Water supply and waste water

challenges towards sustainability

Gourisankar Ghosh

Issues related to drinking water supply

- Source
- Supply
- Cost
- Finance
- Pricing and recovery
- O&M
- Participation
- sustainability

myths

- The problem is shortage of water
- The problem is that Govts do not have fund
- The problem is that people are too poor to pay
- The problem is lack of technology
- The problem is rapid population growth specially in cities

facts

- Waterborne disease with malnutrition is the main cause of morbidity and mortality
- A billion people live without safe water
- Fecal pollution is more dangerous to the water environment
- The cost of supply has actually gone down
- There is no accountability in India for supply of unsafe water in public system

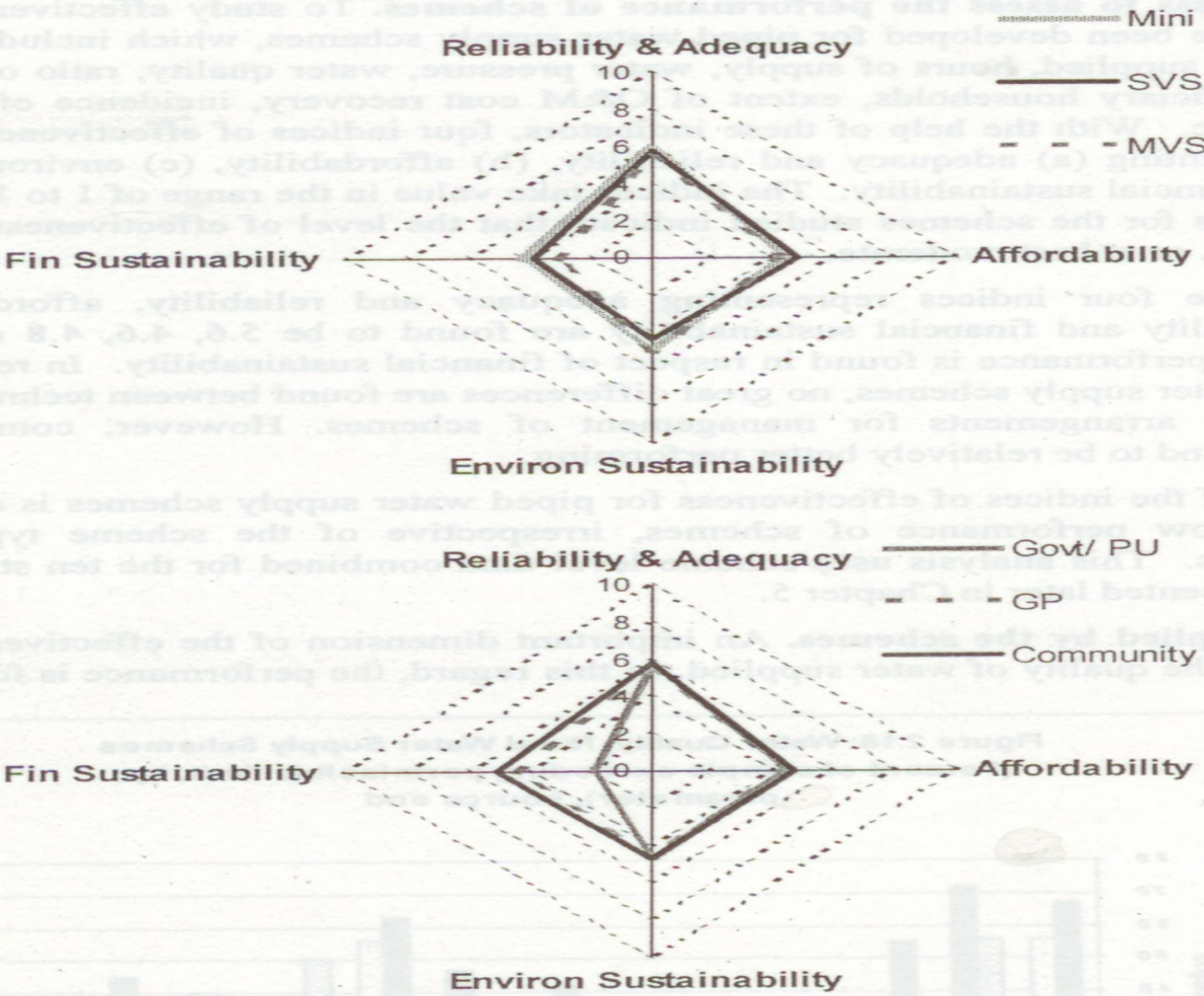
Indian water programme

- ARWSP or the Accelerated Rural water Supply Programme is continuing since 1974
- The Mission is in mission mode since 1985
- The budgetary allocation has gone up from 16000 cr in 10 plan to 39400 cr in 11 plan
- No sustainability in sight

Basic problem

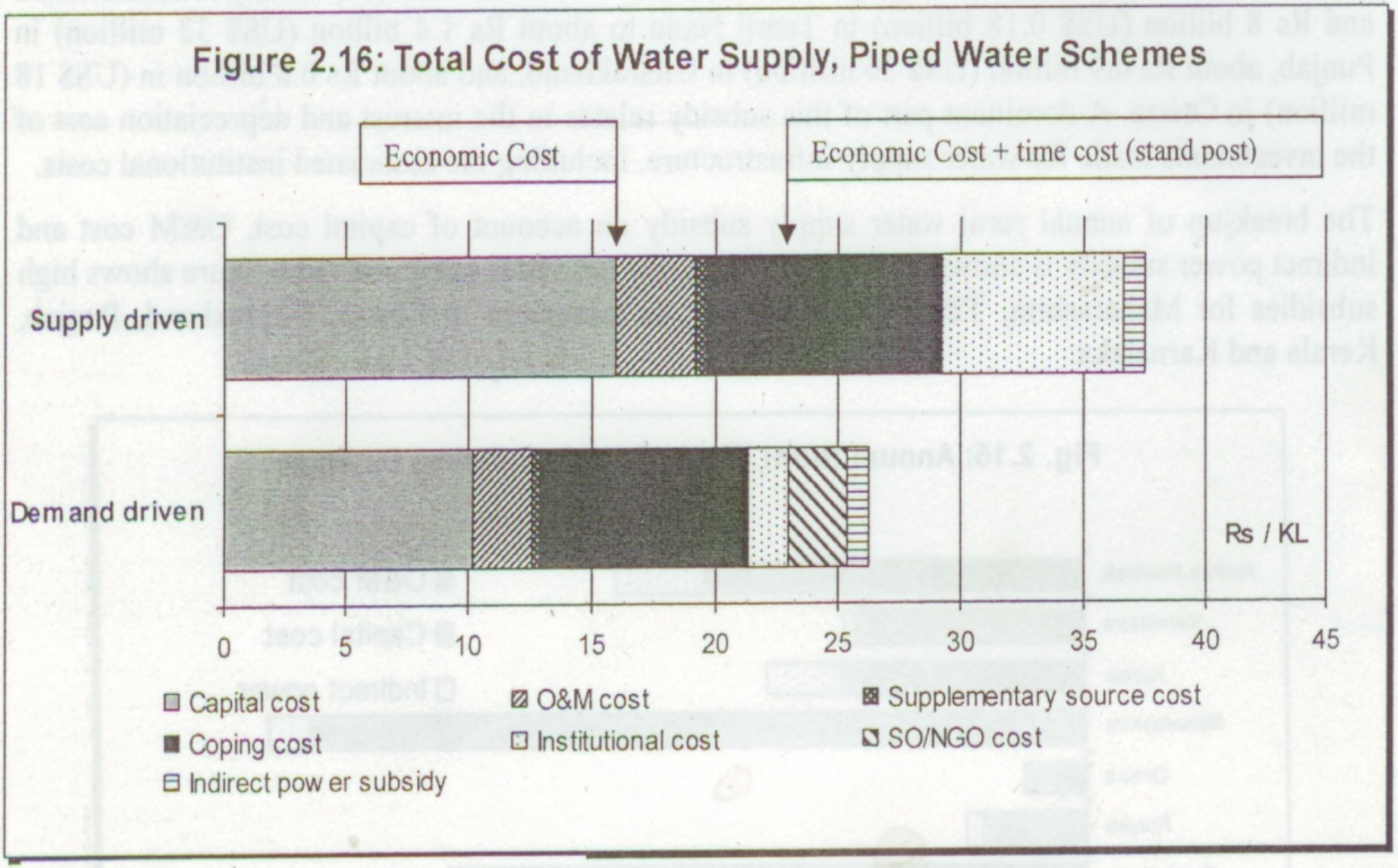
- No clear cut national water policy
- No regulatory control on water source
- Agriculture is inefficient and consumes more water
- Top down subsidised programme does not involve people
- No impact as there is no hygiene or health education
- Indirect negative impact on other sectors like tourism, housing, industry etc.

Figure 2.17: Indices of Effectiveness, Comparison across technology and institutional Arrangement



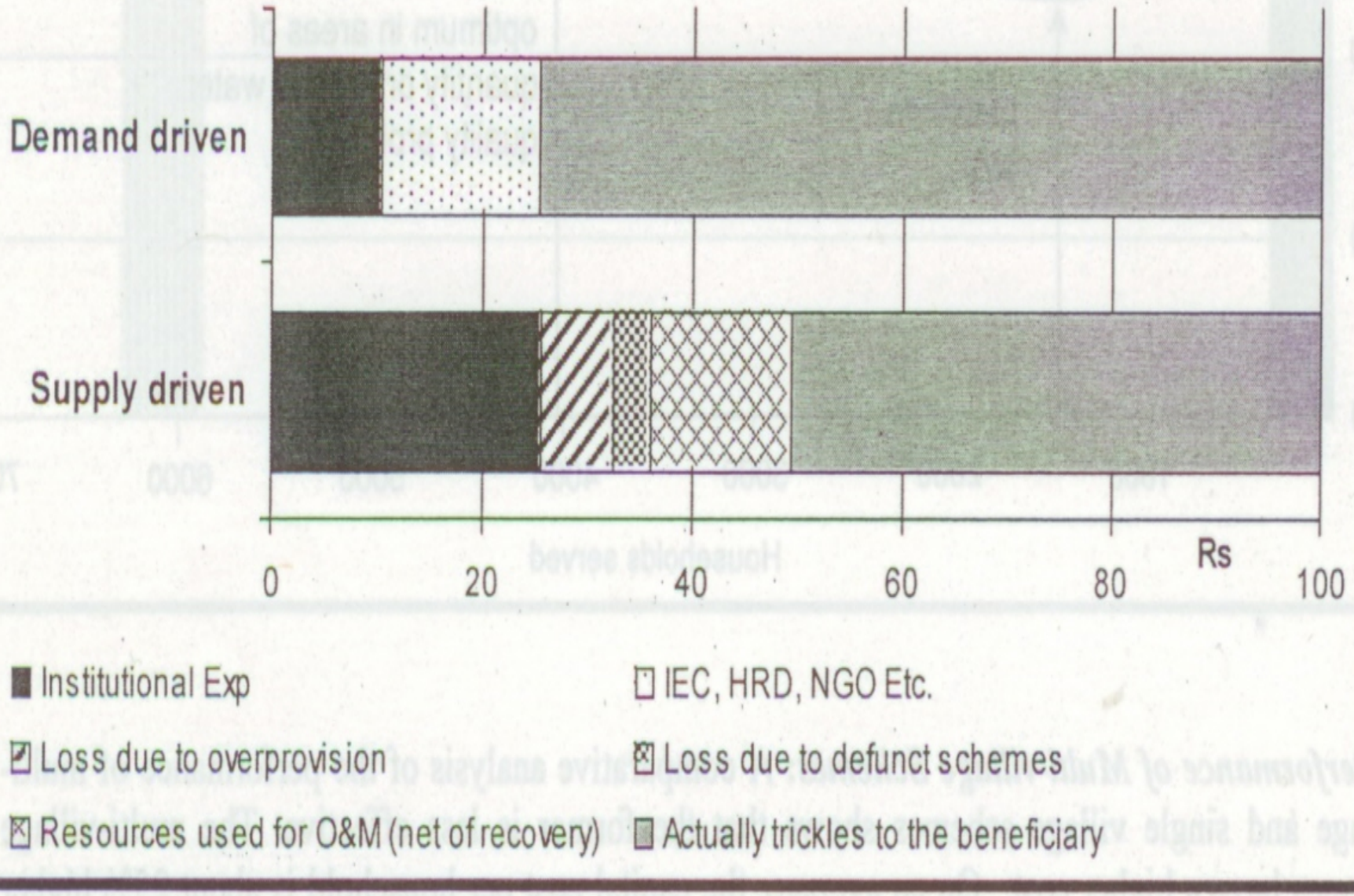
Source: computed from survey data; Range: Max 10, Min 1

Figure 2.16: Total Cost of Water Supply, Piped Water Schemes



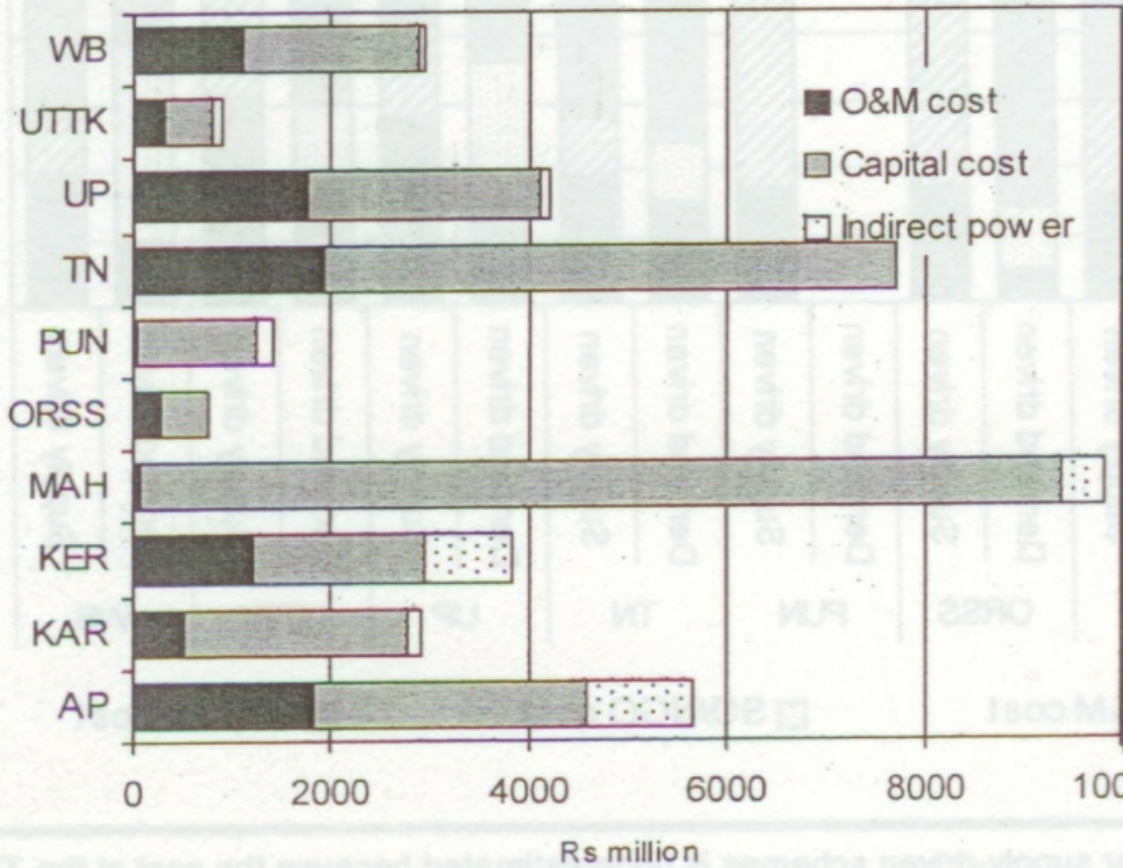
Source : Computed from Survey Data

Fig 2.19: How Rs 100 is Spent in Demand and Supply Driven Programs



Source: computed from survey data

Fig 3.17: Estimated annual subsidy for Rural Water Supply in ten states, 2005-06



	Subsidy per HH served (Rs/month)	Ratio to state domestic product (%)
WB	21	0.2
UTTK	63	0.4
UP	17	0.2
TN	88	0.4
PUN	37	0.2
ORSS	10	0.3
MAH	71	0.3
KER	65	0.4
KAR	33	0.2
AP	43	0.3

Source: Computed from flow of fund data collected from states and field survey data

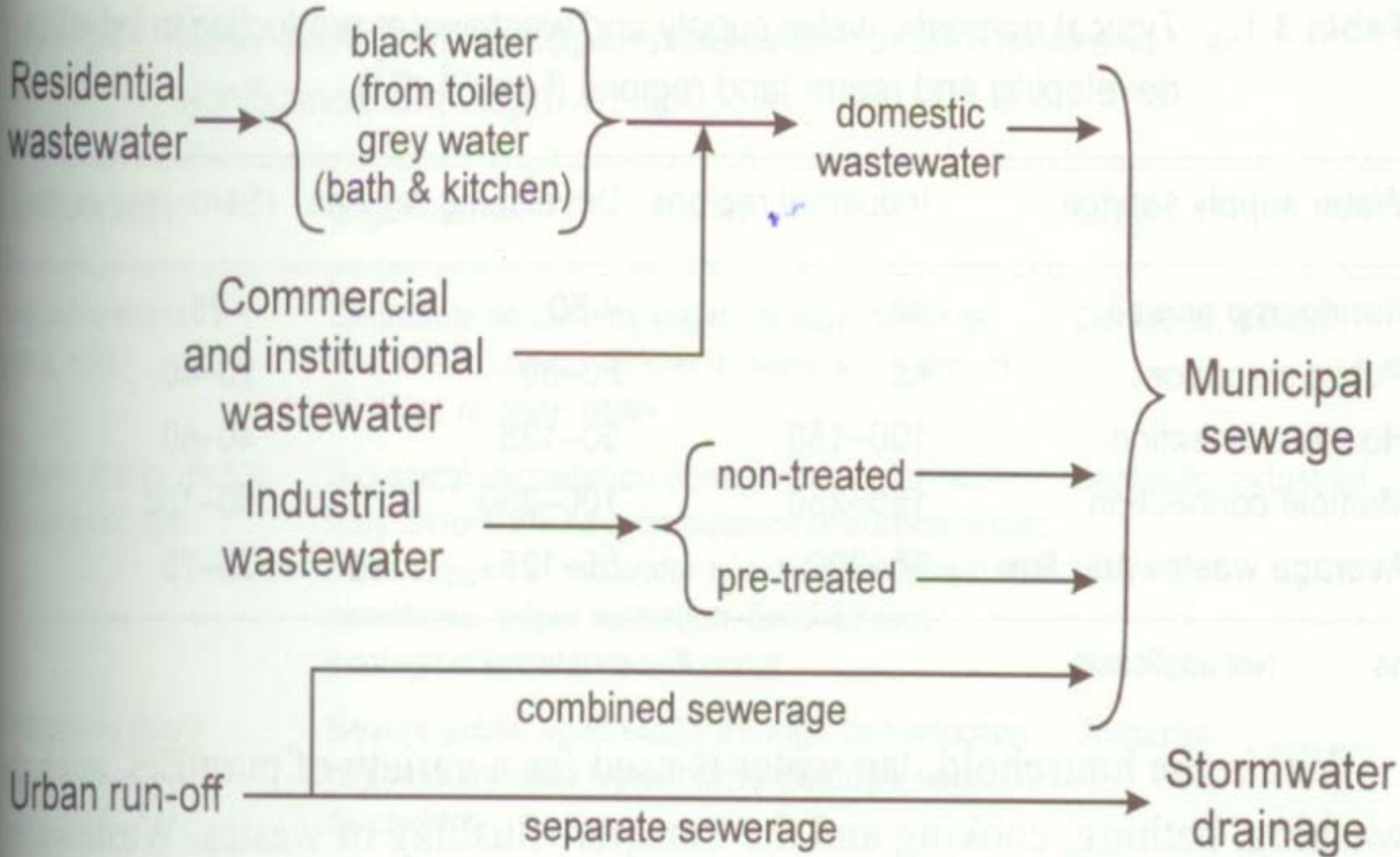


Figure 3.1 Origin and flows of wastewater in an urban environment

Table 4.1 Increases in crop yields (tons ha^{-1} a^{-1}) arising from wastewater irrigation in Nagpur, India

Irrigation water	Wheat 8 yrs[1]	Moong beans 5 yrs[1]	Rice 7 yrs[1]	Potato 4 yrs[1]	Cotton 3 yrs[1]
Raw wastewater	3.34	0.90	2.97	23.11	2.56
Settled wastewater	3.45	0.87	2.94	20.78	2.30
Stabilisation pond effluent	3.45	0.78	2.98	22.31	2.41
Freshwater + NPK	2.70	0.72	2.03	17.16	1.70

[1] Years of harvest used to calculate average yield

Source: Shende, 1985

Table 3.3 Variation in the composition of domestic wastewater

Contaminant	Specific production (g cap^{-1} d^{-1})[2]	Concentration[1] (mg l^{-1})[2]
Total dissolved solids	100–150	400–2,500
Total suspended solids	40–80	160–1,350
BOD	30–60	120–1,000
COD	70–150	280–2,500
Kjeldahl-nitrogen (as N)	8–12	30–200
Total phosphorus (as P)	1–3	4–50
Faecal coliform (No. per 100 ml)	10^6–10^9	4×10^6–1.7×10^7

BOD Biochemical oxygen demand
COD Chemical oxygen demand

[1] Assuming water consumption rate of 60–250 l cap^{-1} d^{-1}

[2] Except for faecal coliforms

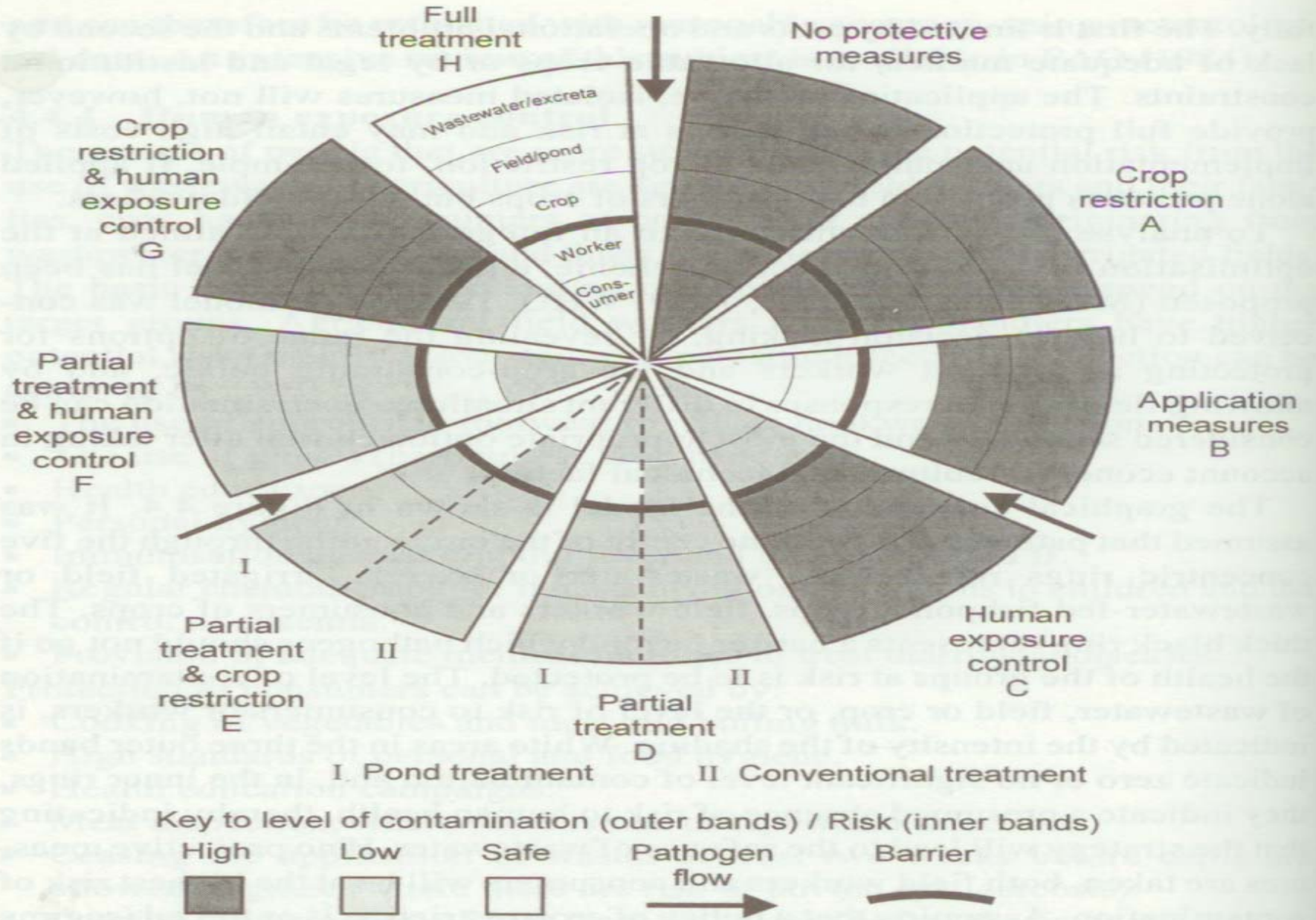


Figure 4.4 A model illustrating the effect of control measures in reducing health risks from wastewater use (After Mara and Cairncross, 1989; WHO, 1989)

Table 4.3 Removal of excreted bacteria and helminths by various wastewater treatment systems

Treatment process	Removal (log_{10} units) of			
	Bacteria	Helminths	Viruses	Cysts
Primary sedimentation				
Plain	0–1	0–2	0–1	0–1
Chemically assisted[1]	1–2	1–3 (G)	0–1	0–1
Activated sludge[2]	0–2	0–2	0–1	0–1
Biofiltration[2]	0–2	0–2	0–1	0–1
Aerated lagoon[3]	1–2	1–3 (G)	1–2	0–1
Oxidation ditch[2]	1–2	0–2	1–2	0–1
Disinfection[4]	2–6	0–1	0–4	0–3
Waste stabilisation ponds[5]	1–6 (G)	1–3 (G)	1–4	1–4
Effluent storage reservoirs[6]	1–6 (G)	1–3 (G)	1–4	1–4

G With good design and proper operation the recommended guidelines are achievable

1 Further research is needed to confirm performance

2 Including secondary sedimentation

3 Including settling pond

4 Chlorination or ozonation

5 Performance depends on number of ponds in series and other environmental factors

6 Performance depends on retention time, which varies with demand

Source: Mara and Cairncross, 1989

Table 7.1 Economic–environmental typology of urban sanitation problems

Urban sanitation problems	Lower-income countries (< US$ 650 per capita)	Lower middle-income countries (US$ 650–2,500 per capita)	Upper middle-income countries (US$ 2,500–6,500 per capita)	Upper-income countries (> US$ 6,500 per capita)
Access to basic sanitation services	Low coverage, especially for urban poor; mainly non-sewered options	Low access for urban poor; increasing use of sewerage	Generally acceptable coverage; higher sewerage levels	Good coverage; mainly sewered
Wastewater treatment	Virtually no treatment	Few treatment facilities; poorly operated	Increasing treatment capacity; operational deficiencies	Generally high treatment levels; major investments over past 30 years
Water pollution issues	Health problems from inadequate sanitation and raw domestic sewage "in the streets"	Severe health problems from untreated municipal discharge	Severe pollution problems from poorly treated municipal and mixed industrial discharges	Primarily concerned with amenity value and toxic substances

Source: Adapted from Bartone, *et al.*, 1994

Economic instruments

- Polluters Pay Principle (OECD 1972)
- Regulatory (CAC) ?
- Education and Persuasion
- Economic?
  - Marginal Cost Pricing
  - Pollution charges
    - Effluent charges
    - User charges
    - Product charges
    - Administrative charges
  - Marketable permits
  - Subsidies
  - Deposit-refund system
  - Enforcement incentives

What we need

- An integrated water management approach
- A multi disciplinary ministry of water
- An authority for integrated water management
- Strengthening of non engineering discipline in CWC and in mission
- Disbursement of fund to states based on performance and not on no source
- Independent evaluation as in rural development schemes
- participation of all stakeholders
- Better governance