ESAP Chapter 2 Figures

Figure 2-1. Changes in irrigated areas in ESAP, 1961-2003. Source: FAO, 2006a.

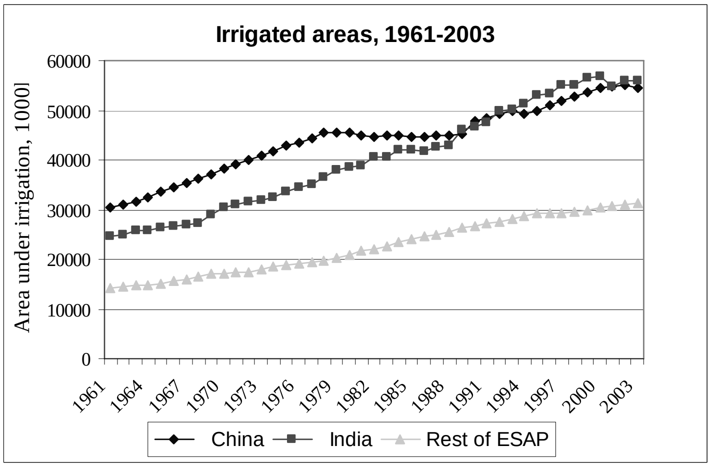


Figure 2-2. Total number of agricultural tractors in use in ESAP, 1961-2000. Source: FAO, 2006a.

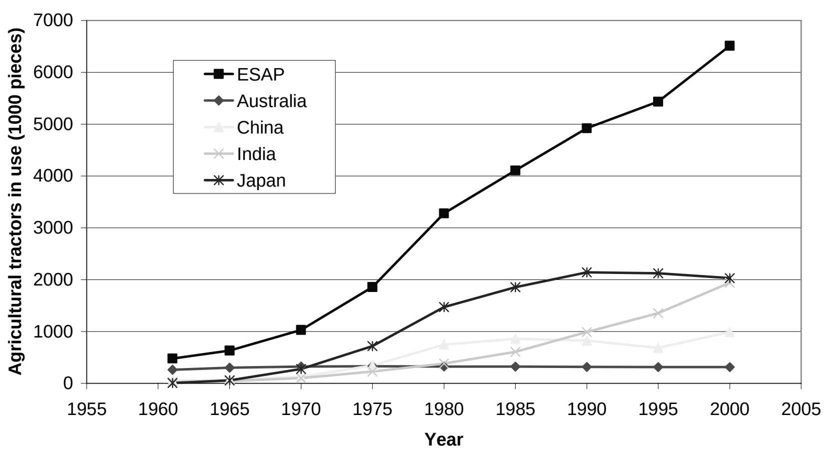


Figure 2-3. Chemical fertilizer use per ha of arable land in ESAP, 1961-2005. Source: FAO, 2006a.

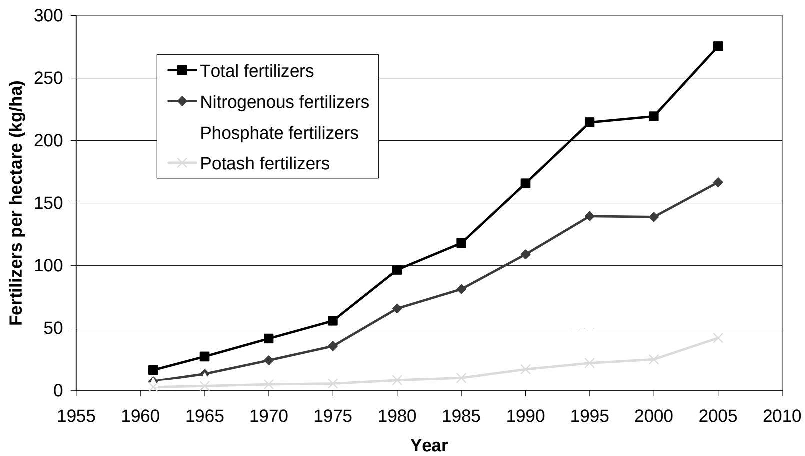


Figure 2-4. Pesticide use per hectare of sown area in China, 1991-2004. Source: China Agricultural Development Bulletin, Ministry of Agriculture, China, 2005.

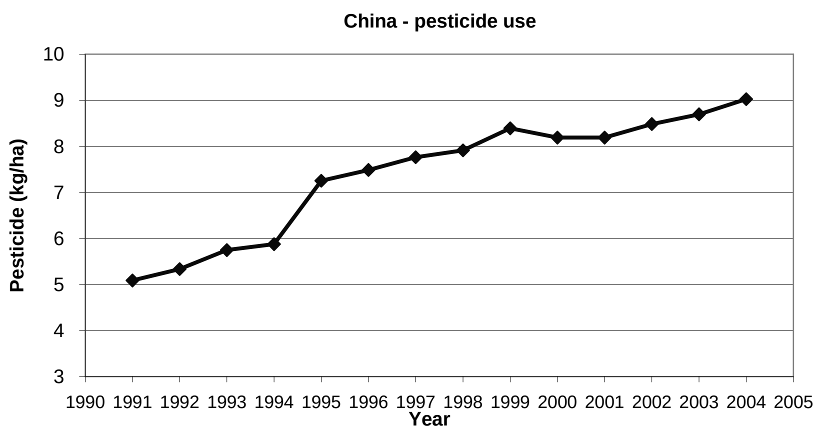


Figure 2-5. Changes in harvest area and cereal production in ESAP, 1961-2005. Source: FAO, 2006a.

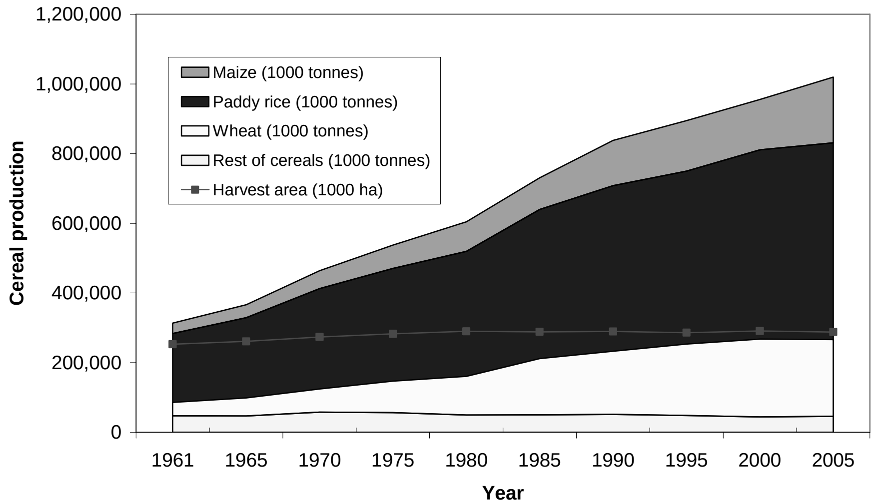


Figure 2-6. Average crop yield trends in ESAP, 1961-2005. Source: FAO, 2006a.

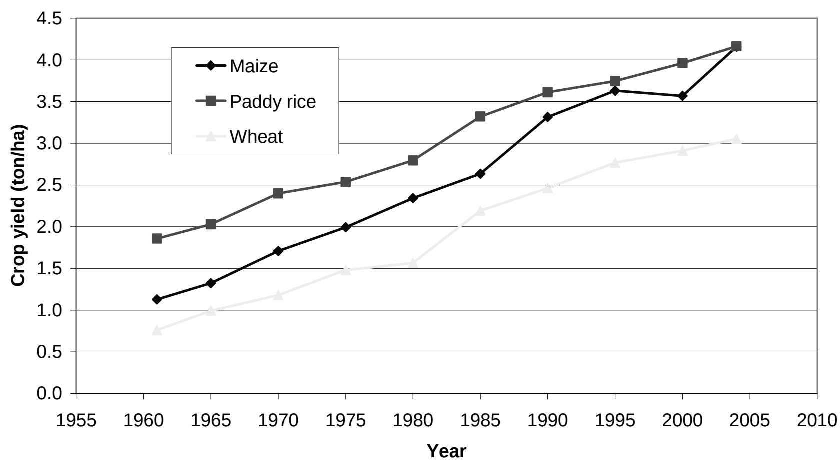


Figure 2-7. Cereal production per capita in ESAP, 1961-2005. Source: FAO, 2006a.

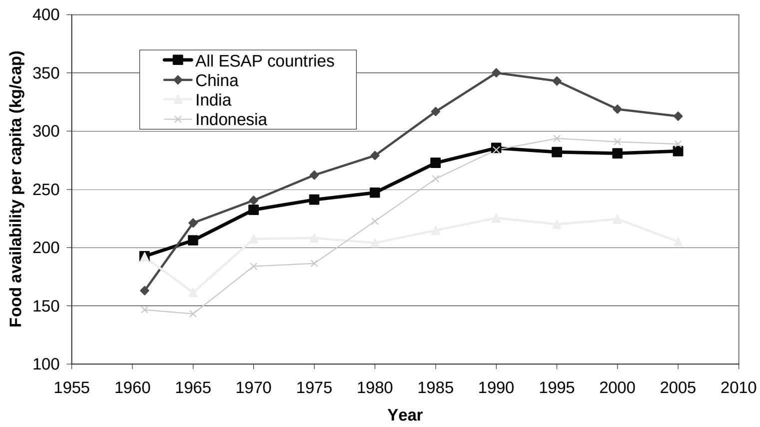


Figure 2.8. Food consumption per capita in ESAP, 1990-2005. Source: FAO, 2006a.

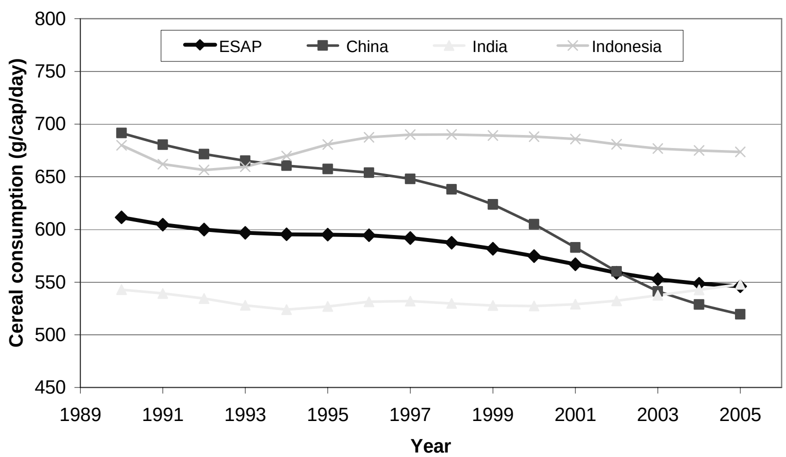
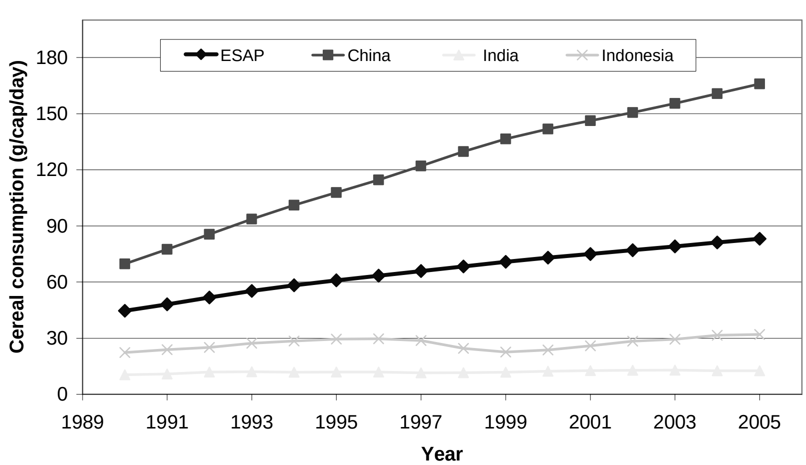


Figure 2-9. Meat consumption per capita in ESAP, 1990-2005. Source: FAO, 2006a.



Box 2-1. Potential of rainfed agriculture.

There are different views on the potential of rainfed systems. Proponents argue that evidence exists for great potential and poverty reduction from new approaches to enhancing rainfed agricultural systems. New pro-poor small-scale, low-cost approaches such as treadle pumps, water bags, and water harvesting are proving to be the key to unlocking rainfed potential and reducing poverty on marginal rainfed lands. Although crop yields seem low considering the amounts of land, water, labour and capita required, new technologies are available to help farmers predict uncertain variables such as rainfall. This improved predictability can help increase the contribution of rainfed agriculture.

Skeptics, on the other hand, point out that rainfed agriculture has been the focus of research for many years, the ideas have been in place for a long time, yet gains are not forthcoming. Thus rainfed systems do not hold as much promise as claimed. Dependence on approaches to enhancing rainfed agriculture involves high risk due to climate variability, particularly affecting small and poor farmers. As poor people often live in semi-arid agricultural environments where the ability to cope with weather variation is very low, and the failure of crop often means starvation or even death. A study in three semi-arid watersheds in India by Bouma and Scott (2006) showed that large scale investments in soil and water conservation did not have a significant impact on dryland yields, at least not under prolonged conditions of drought.

Box 2-2 Barriers to change arising from some institutional rigidities

- Linear approach to technology development and promotion: In this model, extensionare conduit for transferring technologies developed by the research systems with or without participation by the farmers. Though there are limitations of this model, it continues to be the dominant paradigm determining investments in agricultural research and extension. Administration and funding by different departments or ministries further constrain development of relationships.

- Due to the perceived hierarchy between research and extension, the process is top-down with limited feedback and each one blames the other for poor performance of technology diffusion and adoption. Hierarchies also exist between biological and social scientists, preventing interactions among these two groups.

- While farmers, NGOs and the private sector need research and scientific expertise to solve specific problems, what research offers are pre-determined technologies. Interface meetings with the private sector haven't moved beyond the partnership rhetoric, especially due to this mismatch in expectations. While procedures for transferring technologies are in place, arrangements for providing technical expertise to solve problems haven't been fully developed

- Narrow focus of extension on technology dissemination: Extension has been limited to the transfer of technologies, and does not consider the varied needs of end-users (such as market information and support services).

- Evaluation parameters within research organizations favor (1) technology development at the cost of problem solving and (2) reporting only success at the cost of learning from failures and (3) favor reporting only technical innovations at the cost of process and institutional innovations that facilitated development and promotion of technologies. Similar is the case within extension where performance is evaluated in terms of number of farmers adopting a specific technology, inputs distributed and increase in productivity that has been achieved. This restricts extension staff from trying other promising approaches that could potentially increase farmers' incomes.

- Focusing only on farmers as clients have restricted the interaction of research and extension to only farmers at the cost of interaction and working with a range of other actors like NGOs, agro-processors, traders, private sector and producer associations.

- Interaction among the different actors are further constrained by the high levels of mistrust between the different actors (public and private; private and NGOs etc.) and lack of mechanisms to develop better understanding. Though some of the public, private and NGO actors have come together as part of specific initiatives promoted by donors, this has been restricted to the particular project duration. Levels of mistrust are still considered too high between NGOs and the private sector and lack of transparency in the conduct of research and inability of many scientists to communicate with different stakeholders have further contributed to the perpetuation of distrust.

- Long chains of command and control constrain the ability of the different organizations, especially the public and private sector to respond quickly to the challenges from the field (or market). This is also constraining development of joint activities even when the policy favor partnerships and linkages.

- The current patterns of funding and governance (mostly public) ensure that the organizations are only accountable to the Ministry/Department funding and governing them with only weak or limited accountability to the clients. Companies in the private sector also behave as if they are only accountable to their shareholders and not to other stakeholders who can potentially influence their operations.

Box 2-3 The impact of the green revolution in India

Roots to the agrarian changes in India goes back to colonized colonization era when agri-exports increased under the obligation to pay taxes resulting in diversion of resources away from domestically consumed products, decreased availability of food and increased vulnerability to famine (Dutt, 1901; Arena, 2005). After the second world war, there was a concerted effort to increase food productivity. One such effort was the Green Revolution (see section 2.2.2.1. These HYV use larger quantities of nutrients and water more efficiently than the earlier varieties, which tended to lodge or fall down if grown in soils with good fertility, can be planted more densely and did not require long growing periods. They thus have a more favorable harvest index, i.e., the ratio of the economic yield to the total biological yield (Shiva, 1993) and the shorter growing season in some cases allows the farmers two to three harvests per year when irrigation is available and often with the use of machinery and thus more capital intenise (Bhagavan et al., 1973).

The early benefits of the Green Revolution in India were captured by the big farmers (Lewis, 1970), and technical change had strengthened the political dominance of land owners and accentuated income inequality (Frankel, 1971; Griffin, 1979). In South Asia and particularly India, total food available per person actually increased but greater hunger prevailed due to unequal access to food and food-producing resources (Rosset and Collins, 1998).

Another impact that has been linked to Green Revolution technologies in India is the increase in indebtedness and the increased rates of suicide of farmers on marginal lands. It has been suggested that this is due to the need for capital, lack of seed saving and thus the dependence on buying seeds and the uniform varietals plantings that expose the farmers to the risk of crop failure during droughts (Shiva, 2004)

Table 2-1. Changes in irrigated areas by country, 1961-2003. Source: FAO, 2006a.

Country	Irrigated land, 1000ha		Changes	Area equipped for irrigation as % of cultivated land
	1961	2003	%	
Australia	1001	2545	154.2	5
Bangladesh	426	4725	1009.2	50
Bhutan	8	40	400.0	31
Cambodia	62	270	335.5	7
China	30411	54596	79.5	35
Fiji Islands	1	3	200.0	1
India	24685	55808	126.1	33
Indonesia	3900	4500	15.4	13
Japan	2940	2592	-11.8	55
Korea Dem People's Rep	500	1460	192.0	50
Korea Republic of	650	878	35.1	47
Laos	12	175	1358.3	17
Malaysia	228	365	60.1	5
Mongolia	5	84	1580.0	7
Myanmar	536	1870	248.9	17
Nepal	70	1170	1571.4	46
New Zealand	77	285	270.1	8
Philippines	690	1550	124.6	14
Sri Lanka	335	743	121.8	34
Thailand	1621	4986	207.6	26
Viet Nam	1000	3000	200.0	34
ESAP	**69158**	**141645**	**104.8**	**28**

Table 2-2. Examples of known indigenous agricultural practices emanating from traditional knowledge. Source: Grenier, 1998.

Sector	Indigenous agricultural practice
Crops	Indigenous indicators to determine favorable times to prepare, plant, and harvest gardens; land preparation practices; indigenous ways to propagate plants; seed storage and processing (drying, threshing, cleaning, and grading); seed selection practices; indigenous methods of sowing (seed spacing and intercropping); seedling preparation and care; farming and cropping systems (for example complementary groupings); crop harvesting and storage; food processing and marketing; pest management systems and plant-protection methods.
Livestock	Indigenous methods of animal breeding and production; traditional fodder and forage species and their specific uses; animal-disease classification; traditional ethno-veterinary medicine.
Forestry	Management of forest plots and their productivity; knowledge and use of forest plants and animals; understanding of the interrelationships between tree species, improved crop yields, and soil fertility.
Fisheries	Integrated aquaculture production into cropping systems such as the rice-fish systems; use of larva-eating fish.

Table 2-3. NARS actors and roles in the generation, promotion, dissemination and adoption of AKST.

Stakeholder	Main Roles
Policymakers	Authorize the existence of the NARS; Provide mission and resources; Formulate public policies.
NARS	Set RDE directions, priorities, policies; Formulate RDE agenda & allocate resources; among different priority areas; Plan and conduct research programs/projects; Submit project reports & inform others of research findings; Submit budget requests and undertake resource generation activities; Develop working linkages and establish RDE networks; Provide technical assistance to the public with regards to AKST applications.
Training and Extension agencies including NGOs/PVOs response (change agents)	Disseminate knowledge and encourage adoption of new technologies thru training, demonstration trials, field days, distribution of info materials; Provide feedback to researchers on new research agenda and farmers' response to introduced technologies; Improve skills of recipients for adopting new technologies; Provide access and support to specific farmers' groups via social mobilization efforts (farmers' empowerment).
Farmers	Adopt and adapt research results on a selective basis; Collaborate with researchers and change agents in testing and evaluating the suitability and appropriateness of recommended technologies; Provide feedback on utility of technologies; Combine traditional knowledge and modern technologies based on resource access, appropriateness of technology, and skills; Contribute taxes to government to partially finance public RDE.
Private sector (Agro-industry, lending agencies buyers and distributors)	Adopt and commercialize technologies with business potentials; Provide farmers' access to resources, technology and markets; Finance and conduct limited complimentary RDE activities in their area of business; Contribute taxes to government to partially finance public research.
Consumers	Demand farm produce with certain attributes; Contribute taxes to government to partially finance public RDE.
International & regional agricultural R&D organizations	Provide training and technical guidance to local RDE personnel; Provide access to global germplasm and technology; Undertake collaborative programs with the NARS on areas of common concerns; Generate international funding for common global RDE initiatives; Provide leadership and coordination in global information and knowledge exchange.
Donors	Supplement meager RDE funds of recipient NARS; Provide guidance and RDE directions.

Table 2-4. Some potential ways for facilitating institutional change.

What to do	How best to encourage adoption to change
Learning from the emerging institutional arrangements in the region	This would necessitate a detailed analysis of cases where the various actors in specific contexts come together and collaborated to solve particular problems or address new challenges. What kind of institutional changes were made? How were these sustained?
Develop a culture of learning within the organization	Institutional learning cultivates new ways of doing things. It specifically asks the questions, what rules, habits and conventions have to be changed to do a new task or to do an old one better? (Hall et al, 2005). Organize "capacity development" programs to address the institutional barriers. Opportunities needs to be created and if need be specifically funded to bring in this culture of change. It would be useful to bring the staff together to reflect on the past, what they learnt and what needs to be done to do the same job better?
Develop long-term mutually beneficial relationships	Create opportunities to bring different actors together and develop joint activities. Development of joint collaborative projects needs to be mentored over a period of time and need specific resources. Funding could be potentially used to facilitate development of joint collaborative projects.
Use better framework of analysis	Such as the "innovation systems approach"- to analyze the patterns of interaction and as a framework for planning interventions (World Bank, 2006). This would necessitate detailed exploration of the innovation systems and organization of capacity development programs.

Table 2-5. Rank of World Competitiveness (by Factor) of selected countries, 2006. Source: World Competitiveness Center, 2006.

Factor	Singapore	China	Malaysia	India	Thailand	Korea	Philippines	Indonesia
Overall Rank	3	19	23	29	32	38	49	60
1. **Economic Performance**	4	3	11	7	21	41	52	61
2. **Government Efficiency**	2	17	20	35	21	47	45	51
3. **Business Efficiency**	7	30	20	19	28	45	44	57
4**. Infrastructure**	5	37	31	54	48	24	56	61
(a) Basic Infrastructure	1	20	35	33	38	29	61	53
(b)Technological Infrastructure	3	33	21	43	48	6	37	61
(c) Scientific Infrastructure	16	17	38	26	53	12	58	47
(d) Health and Environment	15	51	39	57	48	32	53	61
(e) Education	13	51	30	59	48	42	57	61

Table 2-6. Overall World Competitiveness Ranking of selected countries, 2003-2006. Source: World Competitiveness Center, 2006.

Country	2003 (of 61 countries)	2004 (of 61 countries)	2005 (of 61 countries)	2006 (of 61 countries)
Singapore	4	2	3	3
Japan	25	23	21	17
China	29	24	31	19
Malaysia	21	16	28	23
India	50	34	39	29
Thailand	30	29	27	32
Korea, Rep.	37	35	29	38
Philippines	49	52	49	49
Indonesia	57	58	59	60

Note: The rankings are based on four factors: (1) Economic performance; (2) Government efficiency; (3) Business efficiency; and (4) Infrastructure. The technological and scientific infrastructures are under the fourth factor.

Table 2-7. Total gross domestic expenditures on research and development in ESAP, 1995-2000. Source: Adapted from Pardey et al., 2006.

Region/Country	Total R&D expenditures (million 2000 international dollars)		Share of global total (percent)	
	1995	**2000**	**1995**	**2000**
Global (164 countries)	561,641	730,939	100	100
E S A P (27 countries)	142,380	194,450	25	27
China	19,469	48,247	14*	25*
India	11,678	20,749	8*	11*
Japan	89,964	99,500	63*	51*

* Share of regional total in percent

Table 2-8. Estimated global public and private agricultural R&D, circa 2000. Source: DAR, 1995; adapted from Pardey et al., 2006.

Region	Expenditures (million 2000 international dollars)			Share (percent)	
	Public	Private	Total	Public	Private
Global	23,010	12,948	35,958	64	36
ESAP	7,523	663	8,186	92	8

Table 2-9. Sustainable agriculture: farmers and biotech approaches. Source: Hobbelink, 1991.

Problem	Biotech response	Farmers response
Pests & diseases	Single-gene resistance; engineered bio-pesticides	Genetic diversity; indigenous varieties; intercropping; insecticidal plants; crop rotation; integrated pest management
Weeds	Herbicide tolerant genes	Early soil coverage; intercropping; cover crops; allelopathic crops
Water	Drought tolerant genes	Moisture conservation practices; contour ploughing; different varieties for different micro climates; water retaining associated crops (Vetiver grass, etc.)
Plant nutrients	Engineered nitrogen fixing crops and microbes	Soil conservation techniques; multiple cropping with legumes; integrated animal and crop agriculture (manure use); composting; green manure
Soil degradation	Saline and other tolerance genes	Restore degraded soils (composting, green manure, rotation, etc.); avoid destruction of the soil in the first place
Yield	Yield increase for mono-cropping	Poly-cropping; one crop for multiple functions; use of associated crops and animals (weeds, fish, snails, etc.)

Table 2-10. Gender, Work Burden and Time allocation in selected Asia and Pacific countries. Source: UNDP, 2004.

Country	Year	Burden of Work			Time allocation (%)			
		Total work time (min. per day)		Female work time (% of male)	Time spent by women		Time spent by men	
		Women	Men		Market activities	Non market activities	Market activities	Non market activities
Australia	1997	435	418	104	30	70	62	38
Bangladesh	1990	545	496	110	35	65	70	30
Indonesia (urban areas)	1992	398	366	109	35	65	86	14
India	2000	457	391	117	35	65	92	8
Japan	1996	393	363	108	43	57	93	7
Korea Rep.	1999	431	373	116	45	55	88	12
Nepal (rural areas)	1978	641	547	117	46	54	67	33
New Zealand	1999	420	417	101	32	68	60	40
Philippines	1975-77	546	452	121	29	71	84	16