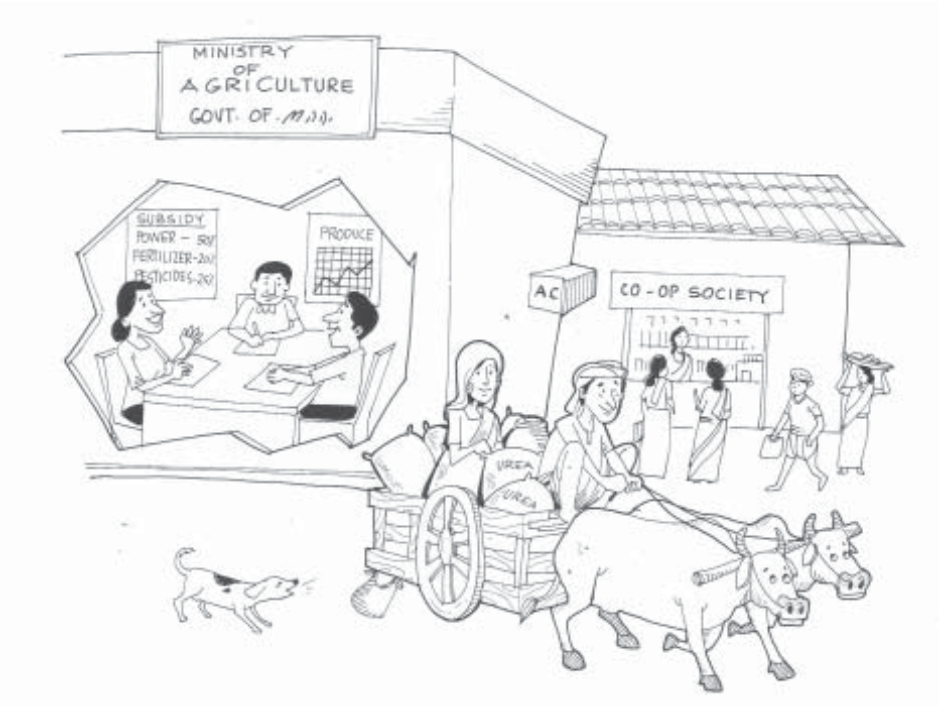
Policies Influencing Productivity and Sustainability



The last three decades have witnessed a phenomenal growth in cereal crop productivity in the developing world, particularly in rice and wheat in Asia. The commitment to achieving food self-sufficiency was the driving political force that made Green Revolution happen in South Asia. High levels of investments in research and infrastructure development, especially irrigation facilities, resulted in rapid intensification of the lowlands.

Contributory Factors

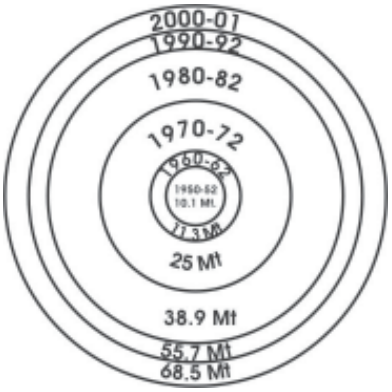
The major factors that contributed to the dramatic increase in production and the initial success of the Green Revolution are the following:

- Introduction of semi-dwarf, high-yielding varieties (HYV) of rice and wheat increased investments in infrastructure, especially irrigation systems and policy support and political commitment to accelerated food grain production.
- Policy support and political commitment were critical to the rapid dissemination and adoption of modern technologies for rapid growth in food production.
- Supply of free irrigation water and free or subsidized power supply for tubewells.
- Provision of fertilizers at subsidized prices.
- Disbursement of farm credit at low interest rates.
- Provision for price support.

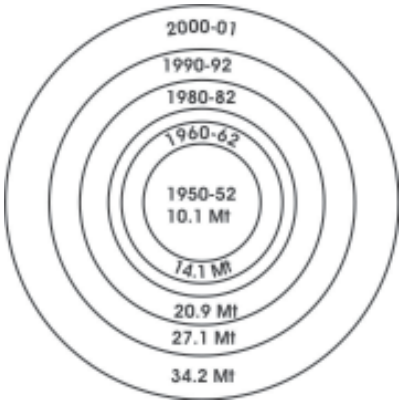
Revolving Door Effect

During the Green Revolution period, subsidies motivated the farmers to adopt new technologies to increase productivity and production of food crops.

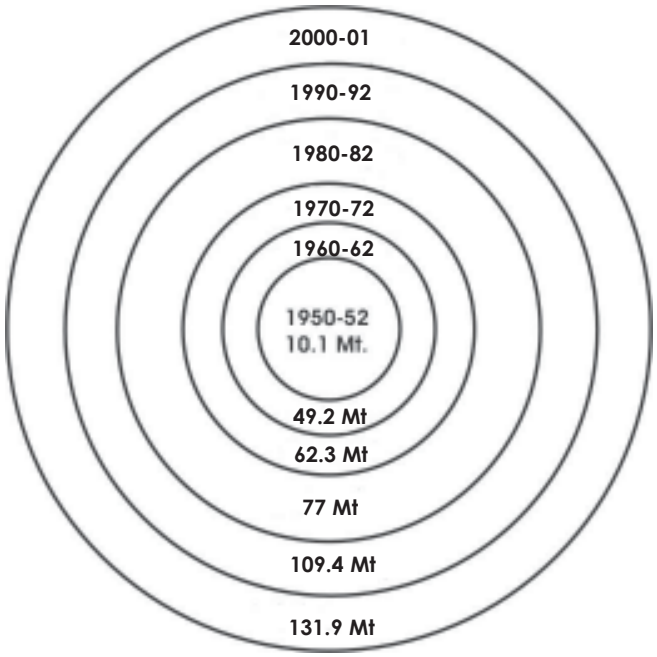
Prolonging the policies of input price subsidies into the post-Green Revolution period has resulted in a distortion of farm-level incentives for efficient input use and has led to much of the resource base degradation observed today.



Wheat production growth (in million tons) in India



Rice production growth (in million tons) in Bangladesh



Rice production growth (in million tons) in India.

Source: P. L. Pingali, 2002

Crucial Policies

Subsidized HYV Seeds

The average wheat yield in Indian Punjab doubled from 2 tons/hectare in 1970-71 to over 4 tons/hectare in 1993-94. By 1979, almost 100% of wheat planted in Punjab was of modern HYVs, thanks to subsidies on HYV seeds.

Support Prices

To encourage domestic food grain production, macro-economic policies were put in place to artificially maintain grain prices at high levels. Rice and wheat became 'safe' crops which would get farmers assured prices at subsidized input costs. As self-sufficiency in food grain production was the motivating factor for many of the policy measures during the 1970s and 1980s, the grain prices were also protected through import restrictions and tariffs.

Tubewell Deregulation

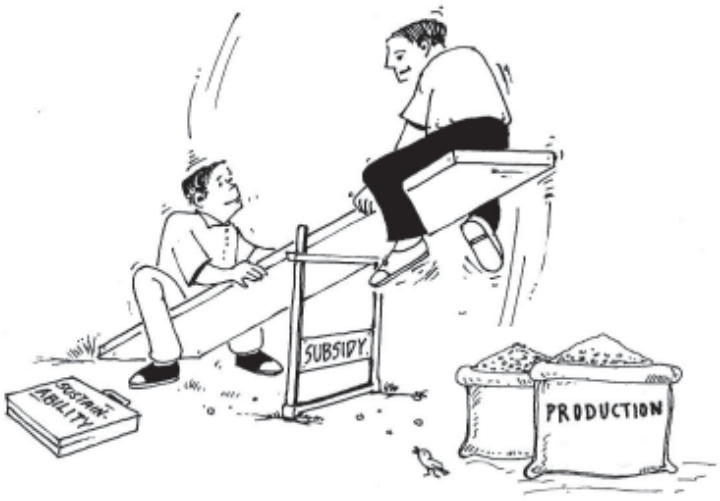
The most successful tubewell development has been through small-scale private investment. Bangladesh triggered a tubewell revolution in early 1980s by deregulating private tubewell imports and markets. Subsequent restrictions on tubewell siting slowed down the growth in tubewell adoption during 1985-87. However, nearly 1.5 million hectares of additional land was irrigated and this stimulated rapid agricultural growth in the 1980s and early 1990s (Rogers *et al.,* 1994).

Changing Trends

Recent signs, however, indicate a slowdown in productivity growth of primary cereals, particularly in intensively cultivated rice-wheat zones of South Asia. Degradation of the lowland resource base, specially land, due to intensive use over a long term, slackening of investments in research and infrastructure as well as reduced policy support explain the current sluggish growth in productivity. Intensification *per se* is not the root cause of resource base degradation, but rather the policy environment that encouraged inappropriate land use and injudicious input use, especially water and chemical fertilizers.

Policy Needs

Ecological degradation is often the consequence of ill-conceived policy. Free or very low-cost irrigation facility promotes its over use thereby resulting in salinity or waterlogging and groundwater pollution. Promotion of nitrogenous fertilizer use through subsidies and year-round cropping with irrigation has reduced the mineralization for the natural supply of nitrogen from soil and has also upset the balance of macronutrients. This imbalance also impacts on insect pest incidence. Policies and incentives can induce inappropriate and inefficient use of land, water and other input use practices.



Cropping pattern choices at both farm and national levels continue to be made on economic grounds rather than on sustainability grounds. Policies designed for achieving food self-sufficiency, which was of utmost importance to the hungry millions in Asian countries thus far, tend to undervalue goods like land and labor resources which are not traded internationally. The dual goals of food self-sufficiency and sustainable resource management are often mutually incompatible. As a result, food self-sufficiency in countries with an exhausted land resource, particularly the countries of South Asia, came at a huge ecological and environmental cost.

Policy Re-Directions

Appropriate policy reform, both at macro as well as sector level, will go a long way towards arresting and possibly reversing, the current resource base degradation trends. Severe environmental degradation in intensified agriculture mainly occurs when incentives are incorrect due to bad policy or a lack of knowledge of the underlying processes of degradation.

Input subsidies that keep prices of certain inputs at lower levels directly affect crop management practices at the farm level. The low prices ensure that the farmer has no need or desire to improve input use efficiency or to learn to use it judiciously. South Asian farmers have for long 'benefited' from subsidies on irrigation water, fertilizers, pesticides and credit. Existing evidence on intensification induced degradation in rice-wheat systems of the Indo-Gangetic Plains of South Asia has been extensively reviewed to arrive at possible policy re-directions and corrections that can ensure sustained productivity growth to meet the future food requirements of this region.

Water

Irrigation water is by far the most critical factor for intensive crop rotation. Its indiscriminate and excessive use is responsible for extensive resource base degradation through waterlogging, salinity, iron toxicity, macro and micronutrient deficiencies and changes in soil physical properties. To create incentives for efficient and more environment-friendly water use, water subsidies (and power subsidies for operation of tubewells) should be phased out, with more realistic water charges for all sectors. In the long-term, markets in tradable water rights should be established where feasible.

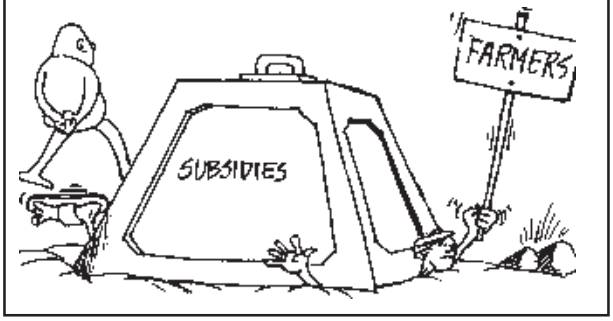
Establishment of secure water rights for water users is an important foundation for the establishment of economic incentives for efficient water allocation. Responsibility for irrigation water management should be devolved to autonomous local institutions with use representations and/or joint ownership.

Fertilizers

Excessive and imbalanced fertilizer application is a direct consequence of the subsidy regime. In Asia, the deficiency of the micronutrient zinc has become a major limiting factor in rice productivity. Subsidies on macro nutrients, specially nitrogen, should be phased out to promote greater fertilizer use efficiency.

The Fertilizer Story

Improving input (fertilizer) use efficiency often requires the farmer to invest in learning about the technology and how best to use it. Techniques for improving fertilizer use efficiency are available but will only be viable at the farm level when fertilizer subsidies are removed. South Asian farmers can get "cheap" fertilizers and hence, there is no incentive to change. The reduction and eventual removal of fertilizer price subsidies can substantially improve fertilizer use efficiency and help reduce fertilizer-related environmental degradation. The funds saved from subsidies can be used for alternative investments.



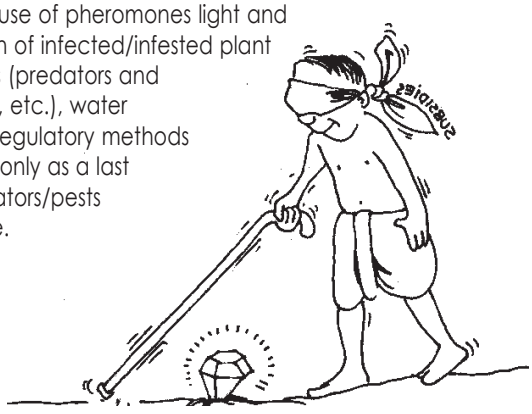
Pesticides

The integrated pest management (IPM) program seeks to reduce pest damage by fostering an appropriate predator-pest ratio at the farm and sector level. Prophylactic pesticide application, on the other hand, disrupts the natural predator-pest balance and causes a resurgence of the pest population later in the crop season (Heong *et al.,* 1992). However, policymakers commonly, and mistakenly, perceive that modern crop varieties are more susceptible to pest-related crop losses and, therefore, that their cultivation is not possible without high levels of chemical pest control. Subsidies are provided for pesticides and pesticide application equipment due to this misconception. To make IPM attractive to the farmers, it is important to remove all explicit and implicit subsidies on pesticides, as otherwise the farmers have no incentive to invest time in acquiring IPM skills.

Integrated Pest Management

Integrated pest management (IPM) is a strategy combining physical, mechanical, biological and chemical methods for managing the pest population at levels below those causing economic loss. IPM is both cost effective and less damaging to the environment than use of pesticides alone.

IPM involves use of insect/disease resistant crop varieties, use of pheromones light and mechanical traps for insect pests, removal and destruction of infected/infested plant parts, conservation and enhancement of natural enemies (predators and parasites) population, use of microbial pesticides (BT, NPV, etc.), water management, reduction of nitrogenous fertilizer use and regulatory methods including plant quarantine. Chemical pesticides are used only as a last resort. This requires investment in learning to identify predators/pests and to estimate their population through field surveillance. (Figueiredo and Braganza, 1992)



Research and Extension Services

Continued high levels of investments in research and infrastructure development as well as institutional and policy reforms are necessary to reverse the current trends in resource base degradation. Location-specific research on soil fertility constraints and agronomic practices, development of improved fertilizer supply and distribution systems and improvement of farm extension services are important. The policy must provide for these.

With the progression towards global integration, competitiveness can only be maintained through dramatic reductions in the cost per unit of production, either through a shift in the yield frontier or through an increase in the input use efficiency. The use of existing insect and disease resistant varieties and integrated pest management to reduce need for pesticide application, optimizing water and fertilizer use efficiency, zero tillage are some of the options. Policy changes that would encourage enhancement of input use efficiency would also contribute to the long-term sustainability of intensive food crop production and help arrest many of the problems described above.

Reference

Figueiredo N. X. and M.A. Braganza. 1992. Pest Management. Agriculture Officers' Association, Panaji, India. pp112.

Adapted from:

Pingali, P.L. and M. Shah. 1999. Rice-Wheat Cropping Systems in the Indo-Gangetic Plains: Policy Re-Directions for Sustainable Resource Use. pages 1-12. *In:* Pingali, P.L. (ed). 1999. Sustaining Rice-Wheat Production Systems. Socioeconomic and Policy Issues. Rice-Wheat Consortium Paper Series 5. Rice-Wheat Consortium for the Indo-Gangetic Plains, New Delhi, India.

Corresponding author:
Prabhu L. Pingali