Enough water for agriculture? Addressing the growing challenge

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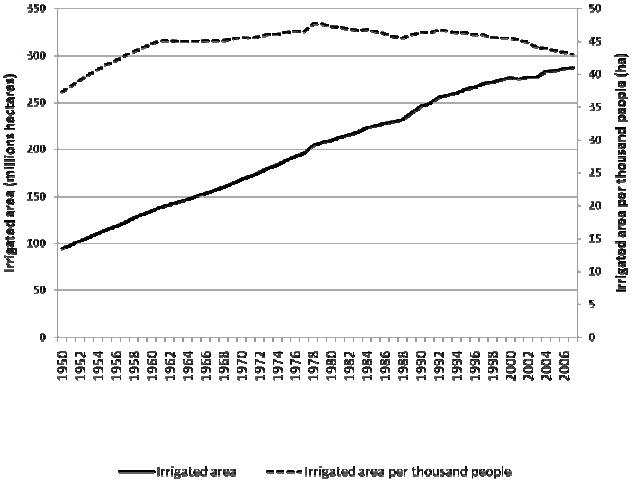
Outline of presentation

- Current issues worldwide
- Possible measures to address the water crisis in India
- Conclusions

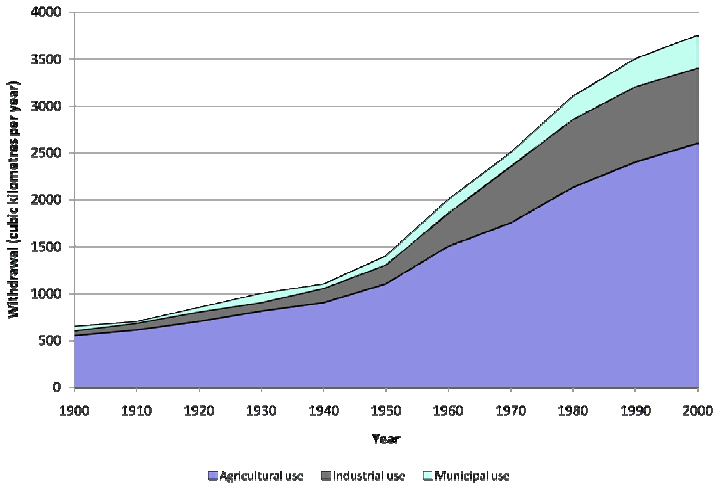
Water for food

- Agriculture is the largest consumer of water resources, taking 71% of all withdrawals (industry 18%, domestic/municipal 8%)
- Three fold increase in irrigated area worldwide in last 50 years, from 94 million ha in 1950 to over 287 million ha in 2007.
- Irrigated area per head of population has varied little, from 37.3 ha/1000 people in 1950 to 43.0 ha/1000 people in 2007 (peak at 47.6 ha/1000 in 1970s).

Growth in irrigated area



Growth in water withdrawals



IWMI assessment

The Comprehensive Assessment of Water Management in Agriculture (IWMI, 2007)

- Promising trends
  - Increase in consumption of food, better nutrition
  - Increase in land and water productivity (grains up to 2.7t/ha from 1.4 t/ha in last four decades)
  - New investments in irrigation and AWM supports economic development
  - Increase in global food trade and flows of virtual water
- Very disturbing trends:
  - Number of malnourished people remains at 850 million.
  - Average per capita food supply in South Asia and Sub-Saharan Africa remains far below the world average.
  - Agricultural pollution of rivers and groundwater increasing.
  - Land and water resources degraded through pollution, erosion, salinisation, seawater intrusion.
  - Increasing number of river basins over-committed and poorly managed.
  - Groundwater levels declining rapidly in densely populated areas of China, India, North Africa and Mexico.
  - Water management institutions slow to adapt to new conditions

IWMI assessment

- Demand for food
  - Food demand will rise dramatically in next 50 years to double current levels.
  - Increase demand due to rising population, but also change of diet as economies develop.
- Availability of water
  - Amount of evapotranspiration will increase 60-90%, from 7,200 km^3/year to 11-13,500 km^3/year.
  - To meet increased demand will need to:
    - use more river/ground water;
    - use marginal quality water;
    - use rainfall better;
    - increase water use efficiency and productivity;
    - reduce post-harvest losses;
    - manage diets;
    - use more virtual water

UK 2011 Foresight Report

"The case for urgent action in the global food system is now compelling. We are at a unique moment in history as diverse factors converge to affect the demand, production and distribution of food over the next 20 to 40 years. The needs of a growing world population will need to be satisfied as critical resources such as ***water, energy and land*** *become increasingly scarce. The food system must become sustainable, whilst adapting to climate change and substantially contributing to climate change mitigation. There is also a need to redouble efforts to address hunger, which continues to affect so many. Deciding how to balance the competing pressures and demands on the global food system is a major task facing policy makers, and was the impetus for this Foresight Project."*

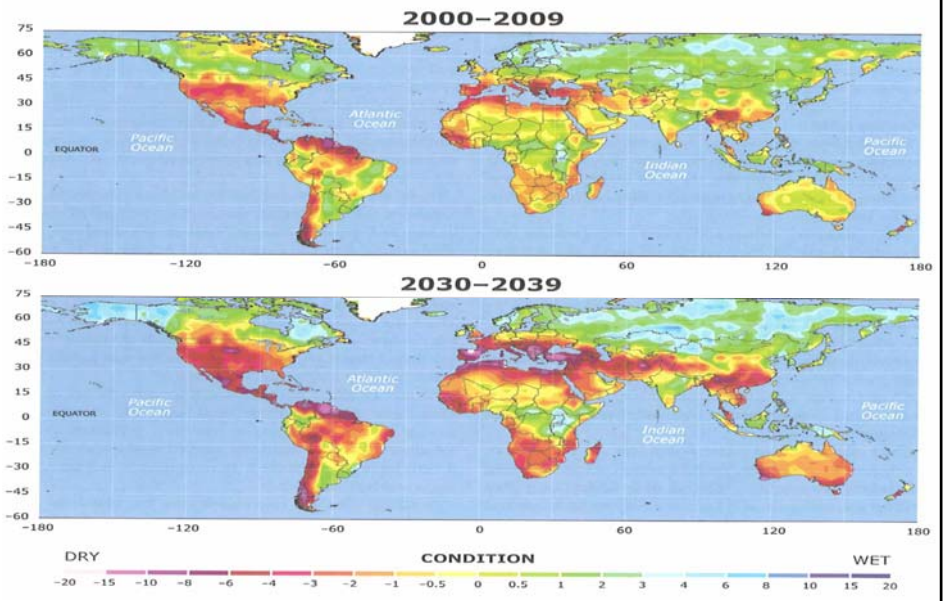
Professor Sir John Beddington CMG, FRS
Chief Scientific Adviser to HM Government, and Head of the Government Office for Science

Forward to the 2011 Foresight Report, The Future of Food and Farming

UK 2011 Foresight Report

- The food system is failing in two major ways:
  - Hunger remains widespread – 925 million people experience hunger
  - Many systems of food production are unsustainable
- Important drivers affecting the food system:
  - Global population increases
  - Changes in the size and nature of per capita demand
  - Governance of food system at national and international levels
  - Climate change
  - Competition for key resources (land, energy and water resources)
  - Changes in values and ethical stances of consumers

National Center for Atmospheric Research Water Maps



UK 2011 Foresight Report

- Challenge A: Balancing future demand and supply
  - Improving productivity using existing knowledge
  - New science and technology to raise production limits
  - Reducing waste
  - Improving governance of the food system
  - Influencing demand
- Challenge B: Addressing future volatility in food system
- Challenge C: Ending hunger
  - 925 million people suffer from hunger (Africa and South Asia)
  - Make agriculture work harder to reduce hunger
  - Take measures in the broader food system
  - Build stronger constituency to end hunger

WRG Charting Our Water Future

The picture shown by the report is certainly sobering: The ever-expanding water demand of the world's growing population and economy, combined with the impacts of climate change, are already making water scarcity a reality in many parts of the world—and with it we are witnessing severe damage to livelihoods, human health, and ecosystems. In just 20 years, this report shows, demand for water will be 40 percent higher than it is today, and more than 50 percent higher in the most rapidly developing countries. Historic rates of supply expansion and efficiency improvement will close only a fraction of this gap. Unless local, national and global communities come together and dramatically improve the way we envision and manage water, there will be many more hungry villages and degraded environments—and economic development itself will be put at risk in many countries.

HRH The Prince of Orange Willem-Alexander
Chairman of the United Nations Secretary-General's Advisory Board on Water and Sanitation

Executive Summary, Charting Our Water Future, The 2030 Water Resources Group

Key findings

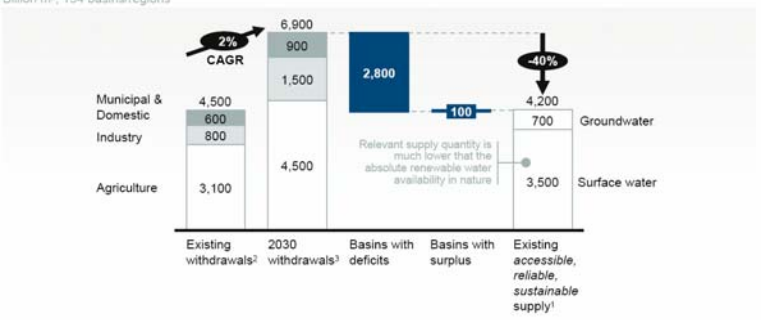
- Water scarcity is an increasing business risk.
- Without a step change improvement in WRM difficult to address related resource challenges, such as food production.
- In many regions current supply will not meet needs
- By 2030 global water requirements could grow from 4,500 billion m^3 today to 6,900 billion m^3, 40 percent above current accessible, reliable supply.
- One third of world population will live in basins where the deficit is greater than 50 percent.
- Water challenge is closely tied to food provision and trade.

Global gap in water needs

Exhibit I

Aggregated global gap between existing accessible, reliable supply[1] and 2030 water withdrawals, assuming no efficiency gains

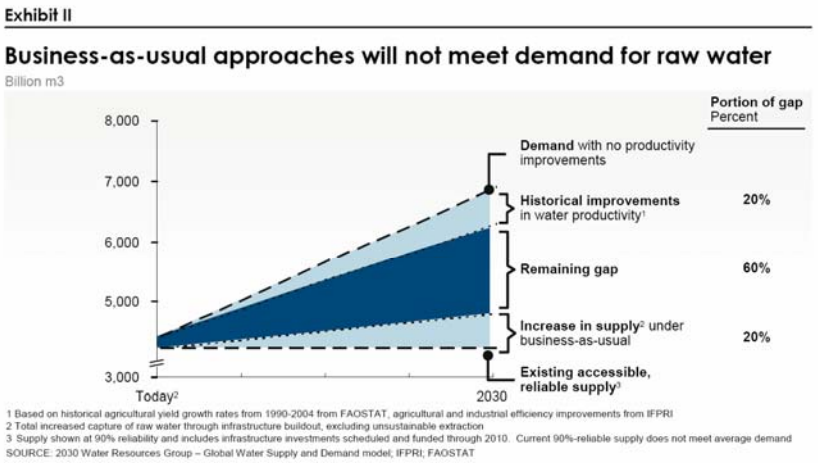
Billion m^3, 154 basins/regions



1 Existing supply which can be provided at 90% reliability, based on historical hydrology and infrastructure investments scheduled through 2010; net of environmental requirements
2 Based on 2010 agricultural production analyses from IFPRI
3 Based on GDP, population projections and agricultural production projections from IFPRI; considers no water productivity gains between 2005-2030

SOURCE: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT-WATER base case

Global gap in water needs



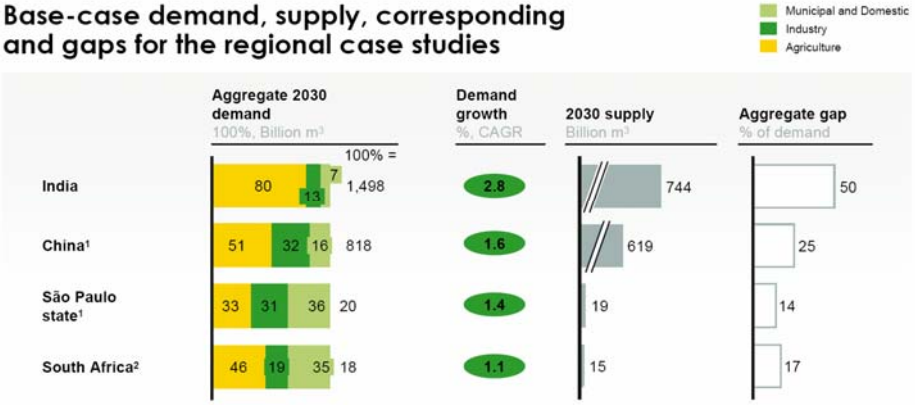
Main challenges

- Competition for scarce water from multiple uses within a river basin.
- Role of agriculture for food, feed, fibre and bioenergy as a key demand driver for water.
- The nexus between water and energy.
- The role of urbanisation in WRM
- Sustainable growth in arid and semi-arid regions

Water gaps by country

Exhibit IV

Base-case demand, supply, corresponding and gaps for the regional case studies



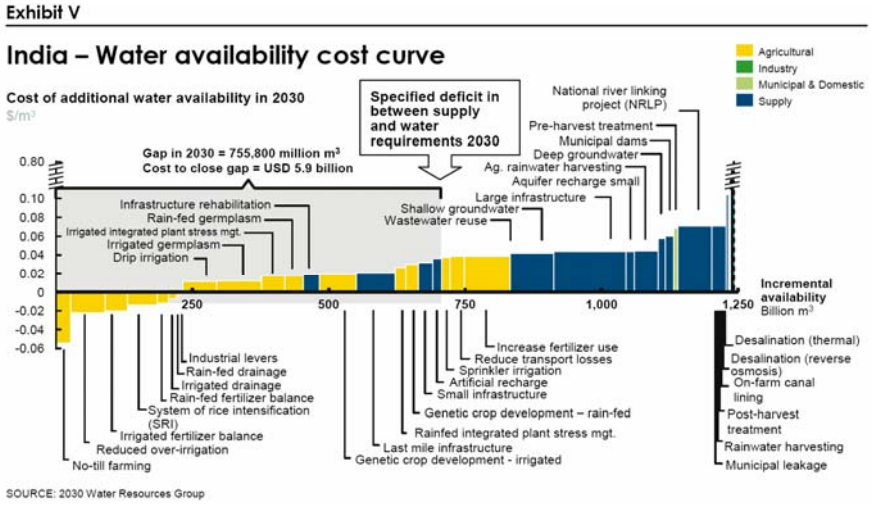
1 Gap greater than demand-supply difference due to mismatch between supply and demand at basin level
2 South Africa agricultural demand includes a 3% contribution from afforestation
SOURCE: 2030 Water Resources Group

Case studies

By 2030:

- India – Demand 1.5 trillion m^3, driven by food demands. Current supply is 740 billion m^3. Most river basins facing severe deficit – Ganges, Krishna, Indus.
- China – Demand 818 billion m^3, 50% agriculture, 32% industrial (thermal power). Current supply 618 billion m^3. Pollution leads to "quality adjustment" – 21% unfit for agriculture.
- Sao Paulo – Demand 20.2 billion m^3, split between domestic, industrial and agriculture. Current supply 618 billion m^3. Pollution a real issue.
- South Africa - Demand 17.7 billion m^3, household demand 34%. Current supply 15 billion m^3. Low rainfall, limited aquifers, dependent on international water transfers.

Water availability cost curve



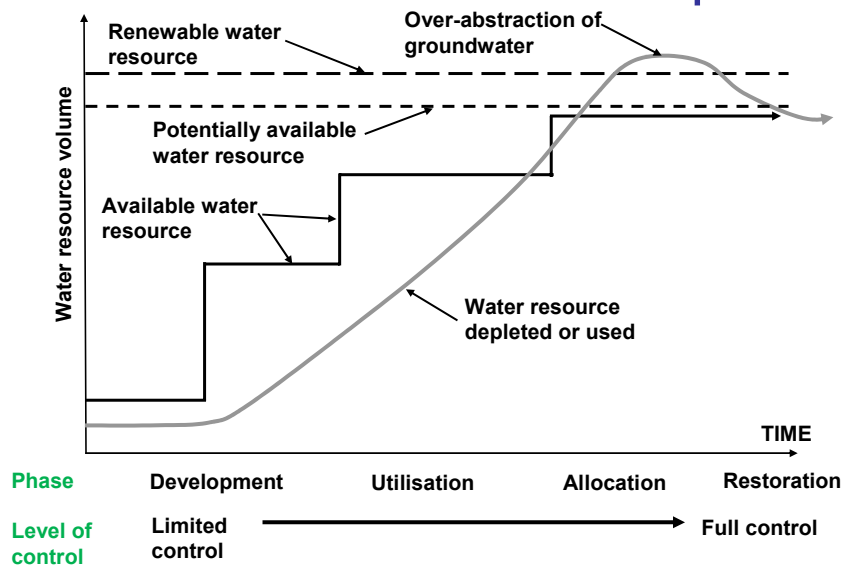
WRG Report – Key findings

- Agricultural productivity is a fundamental part of the solution
  - Increase "crop per drop" – drip, sprinkler, no-till, scheduling
  - Biggest impact on closing gap is in India
- Efficiency in industry and municipal systems equally critical
  - In China biggest growth in demand is industrial and urban. Save on thermal power, wastewater reuse, industrial use.
- Quality and quantity of water are tightly linked
  - Need to improve wastewater quality to enable reuse
- Most solutions imply cross-sectoral trade-offs
  - Have to balance between domestic, industrial, agricultural and environmental

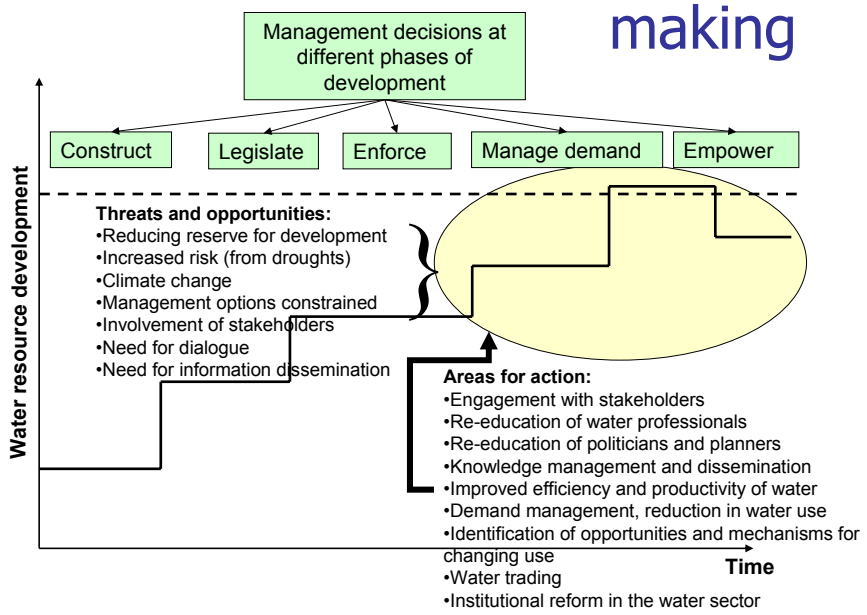
What to do?

- Water resources fully developed in many countries
- Many river basins approaching closure
- Groundwater levels dropping dramatically
- Domestic and industrial use taking priority over agriculture
- Water being taken out of agriculture for other uses
- Food production has to increase, estimated that majority of the increased production will have to come from irrigated agriculture
- Suitable land for irrigation is largely used up, water resources not available

Phases of river basin development



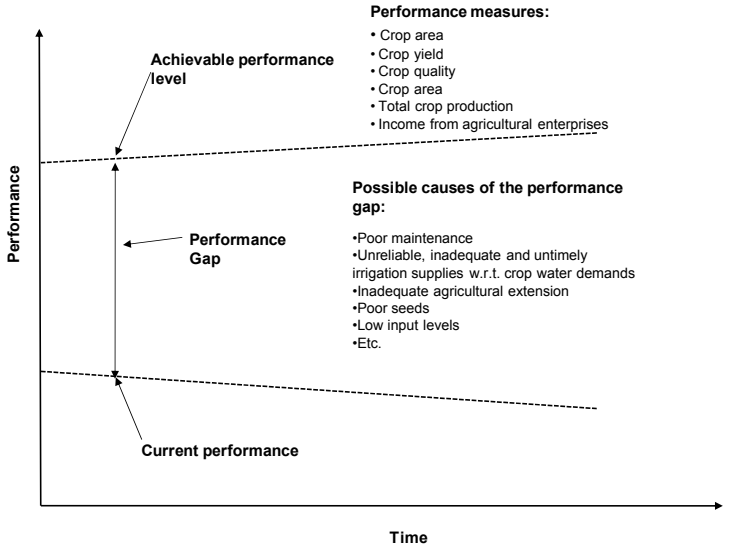
Changing options for decision making



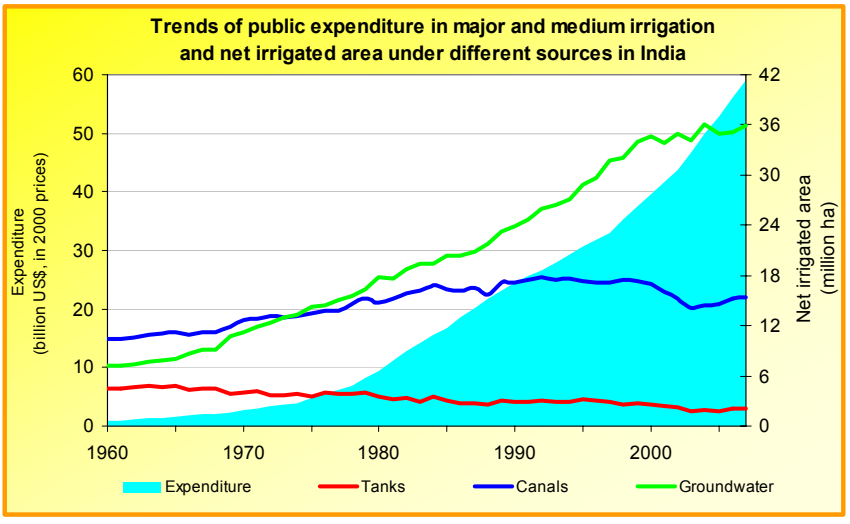
The situation in India

- Agriculture contributes 28% of GDP, 67% of employment
- Irrigation contributes to higher incomes, more secure livelihoods and reduces poverty
- Irrigated area totals 90 million ha, surface water 39%, groundwater 47%, other sources 14%
- Increasing water scarcity - 9 out of 20 river basins deemed to be water scarce (< 1000 m^3 per capita per year)
- Groundwater table declining in many states
- Gross irrigated area not rising despite continued investment
- Actual irrigated area not matching developed area
- Poor performance of I&D schemes
- Condition of I&D systems deteriorating, area reducing
- Conflicts over water increasing

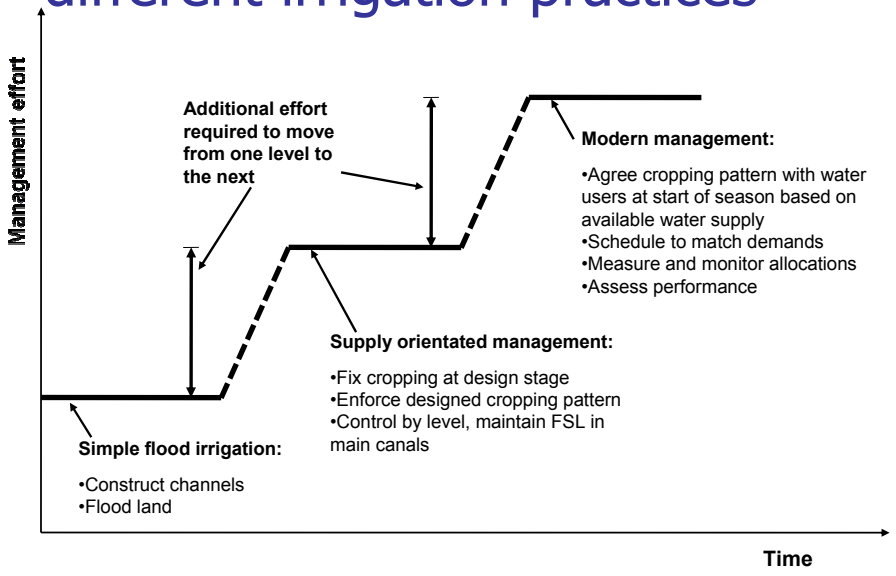
The performance gap



Investment in irrigation

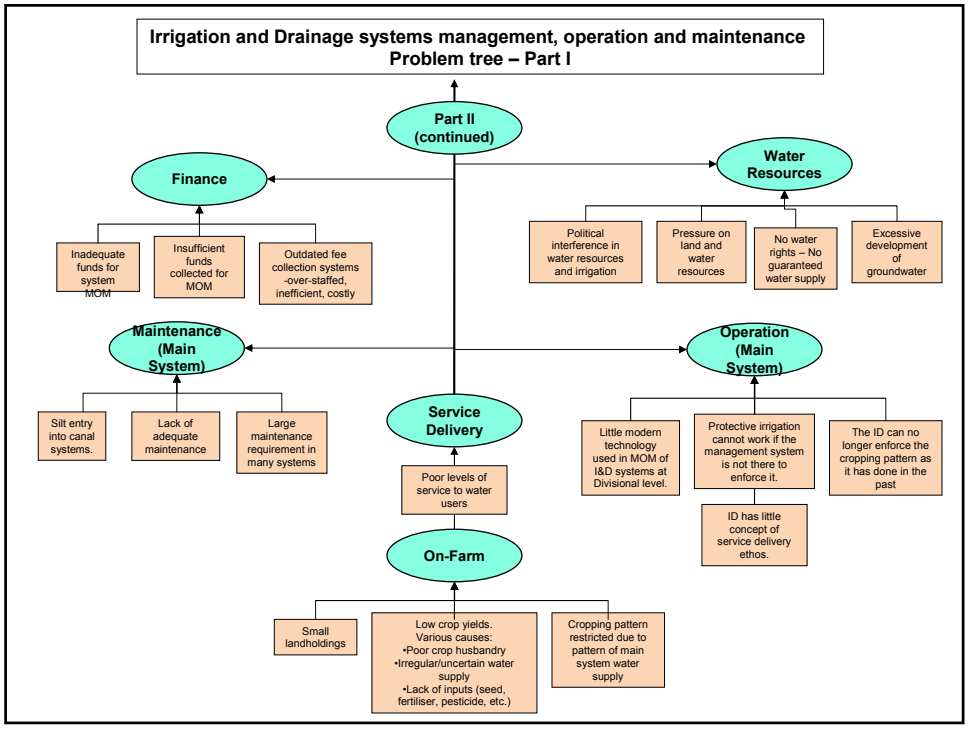


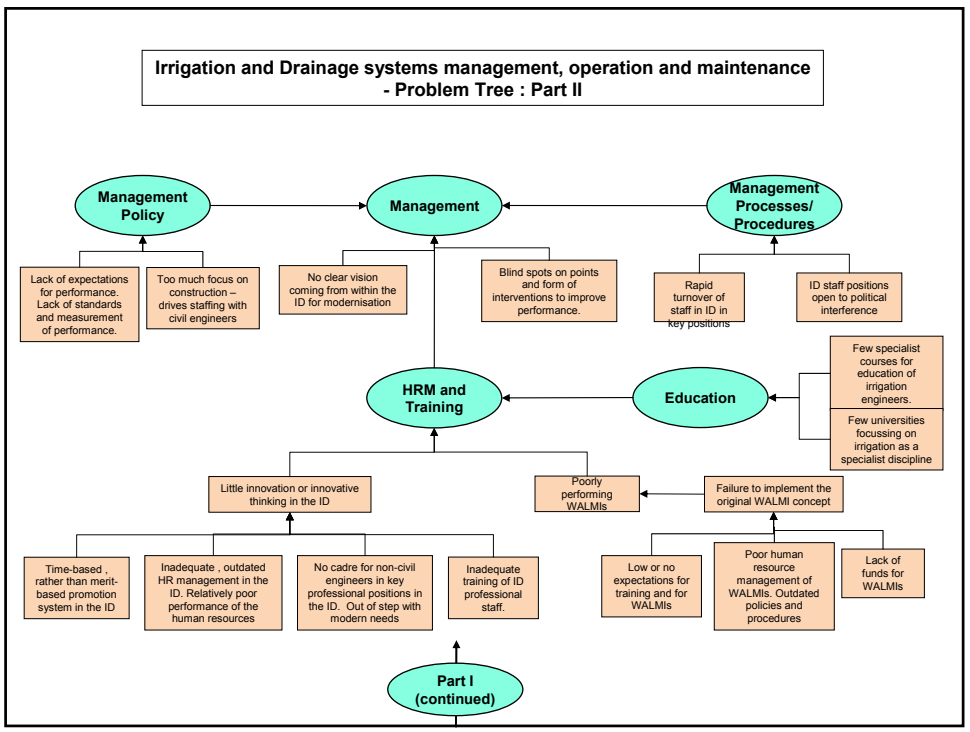
Management effort needed for different irrigation practices



Identifying the problem

- World Bank study in 1998:
  - Identified areas of concern and proposed action
  - Established Water Sector Restructuring Projects in several states (Maharashtra, Madhya Pradesh, Rajasthan, Tamil Nadu, Andhra Pradesh)
- WB SDWUAs study 2010:
  - Identified problems with:
    - participatory programmes
    - main system management
    - water resources management
- National Water Resources Framework Study 2011
  - Funded by International Finance Corporation, on behalf of the National Planning Commission
  - Assisting in preparation of the 12th 5-Year Plan


Irrigation and Drainage systems management, operation and maintenance
Problem tree – Part I
Part II (continued)
Finance
Water Resources
Inadequate funds for system MOM
Insufficient funds collected for MOM
Outdated fee collection systems -over-staffed, inefficient, costly
Political interference in water resources and irrigation
Pressure on land and water resources
No water rights – No guaranteed water supply
Excessive development of groundwater
Maintenance (Main System)
Operation (Main System)
Silt entry into canal systems.
Lack of adequate maintenance
Large maintenance requirement in many systems
Service Delivery
Little modern technology used in MOM of I&D systems at Divisional level.
Protective irrigation cannot work if the management system is not there to enforce it.
The ID can no longer enforce the cropping pattern as it has done in the past
ID has little concept of service delivery ethos.
Poor levels of service to water users
On-Farm
Small landholdings
Low crop yields. Various causes: •Poor crop husbandry •Irregular/uncertain water supply •Lack of inputs (seed, fertiliser, pesticide, etc.)
Cropping pattern restricted due to pattern of main system water supply


Irrigation and Drainage systems management, operation and maintenance
- Problem Tree : Part II
Management Policy
Management
Management Processes/ Procedures
Lack of expectations for performance. Lack of standards and measurement of performance.
Too much focus on construction – drives staffing with civil engineers
No clear vision coming from within the ID for modernisation
Blind spots on points and form of interventions to improve performance.
Rapid turnover of staff in ID in key positions
ID staff positions open to political interference
HRM and Training
Education
Few specialist courses for education of irrigation engineers.
Few universities focussing on irrigation as a specialist discipline
Little innovation or innovative thinking in the ID
Poorly performing WALMIs
Failure to implement the original WALMI concept
Time-based , rather than merit-based promotion system in the ID
Inadequate , outdated HR management in the ID. Relatively poor performance of the human resources
No cadre for non-civil engineers in key professional positions in the ID. Out of step with modern needs
Inadequate training of ID professional staff.
Low or no expectations for training and for WALMIs
Poor human resource management of WALMIs. Outdated policies and procedures
Lack of funds for WALMIs
Part I (continued)

Areas for action – On-farm

- Reform at the on-farm level
  - Strengthen farmer involvement and participation. Establish WUA Support Units at ID Divisional level
  - WUAs to set, collect and utilize service fees
  - Improve water management (raise efficiency and productivity of water use)
  - Use asset management planning to identify MOM costs and thus service fees
  - Volumetric supply
  - Introduce new technology (drip, on-farm storage, buried pipes, land levelling, etc.)
  - Raise yields (agricultural inputs)
  - Conjunctive use of surface and groundwater
  - Private sector involvement in advisory services

Areas for action – On-farm

Areas for action – Main system

- Reform at the main system level (Irrigation Dept.)
  - Change from a construction to a management focus
  - Restructure the whole organisation, separate construction and management, operation and maintenance (MOM)
  - Employ new multi-disciplinary staff, not just civil engineers
  - Modernize management systems (computers, remote sensing, GIS, MIS, etc.)
  - Use asset management planning
  - Focus on *service delivery* and *partnership* with water users
  - Introduce performance-based management systems
  - Support water users associations and farmer participation
  - Free up cropping patterns to match farmer demands
  - Consider public-private partnership for system management

Areas for action – Main system

Areas for action – River basin and policy

- Form State Water Resources Management Agencies responsible for assessment of water resources, licensing, regulation, etc.
- Separate out water resources management from irrigation. Water Resources Department to become the Irrigation Dept., bulk supplier to water users
- Redraft and update water legislation (e.g. Northern India Canal and Drainage Act, 1873!)
- Introduce legal water rights/entitlement
- Convert irrigation tax to a service fee
- Strengthen education in irrigation engineering and agricultural engineering

Conclusions

- Water scarcity is already, or is becoming, a key issue in many countries, especially those relying on irrigation
- New approaches are required to address this growing water crisis, including reforms at the on-farm, main system, river basin and policy level
- New approaches require technical innovations *and* institutional change and support.
- Doing nothing is not an option!

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