Applying science to water productivity: who pays if we do, who pays if we don’t?

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- What is the right criterion for assessing the impact from investments in research?
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- Who pays if we apply science to water productivity?

Applying science to WP

Applying science to crop water productivity: assertions

- Business as usual is not an option:
- In many areas, the supply of adequate water for crop production is threatened.
- Traditional strategies for expanding supplies are environmentally expensive and unsustainable.
- Yields of crops grown under conditions of abiotic stress are declining. Soils become exhausted and water limiting.

Applying science…(2)

- Water is a topic for global public goods research only when the research is helping to contribute to *new* scientific knowledge to develop a better understanding of the processes, policies, institutions, or organizational innovations across regions so as to transfer technologies or knowledge (World Bank, 2003).

Applying science…(3)

- CGIAR research is expected to provide global public goods that would not otherwise be produced (e.g. private sector), through tapping economies of scale and scope, not available to country-based research.
- Improving NRM is, in most cases and over the longer term, a complement to development of improved germplasm.

Applying science….(4)

- Plant breeding to enhance crop tolerance for abiotic stresses (water demand management).
- Water management to enhance water allocation (supply management).
- Policies and institutions to enhance adoption of technologies and sustainability of productivity.
- Together define a new pathway to impact on food security.

Applying science: obstacles and costs

- Integrated scientific approaches are expensive because of high transaction costs.
- Higher rates of return are associated with research on germplasm than on natural resource issues
- Estimating benefits is complicated. Lag time between investment and reaping the benefits (15 - 20 years; longer in resource-poor countries).

Assessing the impact of investments in agricultural research

Rates of Return

- Annual rates of return to investments in ag. research and development are more than 30% with wide variations (Alston et al., 2000).
- Between 35 and 70% of US ag. research is needed to maintain previous research gains.
- Can high rates of return be projected into the future?

Questions about benefits and costs

- How to attribute varietal improvements to specific research studies?
- What would have been the pattern of productivity growth without a particular research investment?
- Some positive and negative effects of ag. research are not counted, e.g. rural employment, rural health and education. Spill-over effects elsewhere.

Criteria for impact

- Overarching goals of applying science to WP are food security and poverty reduction.
- Relating impact indicator with research investment only valid in absence of other effects on indicators, e.g. markets and policies.(Ekboir, 2003)
- Findings of impact assessments should help improve policies and programs (Mackay and Horton, 2003).

Impact of ag. research on poverty reduction

- Public funded R&D has key role in implementing pro-poor ag. research strategy. But not the only one, nor even the most effective.
- Science applied to WP could lead to long-term savings in relief aid for poor people in drought-prone areas.

Scaling up of NRM research findings

NRM research for large-scale problems

- For profitable investments, R&D strategies should focus on solutions for large-scale problems affecting a significant number of poor people, and only those that can be scaled up from benchmark sites (Barghouti and Hazell, 2000).
- Scaling up implies that local people/institutions can cost-effectively adapt improved NRM practices to different sites.

NRM research for less-favored areas

- NRM research has lower economies of scale and scope than germplasm research.
- Growing conditions are diverse and risky; skepticism about efficacy of NRM research.
- Developing improved technologies is expensive. Farmers may reject them because of risk of input loss in bad years.

Conditions for scaling up

- Ensure policy environment is enabling.
- Invest in infra-structure for markets, transport and communications.
- Ensure support of government agencies for local sustainable agricultural initiatives.
- Develop social capital within rural communities.

(Altieri, 2003; Pretty and Hine, 2001)

Case study: the Indian drought of 2002

- In 2002, eastern India experienced the worst floods in four years, while 14 western states experienced the worst drought on record.

- In the drought-affected states, rainfall for the karif (rainy) season was about average except for July, which was the driest on record.

- By December, the Government of India was taking major steps in drought relief.

Drought relief measures in India in 2002

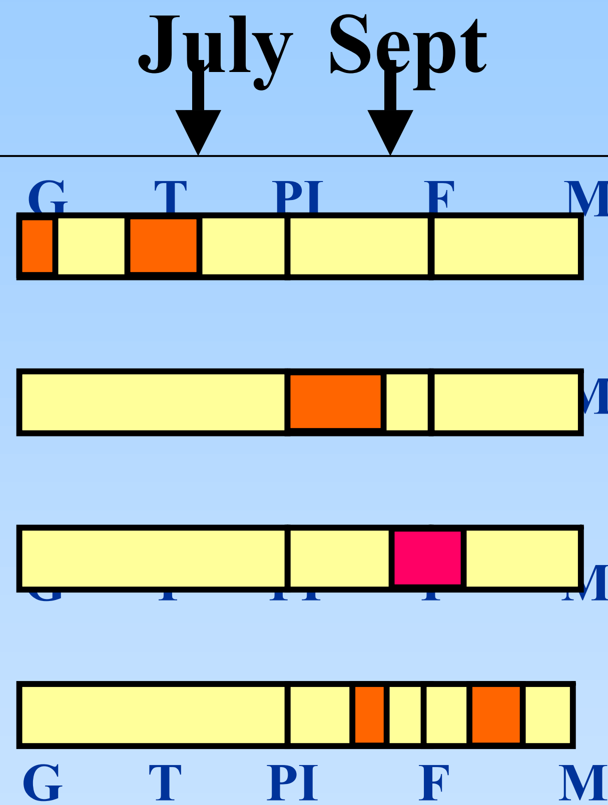
- To avoid starvation, the central government distributed 4.3 million tons of free rice and wheat to 14 out of 29 states
- These states received the equivalent of US$115.5 million for drought relief measures, including public health.
- The Government waived one year's interest on loans to millions of farmers in drought-affected states at a cost of US$1.25 billion, which is about equal to the central Government's entire annual budget for research in science and technology.

The Indian drought of 2002

- In October the Central Bank revised its forecast for India's economic growth for 2003 from 6.0-6.5% to 5.0-5.5%.
- Prime Minister Vajpayee asked experts to prepare a plan to link major rivers in the states frequently parched by drought.
- Tanker trains provided water to Rajastan, one of the worst hit states.

Could the 2002 drought have been worse?

Yes, drought in September would have been worse.



Four yield components

a = panicles m^{-2}

b = spikelets $panicle^{-1}$

c = spikelet fertility (%)

d = single grain weight (mg)

Yield = 10^{-5} x abcd g m^{-2}

Period of greatest sensitivity to stress for each yield com

Most stress-sensitive yield component

Drought in India

- In the decade 1990-2000 the Government of India spent the equivalent of US$2 billion on drought relief.

Indira Hirway (2001)

- In a typical drought year in eastern India, farmers lose US$735 million in rice production, US$370 million in other crops, and US$480 million in wages.

- The estimated loss to drought is $400 million per year averaged over 30 years including drought and non-drought years.

- A farming family may take up to 5 years to recover financially from a single drought season. The social impact on women and girls is particularly severe.

Sushil Pandey et al. (2000)

Who pays for applying science to water productivity?

Private sector investments in ag. research

- Private sector funding of R&D through privatization, user contributions and the levying of fees.
- Private sector strongly present in large-scale seed production and distribution, and in improvement of irrigation infra-structure.
- Private sector involvement small when target group is poor farmers and the NRM problems are severe.

Who pays?

- In plant breeding projects, most of the cost occurs early during gene and mechanism discovery, and later during large-scale seed production and distribution (public and private sectors).
- In water management projects, many advantageous technologies are known, but farmers lack the resources to apply them.
- Scale-up of plant breeding results is not very expensive; scale-up issues associated with NRM are difficult.

Research category	Research aspects	Cost factors	Who Pays?
Plant breeding	Increased biomass Production and higher water use efficiency. Increased tolerance of biotic and abiotic stress	Gene discovery, testing seedling vigor and safe deployment. Field evaluation. Seed production and distribution; adoption	Funders of I. and N. ag research. Private and public sector. Extension services.
NRM	Adoption of improved agronomic and soil conservation measures. Scale-up of successful techniques. More reuse of water resources; higher water productivity.	Data collection on net water consumption. Monitoring of effects of upstream interventions. Field testing of innovations. Strengthening collective action. Adoption and adaptation.	Farmers. Funders of I and N. ag research. Public sector Small private sector Extension services (?)
Institutional and policy research	Institutional framework for adoption of outcome of CPWF. Law enforcement. Water rights; resource pricing, markets, incentives, etc. Decision support tool	Location-specific policy development; stakeholder participation; policy support. Evaluation and monitoring of institutions. Impact assessment. Development of DSS.	Funders of I and N ag research. Public sector (recipient countries).

Conclusions

- Continuing research as usual is not an option.
- Applying science to WP requires coordinated networks of researchers (discipline and locations).
- The B/C ratio is uncertain but it will have a measurable impact on food security.
- Scaling up of benefits from water-based technologies is difficult.
- Private sector pays some (seed distribution, drip irrigation); public sector pays for most research.
- Vulnerable people everywhere will pay if we don't apply science to W.P.