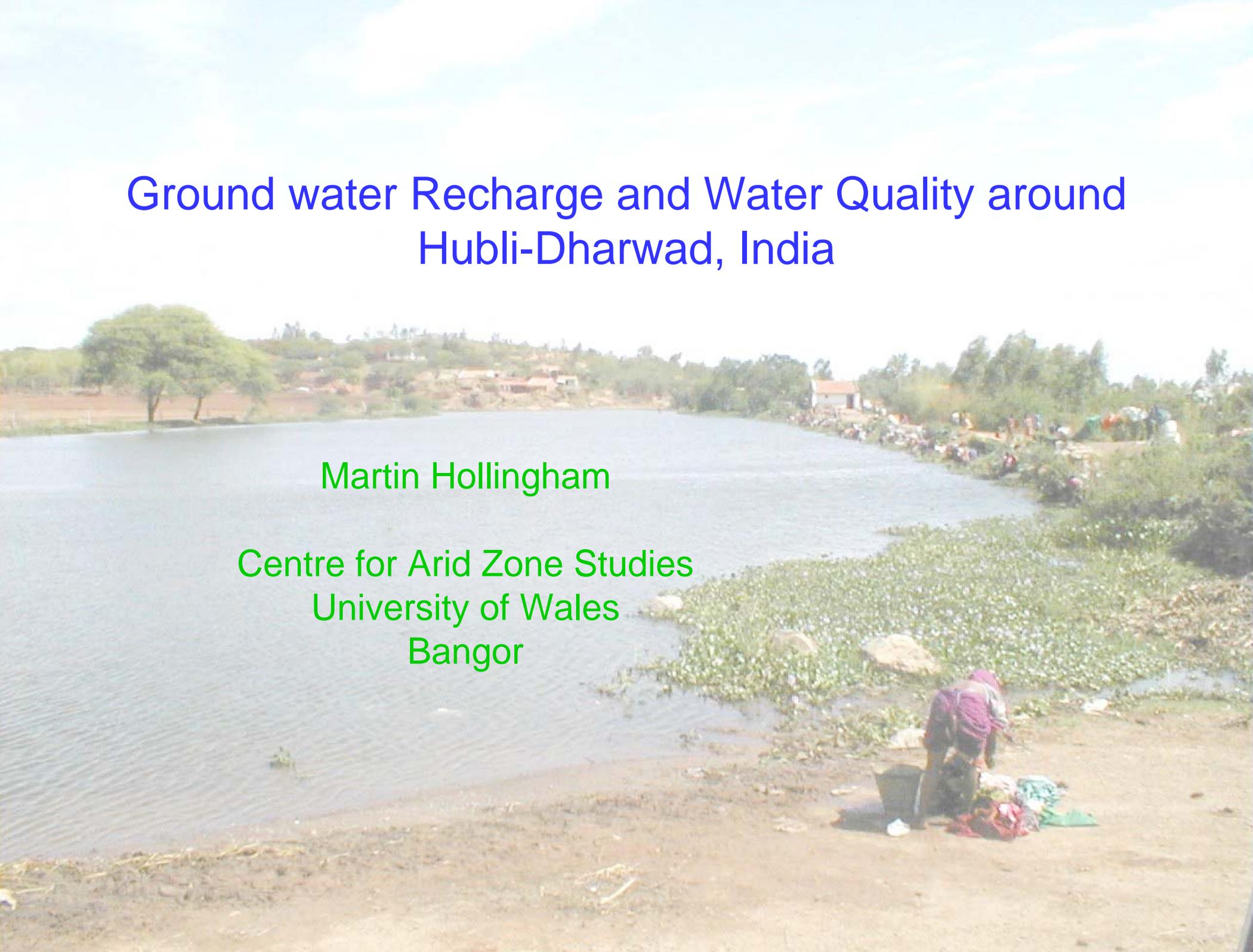


Ground water Recharge and Water Quality around Hubli-Dharwad, India

Martin Hollingham

Centre for Arid Zone Studies
University of Wales
Bangor

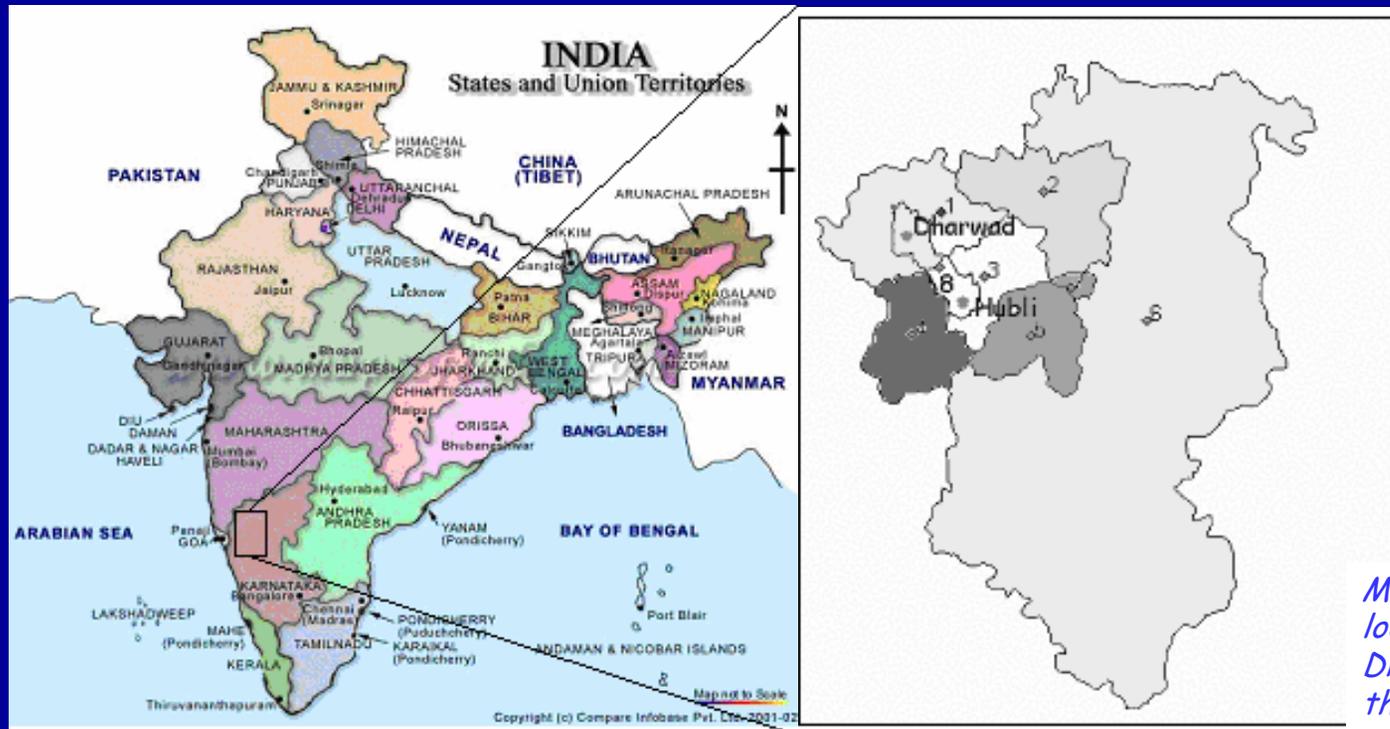


Introduction

A water resources assessment of periurban villages around Hubli-Dharwad, Karnataka, India, was conducted as part of a wider resources and development project.

Since 1956 Hubli-Dharwad has relied on piped reservoir sources, while the rural areas have increasingly relied on boreholes.

Increasing amounts of water are now being abstracted for irrigation in rural areas and many boreholes are now dry or have hard mineral waters which are bad for human health and damages some crops.



Map of India, Showing location of Hubli and Dharwad Taluks within the Dharwad District.

Artificial Water Balance

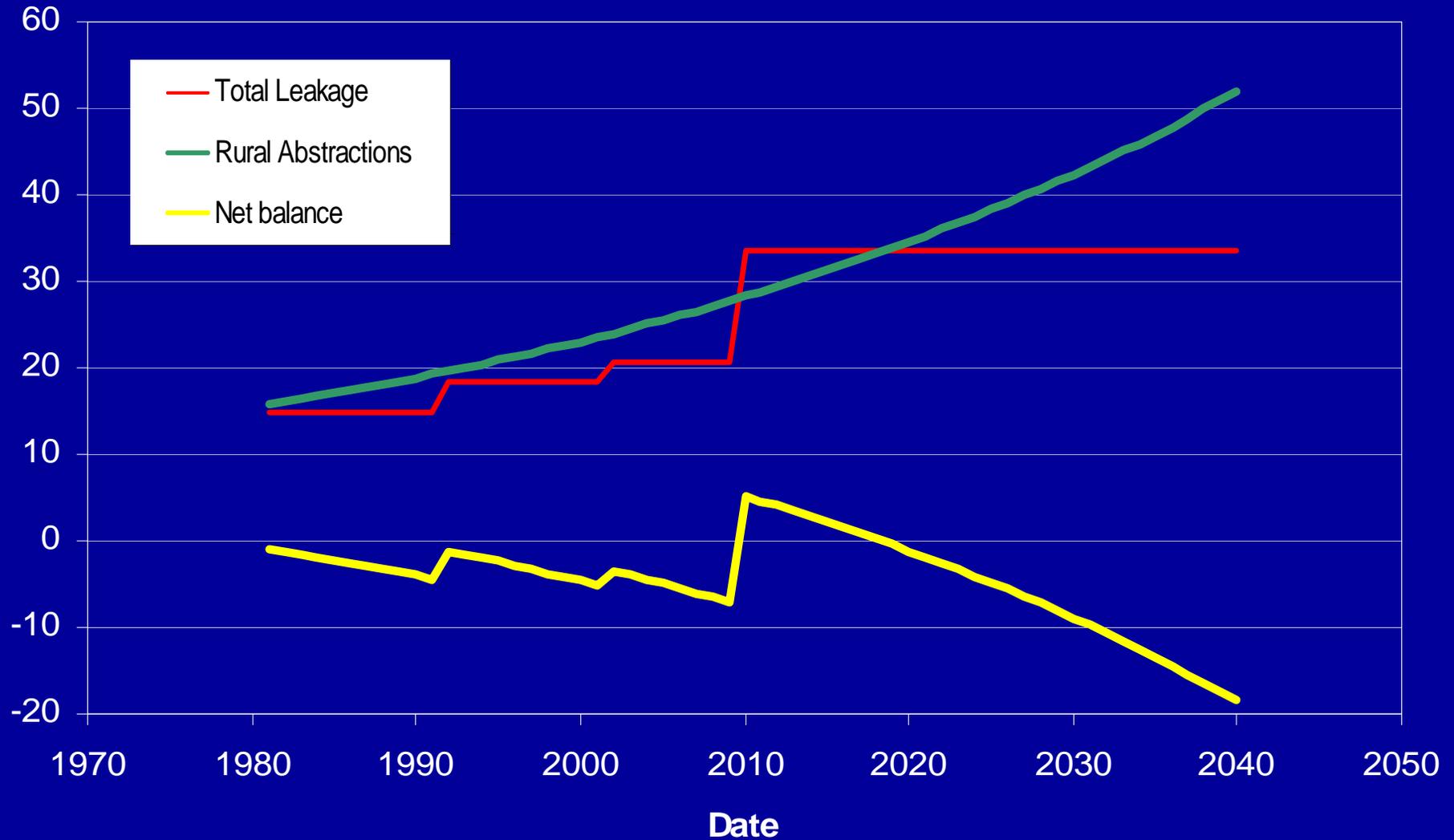


- In the Hubli – Dharwad urban area:-
 - 40% of the water supplied by the water supply network leaks into the ground
 - There are no sewage treatment facilities
 - 30% of sewage goes to cesspits and then seeps into the ground
 - 70% of sewage enters the sewerage network
 - where it leaks into the ground or drains into local rivers
 - some of which is used for irrigation in rural areas

Volumes of water supplied to the Hubli Dharwad.
(millions m³/yr)

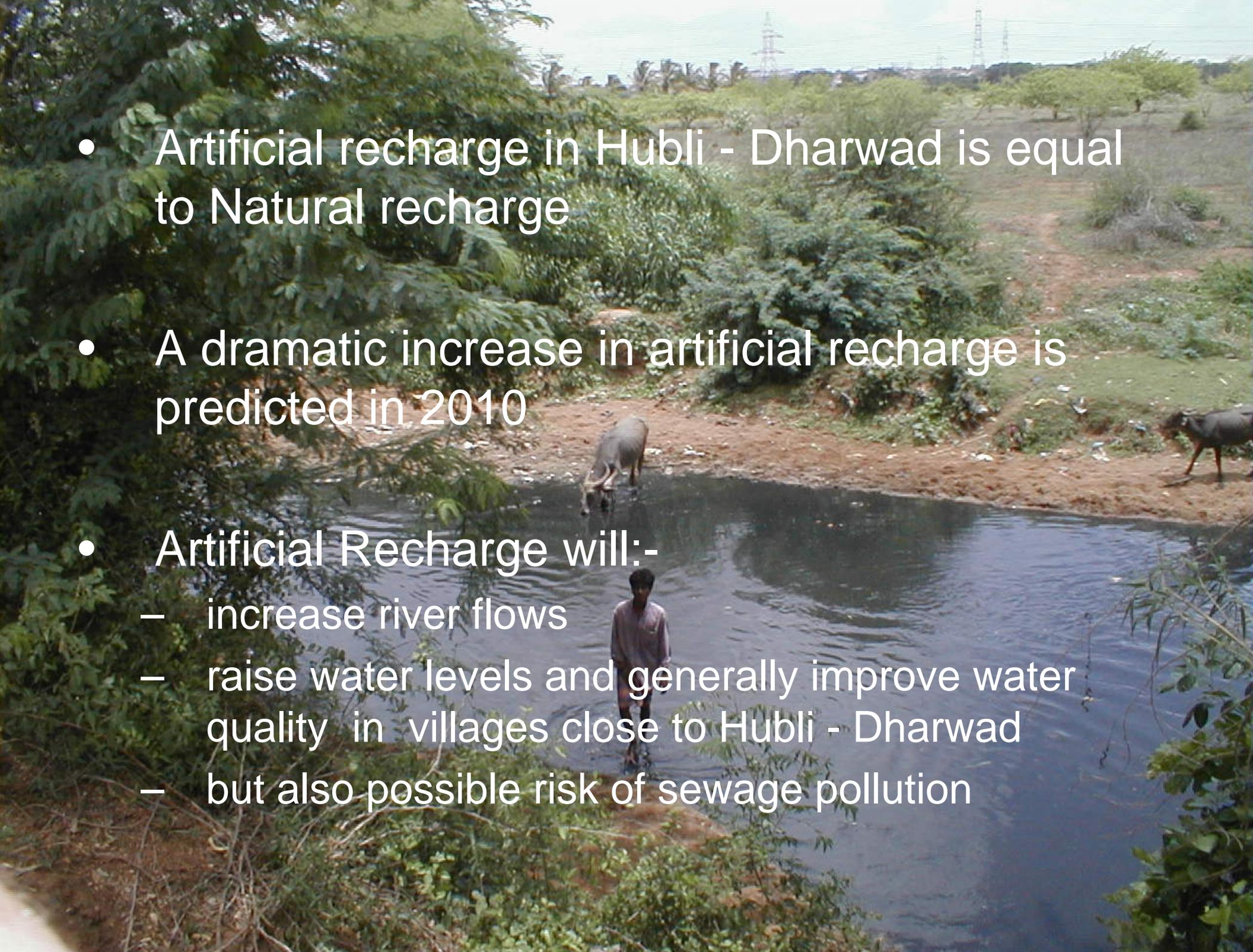
| Reservoir | | Water supplied | | Leakage | | |
|-----------|---------------------------------|----------------|----------------------------|--|---|-------------------------------------|
| | | Contribution | Total (T _w) | Mains (M) =40% of T _w | Sewage (S) =30% of (T _w -M) | Total (T _L) = M+S |
| 1956 | Neersagar (unenhanced) | 6.6 | 6.6 | 2.6 | 1.2 | 3.8 |
| 1967 | Neersagar (enhanced) | 13.1 | 13.1 | 5.2 | 2.4 | 7.6 |
| 1983 | Malaprabha stage 1 | 12.4 | 25.5 | 10.2 | 4.6 | 14.8 |
| 1993 | Malaprabha stage 2 | 6.2 | 31.7 | 12.7 | 5.7 | 18.4 |
| 2002 | Malaprabha repaired pipeline | 3.7 | 35.4 | 14.2 | 6.4 | 20.5 |
| 2010 | Malaprabha stage 3 | 22.3 | 57.7 | 23.1 | 10.4 | 33.5 |

Net Balance of Artificial recharge and Abstractions



Comparison of depths of water (mm/yr) being abstracted and recharging the Groundwater (figures in brackets millions m³ applied over relevant area)

| | Annual average Natural Recharge | Leakage within HDMC suburban area (280 km ²) | Abstractions within H+D Taluks (1657 km ²) |
|------|---------------------------------|--|--|
| 2002 | 53 - 85 | 73 (20.5) | 14 (23.9) |
| 2010 | 53 - 85 | 119 (33.5) | 16 (28.0) |

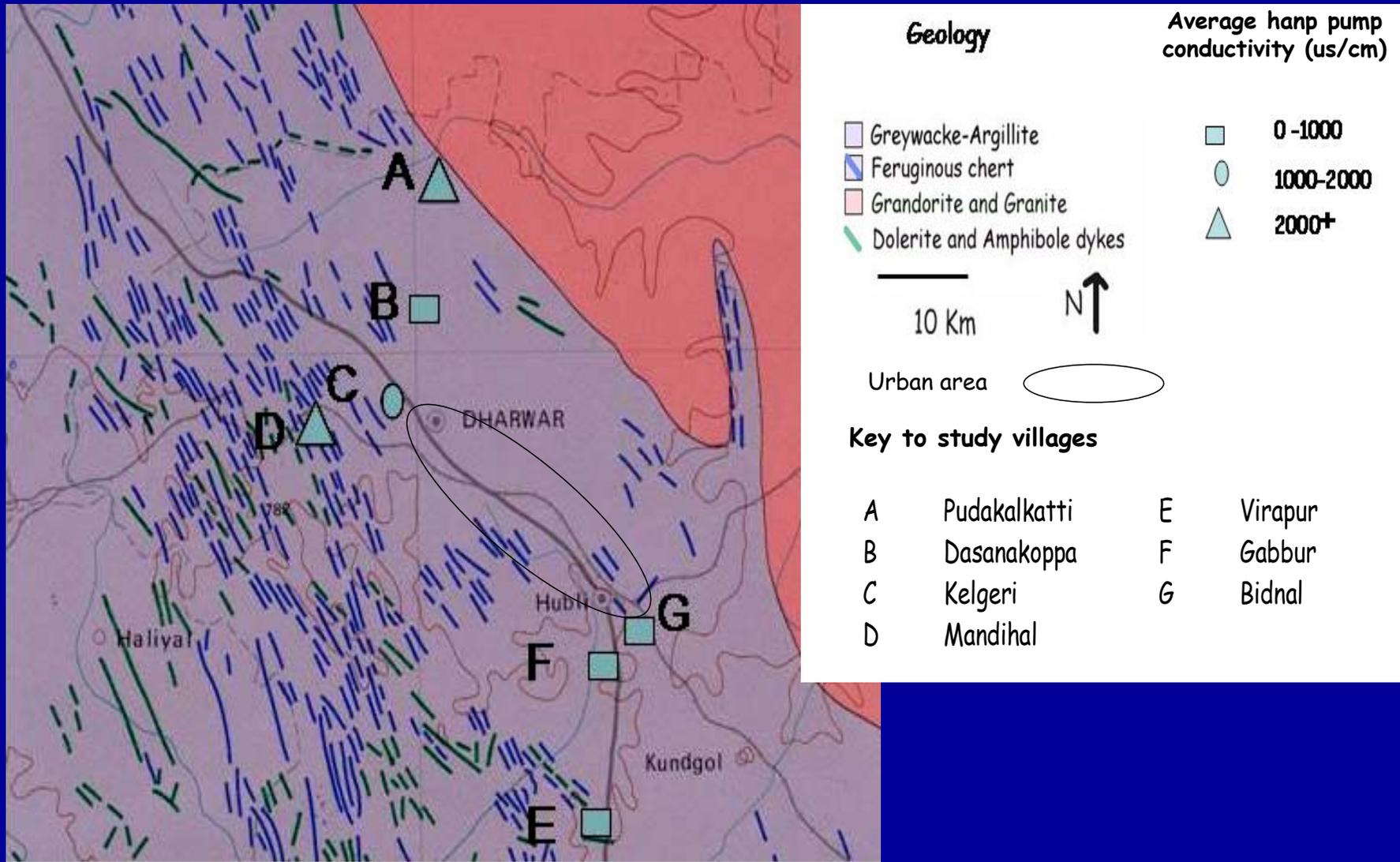
- 
- A photograph of a rural landscape. In the foreground, a man in a light-colored shirt and dark shorts stands waist-deep in a dark pond. To his left, a water buffalo is partially submerged in the water. To his right, another water buffalo is on the muddy bank. The background shows a line of green trees and bushes, with several high-voltage power lines visible against a clear sky. The overall scene is a typical rural setting in a developing region.
- Artificial recharge in Hubli - Dharwad is equal to Natural recharge
 - A dramatic increase in artificial recharge is predicted in 2010
 - Artificial Recharge will:-
 - increase river flows
 - raise water levels and generally improve water quality in villages close to Hubli - Dharwad
 - but also possible risk of sewage pollution

Water Quality Survey

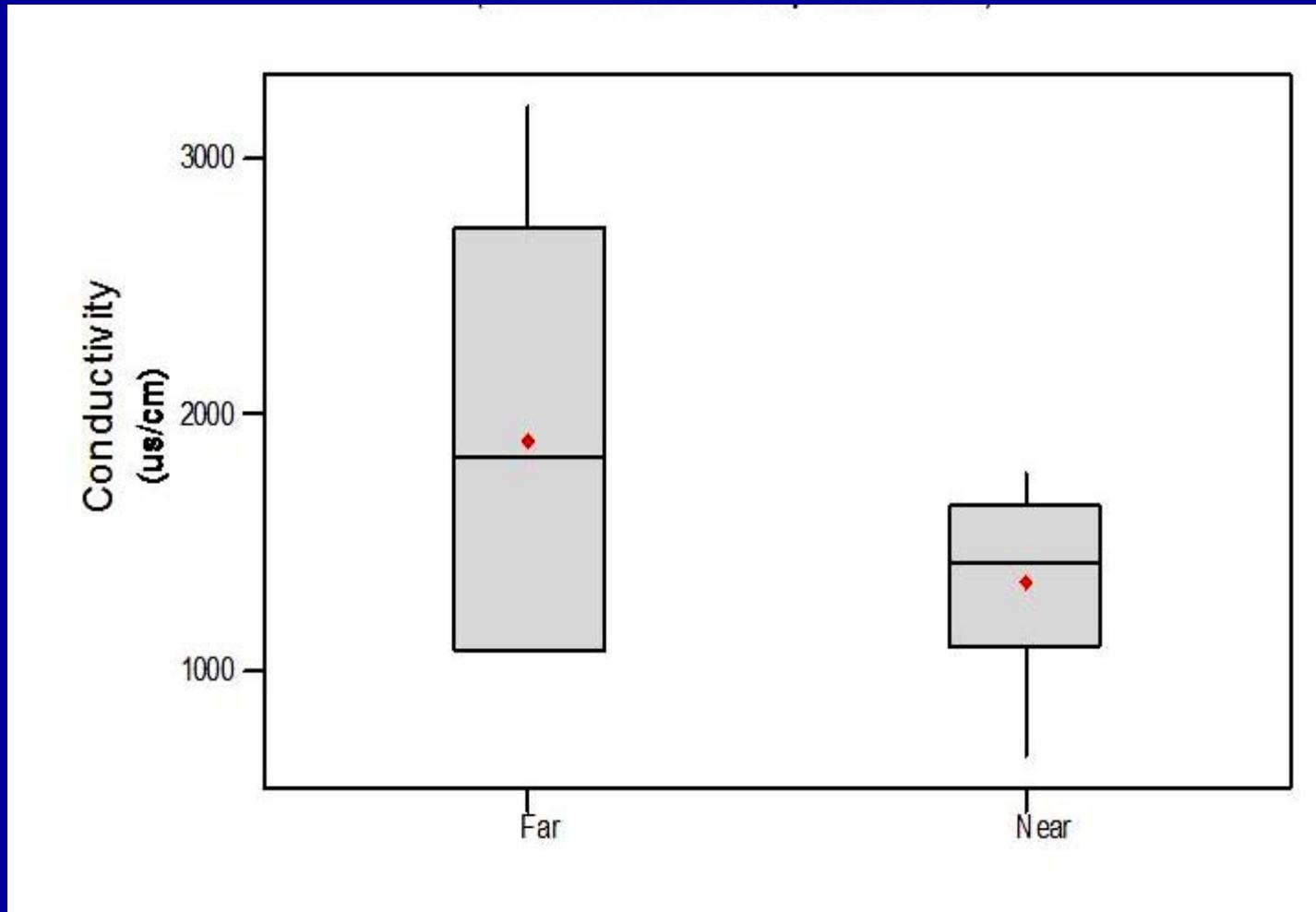
- Water quality from 27 hand pumps in eight periurban villages was surveyed in May 2001 at the start of the monsoon
- The water quality survey looked at
 - 4 **Near** villages (2-7 km)
 - 3 **Far** villages (8-15 km)



Locations of study villages



Box plots of water conductivities of hand pumps in Near and Far villages in 2001



- Water quality data shows that:-
 - Near villages have more dilute water than Far villages
 - Confirms that theory that greater recharge is occurring in Hubli – Dharwad than in rural areas.



Conclusions

- In 2002, additional recharge from sewage and water supply leakage was equal to natural recharge.
- When the 3rd stage of the Malaprabha starts to provide water around 2010, artificial recharge will dramatically increase.
- Recharge will increase groundwater levels and dilute groundwaters within the Hubli-Dharwad and the immediate area, compared to rural areas.
- Increase flows of rivers draining the city and increase the volume of water for informal irrigation systems next to rivers.
- Repairing leakage from the water mains would delay the need for further supplies
- Building sewage treatment works, repairing the sewerage system and removing cesspits would reduce the pollution risk of the groundwater and provide valuable irrigation water.