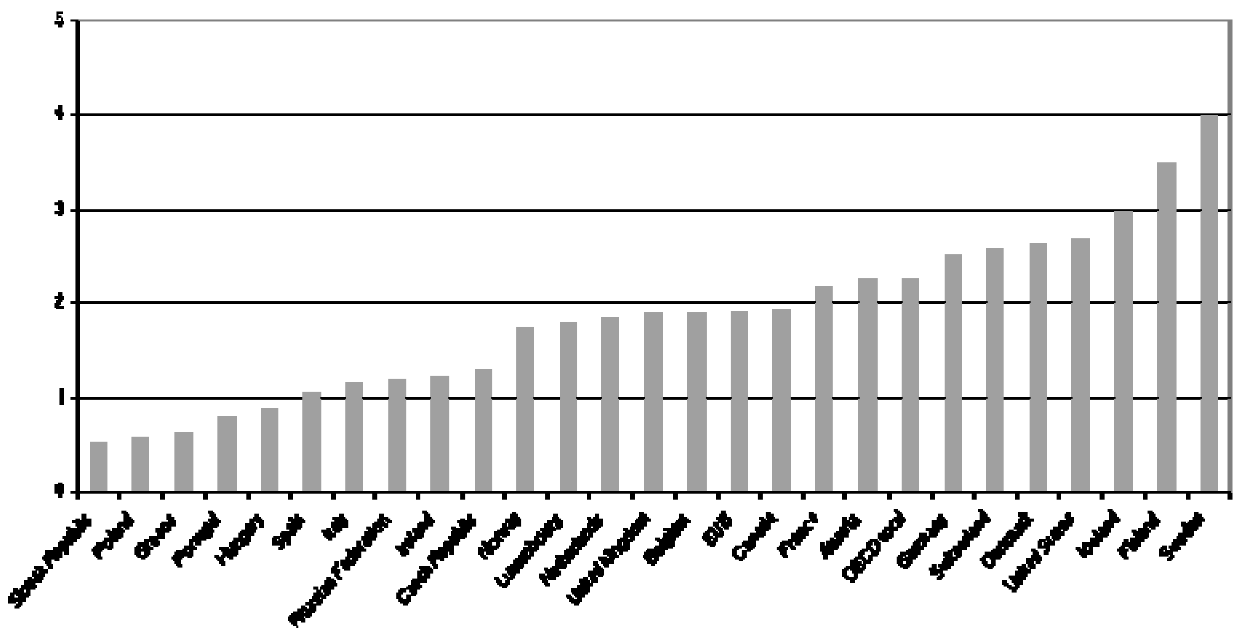
NAE Draft 2 - Chapter 2D: Figures, tables and text boxes

Table 2D, 1: Prevalence of undernourishment in developing countries 1979-2002 (Falcon and Naylor, 2005)

Proportion in Percentages	Sub-Saharan Africa	Near East & North Africa	Latin America	Asia (Excluding China)	China	Developing World
1979–81	36	9	15	33	30	28
1990–92	35	8	14	21	16	20
2000–2	33	10	11	17	11	17
Absolute numbers in millions						
1979–81	125.4	21.5	38.3	634.3	303.8	920
1999–92	170.4	24.8	47.1	484.6	193	823.8
2000–2	203.5	39.2	41	443.2	142.1	814.6

Source: FAO State of Food Insecurity in the world, various years.

Figure 2D, 1: Gross domestic expenditure of NAE countries on research and development as percentage of GDP (2004 or latest available year)



Source: OECD

Text box 2D, 1: Women in science in NAE

The presence of women in science has increased in NAE since the Second World War but they are still under-represented (ETAN, 2000). In the US women in academia began to make considerable progress in the 1970s through concerted protests, appropriate legislation and class action suits. Canada has also devoted considerable attention to the issue (ETAN, 2000). In Europe the issue of under-representation of women in science was taken up first in the Nordic countries in the early 1980s, particularly in Finland and Sweden (ETAN, 2000). More attention was paid to this issue at EU level in the late 1980s. For example, the European Parliament's *Resolution on Women and Research* from 1988 stated that "the under-representation of women in academic life is a highly topical problem and calls for practical incentives" and called on Member States to "promote positive measures to further the presence of women at the highest levels in universities and research institutes" (ETAN, 2000). However, although women now constitute about half the undergraduate population they still play a minor role in decision-making concerning scientific policies and priorities in many NAE countries (Table 2, Figure 2.) (ETAN, 2000). The proportion of women in senior scientific positions is small as there is a continuous drop in the numbers of women at each level of the academic ladder and many highly trained women are lost to science. In 2004, the proportions of female in the highest senior grade in some AKST-relevant fields of science in EU25 were 15% in agricultural sciences, 11% in natural sciences and 17% in social sciences (European Commission, 2006).

Working patterns of women vary between NAE countries. While career breaks and part-time working are common in some Northern European countries such as the UK and the Netherlands, in other parts of Europe, for example in Spain, France and Italy, women are much more likely to work full-time and throughout their adult lives. Systems of support and cultural expectations reflect and partly create these differences (ETAN, 2000).

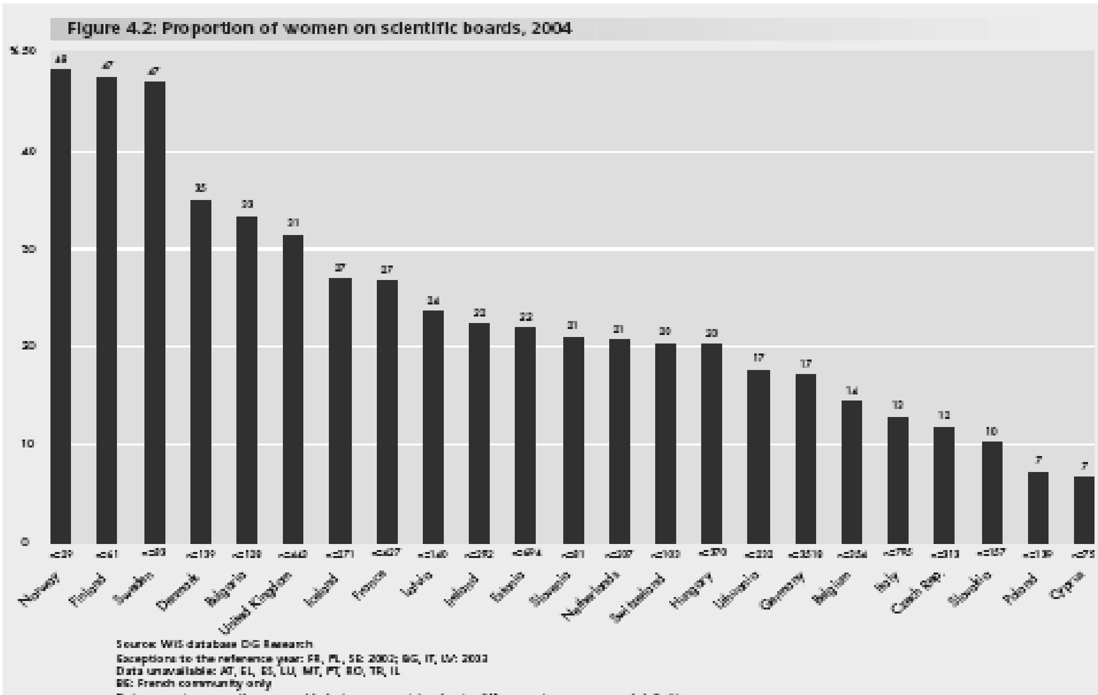
Table 2D, 2: Percentage of female professors in university faculties (different ranks, all disciplines)

Country	Year	A (Full)	B (Assoc)	C (Assist)
Turkey	1996/7	21.5	30.7	28.0
Finland	1998	18.4		
Portugal [a]	1997	17.0	36.0	44.0
France	1997/8	13.8	34.2	
Spain	1995/6	13.2	34.9	30.9
Norway	1997	11.7	27.7	37.6
Sweden	1997/8	11.0	22.0	45.0
Italy	1997	11.0	27.0	40.0
Greece	1997/8	9.5	20.3	30.6
UK	1996/7	8.5	18.4	33.3
Iceland	1996	8.0	22.0	45.0
Israel	1996	7.8	16.0	30.8
Belgium (Fr)	1997	7.0	7.0	18.0
Denmark	1997	7.0	19.0	32.0
Ireland	1997/8	6.8	7.5	16.3
Austria	1999	6.0	7.0	12.0
Germany	1998	5.9	11.3	23.8
Switzerland	1996	5.7	19.2	25.6
Belgium (Fl)	1998	5.1	10.0	13.1
Netherlands	1998	5.0	7.0	20.0
Australia	1997	14.0	23.0	40.7
USA	1998	13.8	30.0	43.1
Canada	1998	12.0		
New Zealand	1998	10.4	10.2/23.5	45.5

Updated from Osborn (1998)
European and non-European countries are listed in two groups according to the percentage of full professors that are female.
Note: Belgium keeps two sets of statistics, one for the French (Fr) and one for the Flemish (Fl) part.
[a] Portugal. Numbers include only academic staff performing R and D activities.
Note: for sources of figures and notes to Table, see Appendix III

Source: ETAN 2000

Figure 2D, 2: Proportion of women on scientific boards in EU countries in 2004 (Source: European Commission, 2006)



In the life sciences in 2003, the proportion of women amongst PhD graduates was 46% in the US and 54% in the EU25. There is considerable variation between EU member states, e.g. the proportions of female PhD graduates were 50% in Austria, 51% in the Czech Republic, 34% in Denmark, 29% in Estonia, 62% in Finland, 72% in Italyand 89% in Lithuania) (European Commission, 2006). In agricultural and veterinary fields of study in 2003, the proportion of women amongst PhD graduates was 37% in the US compared to 50% in the EU25. The variation between member states was less pronounced, e.g. the proportions of female PhD graduates were 66% in Belgium, 56% in France, 54% in Germany, 32% in Hungary and 54% in Poland (European Commission, 2006). The proportion of female researchers in the government sector in agricultural sciences 2003 in EU 25 was 43% compared to 31% in the natural sciences and 44% in the social sciences (European Commission, 2006).

Fewer data are available for the private research sector. The proportion of women amongst scientists in general in the private sector have been reported to be 21% in France, 10% in Germany, 9% in Austria, 18% in Finland and 28% in Ireland (FEMtech, 2006).

The reasons for this continuing gender imbalance in senior scientific positions are only partly understood. Regional differences in the support systems of support and cultural expectations have already been mentioned. An additional factor is the increase in short-term contracts which has reduced job security. Data show that women are more likely to be among those on short-term contracts. Career planning can also be complicated by structural barriers present in some countries, such as the Habilitation degree that has until recently been considered an essential qualification for professors in Germany, Austria and Switzerland. Studies also indicate that men are also still more likely to be promoted than women (ETAN, 2000)

Text box 2D, 2: An introduction to the evolution of the concepts of ecosystem services and the ecosystem approach

Ecosystem services are the conditions and processes through which natural ecosystems sustain human life. They maintain biodiversity and the production of ecosystem goods, such as forage, seafood, timber, biomass fuels, natural fibre as well as many pharmaceuticals, industrial products and their precursors. In addition to the production of goods, ecosystem services are the actual life-support functions, such as cleansing, recycling, and renewal, and they confer many intangible aesthetic and cultural benefits as well (Daily, 1997).

Agricultural systems are typically managed to maximize food provision services to provide food, but they require several other supporting and regulating services to support production. Agriculture both depends on ecosystem services and generates them. Agricultural ecosystem services have been grouped into three categories: services that directly support agricultural production (such as maintaining fertile soils, nutrient cycling, pollination), services that contribute directly to the quality of life of humans (such as cultural and aesthetic values of the landscape) and services that contribute towards global life-supporting functions (such as carbon sequestration, maintenance of biogeochemical cycles, supply of fresh water, provision of wildlife habitats) (e.g. Björklund, 2003). Others have classified ecosystem services in the context of agroecosystems into four main types: provisioning, supporting, cultural and regulating services (Millennium Ecosystem Assessment, 2005).

The explicit recognition of ecosystem services can be traced to George Perkins Marsh's publication of Man and Nature in 1864, in which he described the development of the Mediterranean ecosystem, the deterioration of the services of retaining soil and supplying fresh water. G. P. Marsh criticized the notion held by many at the time that resources were infinite. Ecosystem services as a concept was first employed to demonstrate the importance of the ecosystem functions to the human population. The valuation of ecosystem services in monetary terms thus has had a central position in the development of the concept (Costanza et al., 1997; c.f. Bouman et al., 2002). Quantitative methods have been developed to increase the awareness of agriculture's contribution to generating ecosystem services and the potential for increasing its contribution (e.g. Rydberg, 2004; Johansson, 2005). Of great interest are not only the attempts to measure, but also to establish and manage ecosystem services.

The strategy not only to conserve ecosystem services as an external resource to ensure the production of ecosystem goods, but to adapt the human economy to the ecosystem functions, through relying on the ecosystem services and thus ensuring their conservation, is sometimes called adaptive management with the target of systems integrity (Thompson, 1997). A similar approach was adopted in Johannesburg World Summit on Sustainable Development in 2002 for conserving biodiversity (Plan of Implementation, 44e) (UN, 2002), leading to the introduction of the term ecosystem approach. The concept was further elaborated by the Conference of the Parties of the Convention on Biological Diversity (http://www.biodiv.org/programs/cross-cutting/ecosystem/default.asp) and has been applied since in various contexts.

The *ecosystem approach* is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems. Therefore, the ecosystem approach is a crucial step towards acknowledging, conserving and relying on the ecosystem functions and structure in the development of agri-food systems, compared to the earlier approach of *sustainable use*, which takes nature as a source of resources and sink of wastes for agriculture and calls for stewardship (Douglass, 1984). An even more narrow approach is that of *food sufficiency*, which lacks long-term perspective or consideration of environmental and social impacts of food production. The environmental, social and economic consequences of the latter approach, which has dominated the development of agri-food systems for the first decades after the WWII, are described in Chapter 2C..

The ecosystem approach has its critics. Wood and Lenne (2005), for example, used the CBD as a framework to reject the three 'received wisdoms' in the agri-environmental policy over the past ten years: the ecosystem approach, the premise that agricultural expansion damages wild biodiversity and the premise that agricultural biodiversity ensures agricultural sustainability (c.f. MA, 2005). They proposed development of intensive agriculture to save off-farm biodiversity. Other recent contributors to this longstanding debate about intensive vs extensive agriculture include e.g. Green et al. (2005), Balmford et al.(2005) and Vandermeer and Perfecto (2005). One argument is that intensification (through increased yield per hectare), although causing declines of biodiversity on agricultural land, may help reduce the need for habitat reduction elsewhere (including natural pristine habitats). Pretty et al. (2006) suggest to exploit win-win situations that can be achieved in combining high productivity and ecosystem services. Another factor to be considers is that intensive agriculture often relied on inputs from beyond national borders (the so called "hidden hectares") to produce, e.g. feed (Deutsch, 2004; Johansson, 2005). Another view is that although the ecosystem approach may be appropriate in Europe, developing countries need the development of more intensive, highly productive agriculture, even if it has to rely on external inputs.

Figure 2D, 3: Paradigmatic changes in rural development thinking between the 1960s and the 1990s according to Ashley and Maxwell (2001).

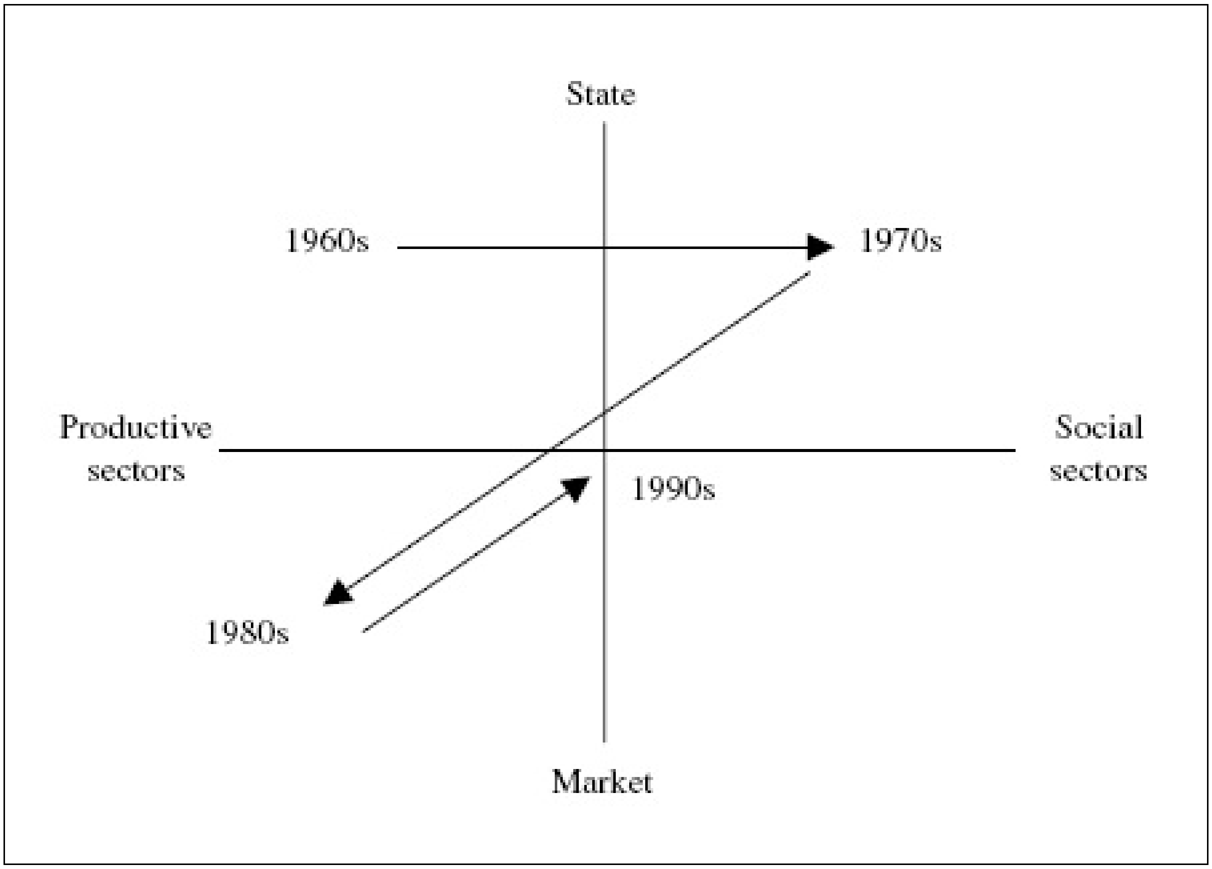
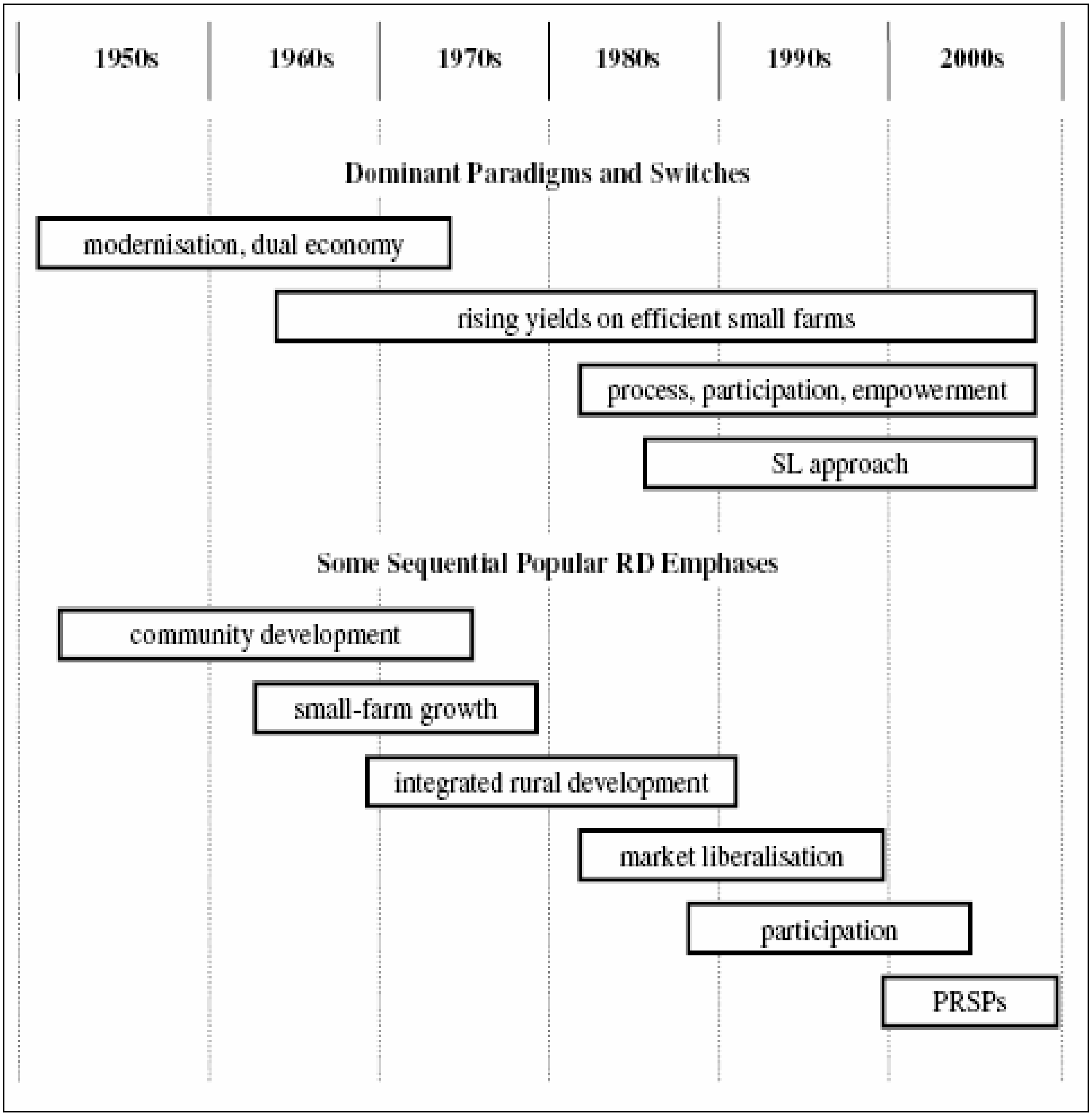


Figure 2D, 4: Paradigms in rural development 1950 to 2000 (SL=sustainable livelihoods, PRSP=participatory rural social protection) according to Ellis and Biggs (2001)



Text box 2D, 3: An introduction to systems approaches

Beginning with Einstein's theory of relativity (1905), a more systemic approach has evolved within science (Jantsch, 1975; Ackoff, 1983), and been formulated into a general theory of systems, for example by Bertalanffy (1973). According to the systems view, useful information about a phenomenon is not obtained by studying its components in isolation, because their interrelations determine the function of both the part and the whole (Bunge, 1985). A system is seen always to be embedded in a larger system, thus implying the aspect of hierarchy, and the interrelations among system levels are important to consider. The soft systems approach (e.g., Checkland, 1981) further assumes that every system can be described in several ways depending on the underlying world-view. This shift from a hard systems methodology (an ontological systems orientation) to a soft systems methodology (an epistemological systems orientation) implies that not only is the phenomenon studied interpreted as a system but also the inquiry into it (Checkland, 1988; Bawden, 1991). This approach, participatory in its very nature (Laszlo and Laszlo, 1997), introduces the researcher as a responsible actor in the human activity system (also Alroe and Kristensen, 1998). Attempts to construct research methodologies especially for agriculture using hard or soft systems approach, were made starting with FSR in low-income countries and by Spedding (1979), Bawden et al. (1985), Odum (1983, 1988) and others. This approach is often seen as an articulation for a plea for holism in science. The danger of interpreting the systems approach as a need to focus solely at a certain, often relatively high, "the" system level, leading to "up-ward reductionism", has been pointed to by e.g. Bunge (1985)

Soft system research has been promoted for situations where there is uncertainty about what constitutes the problem and what represents an acceptable solution as they depend on the perspective of the individuals involved (Stephens and Hess, 1999). A key feature of the soft system approach is that it aims to avoid formulating problems from one perspective to the exclusion of others. Stephens and Hess (1999) suggested that "an idealised pathway may be to adopt soft systems approaches to problem identification, hard systems methods to researching acceptable and sustainable solutions, and then to develop bilateral projects … [to] facilitate the uptake of outputs" , although they were concerned that that the current short term funding situation does not allow the necessary time or the freedom of thought.

Figure 2D, 5 (a): Transfer of Technology (TOT) model, (b) Farming Systems Research (FSR) model (Buhler et al., 2002)

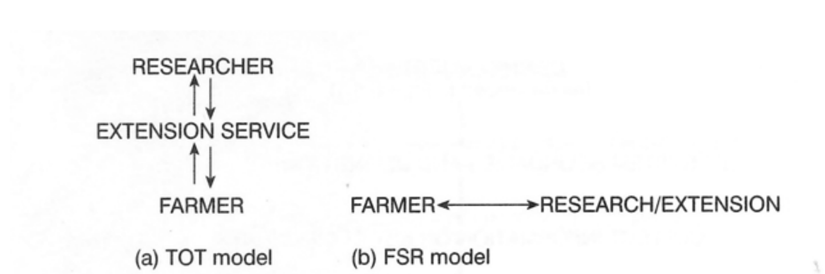
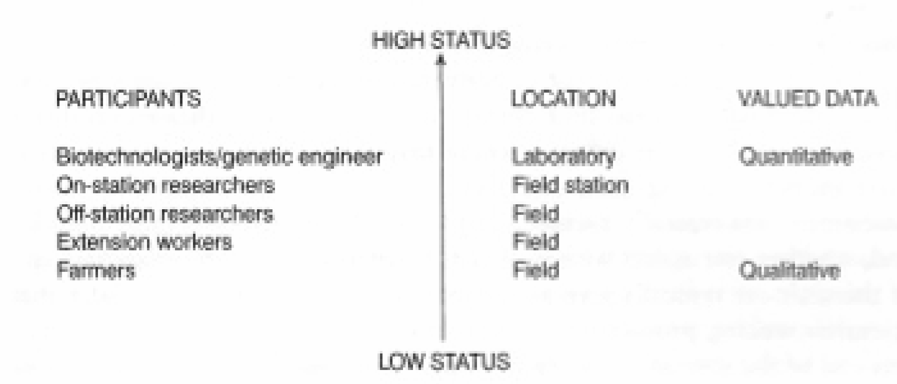


Table 2D, 3: Types of participation in development (Buhler et al., 2002)

Type of participation	*Characteristic*
1 Manipulative	A pretence (no real power). For example, the presence of 'people's' representatives on a board or committee, but who are outnumbered by external agents
2 Passive	People told about a decision or what has already happened, with no ability to change it
3 Consultative	People answer questions. The form of the questions and analysis of results is done by external agents, It equates to the 'consultative' form of OFR (Table 5.1)
4 Material incentive	People contribute resources (eg land, labour) in return for some incentive. The 'contractual' form of OFR (Table 5.1) is an example
5 Functional	Participation seen by external agents as a means to achieve goals (eg reduced costs) usually after major decisions have already been made
6 Interactive	People involved in analysis and development of action plans, for example. Participation is seen as a right and not just as a mechanical function. This equates to the 'collaborative' form of OFR (Table 5.1)
7 Self-mobilization	People mobilize themselves and initiate actions without the involvement of any external agency, although the latter can help with an enabling framework. This equates to the 'collegial' form of OFR (Table 5.1)

Source: after Pretty, 1995
Note: Linkages have also been made to similar categories in Table 5.1 (referring to on-farm research, OFR)

Figure 6: Hierarchy of status as suggested by Buhler et al., 2002 (adapted from Chambers, 1997)



Source: after Chambers, 1997

Table 4: A comparison of agricultural higher education in the US and Russia [IN 2000?], (Miller et al., 2000)

ISSUE	USA	RUSSIA
Curriculum	Determined by faculty at each institution	Approximately 75% set by federal government
Course content	Set by faculty at each institution	Centrally determined
Enrollment	Determined by market and campus	Quota determined centrally
Tuition	Set by individual campuses	Quota students free; above quota set by campus
Student/faculty ratio	Individual campus	System
Entrance requirements	Campus determined	Centrally determined
Greatest fiscal support	State government and tuition	Federal government
Links to research and extension	Inherent in land-grant system	No extension system and only weak links to research
Quality and applicability of education	Quality comparable, applied aspects greater	Quality comparable, lacking in application
Years of education	Comparable	Comparable
Senior project	Not required in most cases	Required

Figure 2D, 7: Funding for agricultural research in the US. The data for USDA funding were obtained from NSF (2006), and those for total public and total private research from USDA Economic Research Service (2006; http://www.ers.usda.gov/ Data/AgResearchFunding/) adjusted to constant 2000 dollars by gross domestic price deflators from US DOC (2006). The difference between the total public research and the USDA research is primarily funding for state agricultural research stations

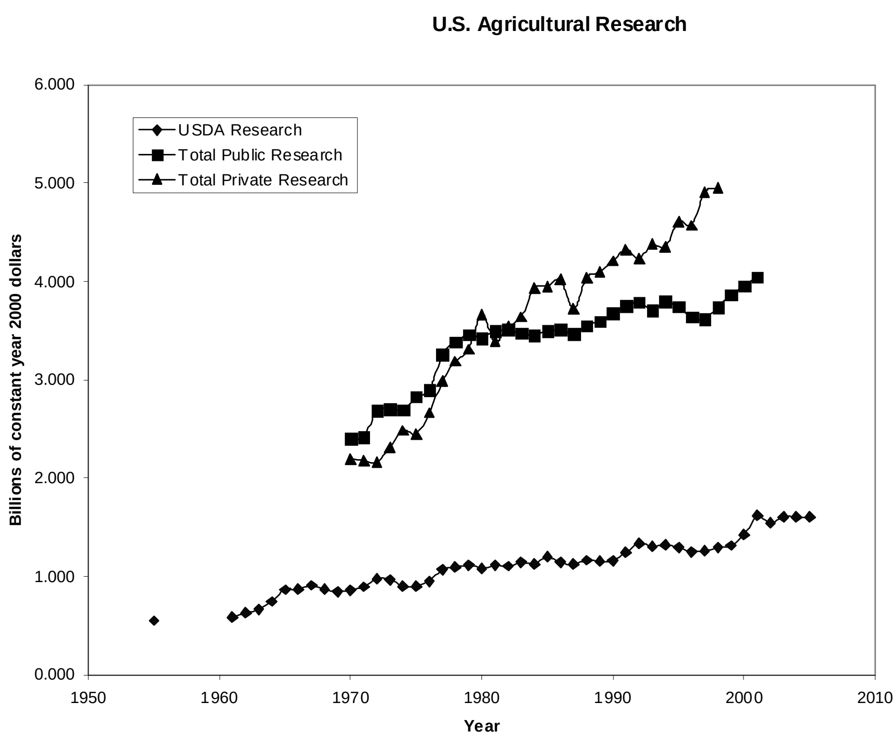


Table 2D, 5: Public and private agricultural R&D expenditure, circa 2000 (CGIAR Science Council, 2005a)

	Expenditure (millions 2000 international dollars)			Share (%)		
	Public	Private	Total	Public	Private	Total
Developing countries	12 819	869	13 688	93.7	6.3	100
Developed countries	10 191	12 577	22 767	44.8	55.2	100
Total	**23 010**	**13 446**	**36 456**	**63.1**	**36.9**	**100**

Source: Pardey et al. (2005) based on data from ASTI, available at http://www.asti.cgiar.org/.

Figure 2D, 8: The increase in the share of restricted funding to CGIAR (World Bank, 2003b)

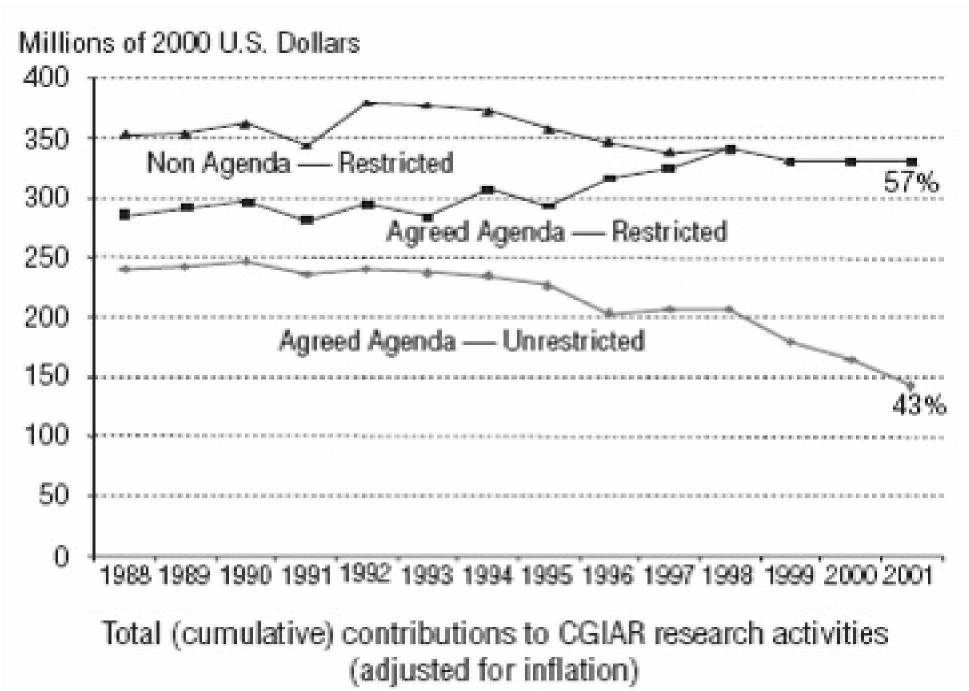


Figure 2D, 9: Nominal and real expenditures of CGIAR-supported centers (CGIAR Science Council, 2005a). Note: Expenditures pre-1972 represent funds to precursor international research institutes (IRRI from 1960, CIMMYT and CIAT from 1966 and IITA from 1971). Real expenditures are nominal expenditures deflated to base year 2000 prices.

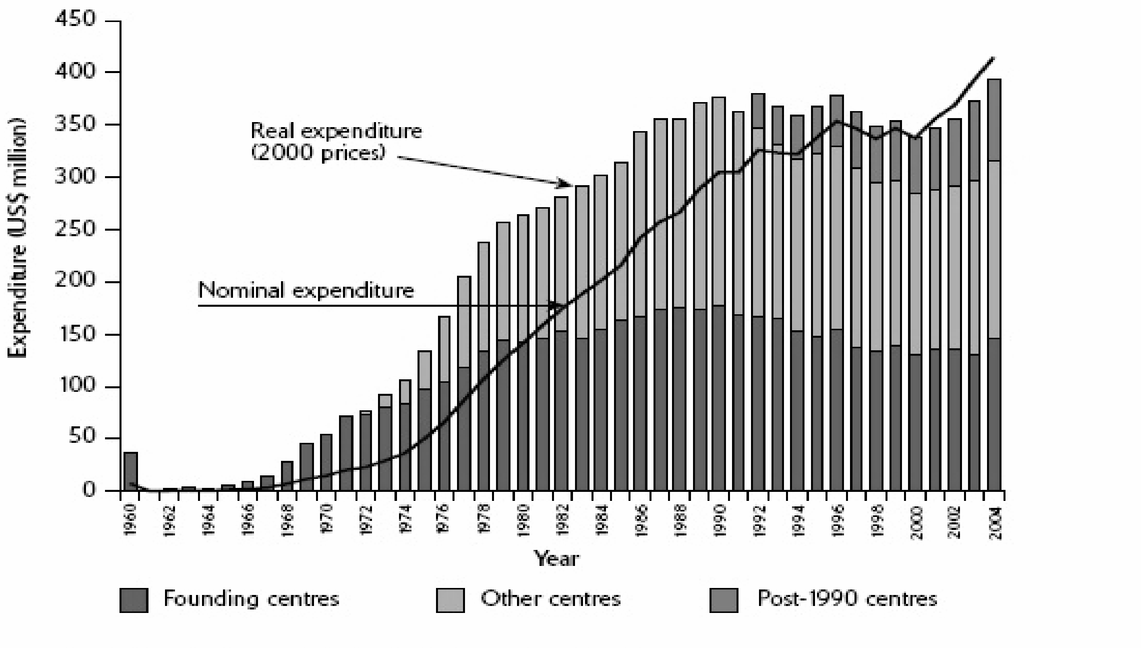


Figure 2D, 10: The development of the research agenda of CGIAR from 1960 to 2005 (CGIAR Science Council, 2005b)

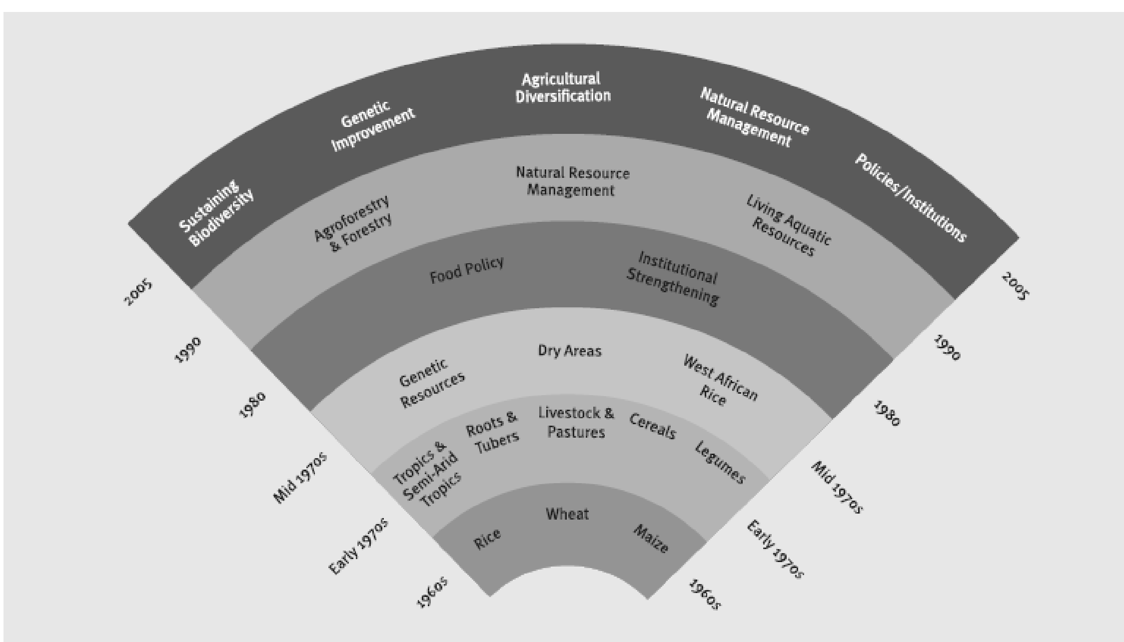


Figure 2D, 11: Average annual change in CGIAR's expenditures by type of research activity (adjusted for inflation) for the period 1992-2001 (World Bank, 2003b)

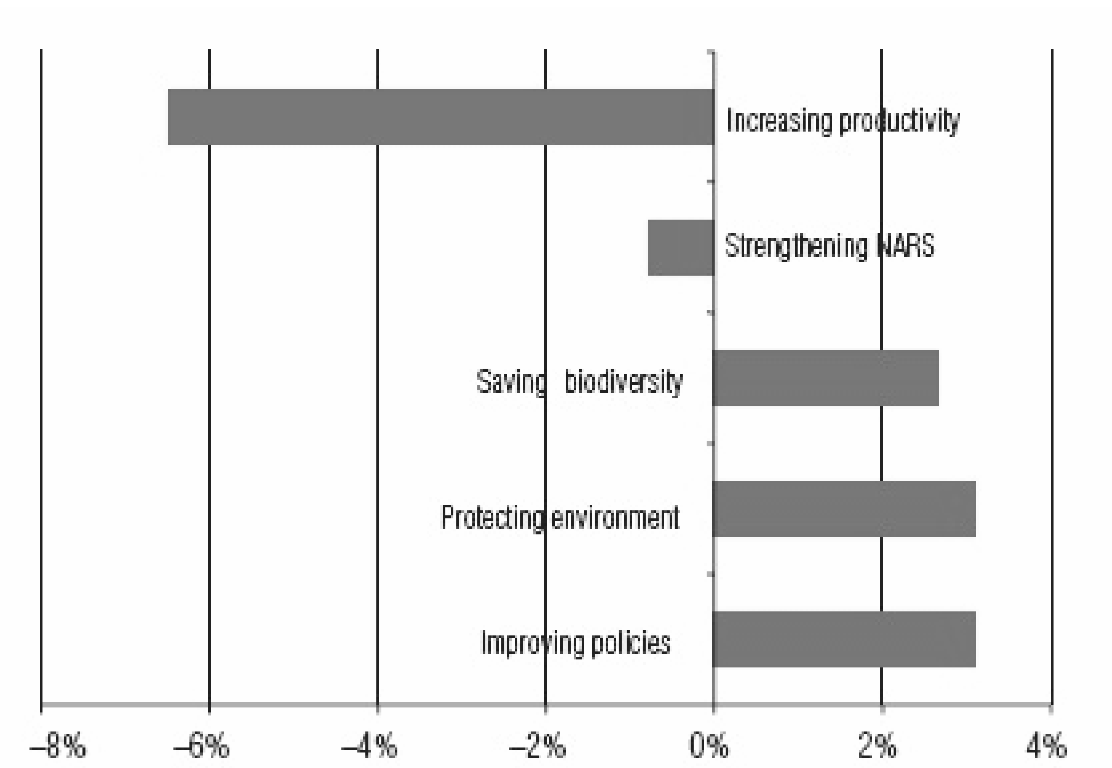


Table 2D, 6: Agriculture's share of overseas aid (ODA=Official Development Assistance, n.a.=not available) (Source: CGIAR Science Council, 2005a).

Year	Total ODA (in 2000 US$ millions)	Bilateral aid	
		Amount (in 2000 US$ millions)	Share to agriculture (%)
1970	24 719	20 886	4.91
1975	35 448	26 233	11.13
1980	49 166	31 875	16.63
1985	41 773	30 782	15.93
1990	67 071	47 540	11.39
1995	64 077	44 129	9.82
2000	53 749	36 064	6.36
2003	65 502	47 222	4.22
2004	74 483	50 700	n.a.

Figure 2D, 12: Decline of World Bank lending to agriculture in the 1990s (World Bank, 2003)

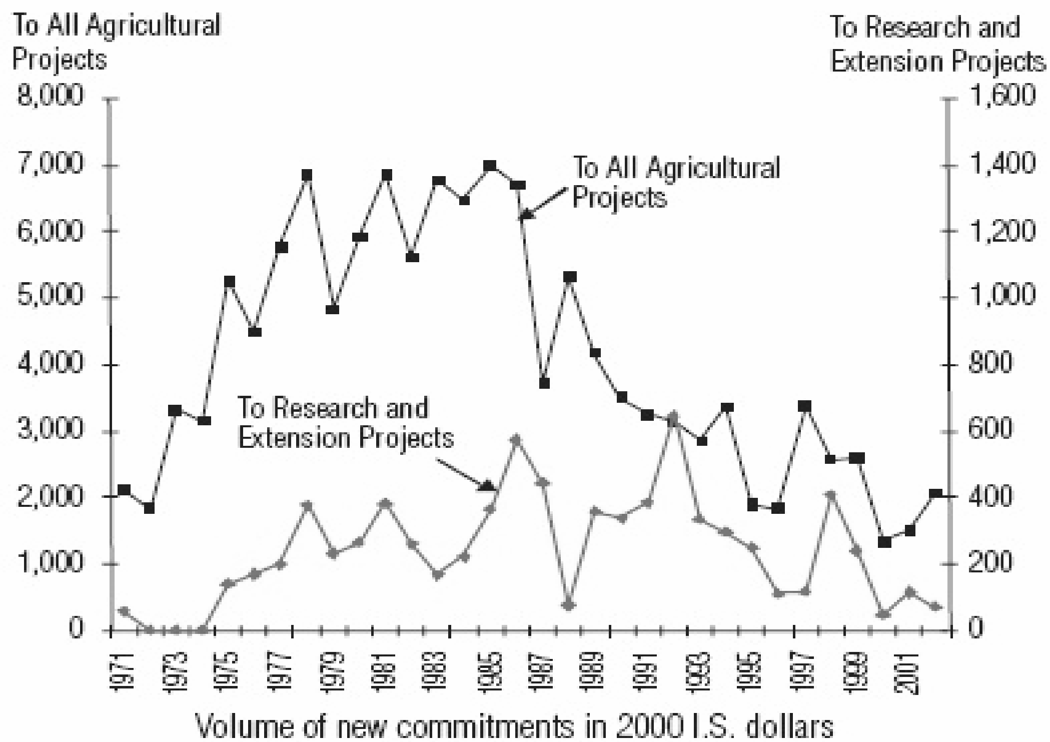
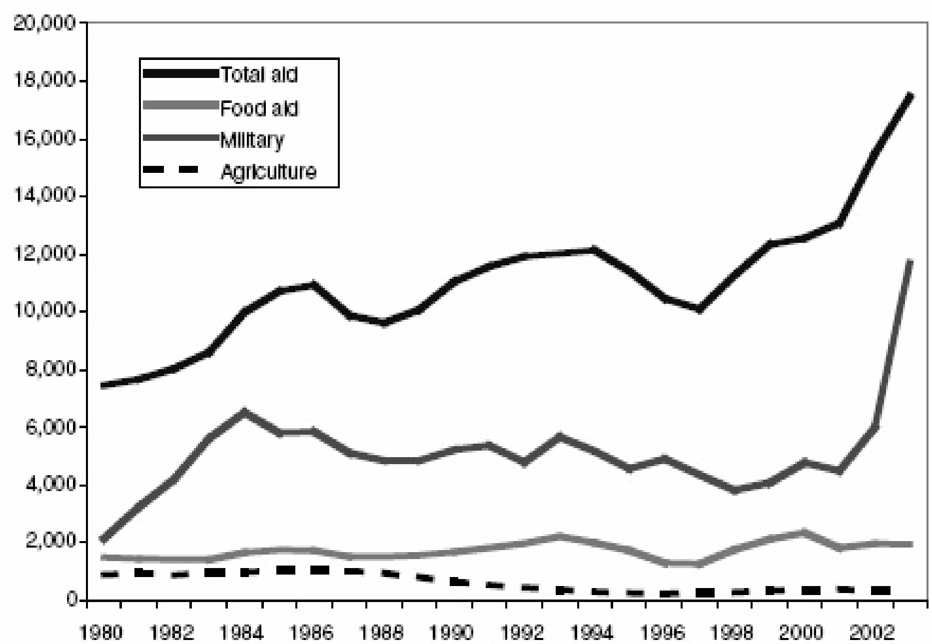


Figure 2D, 13: US overseas loans and grants 1980-2003 (millions US dollars) (Falcon and Naylor, 2005).



Source: USAID (2005a).

Text box 2D, 4: Example 1: Pesticide regulation in Europe and the US

Pesticides are presumptively dangerous under US and also EU laws. Accordingly, each regulatory system establishes conditions under which they can be used without evidence of unreasonable harm to humans or the environment, and these become mandatory for users. Scientific analysis of pesticide safety has advanced considerably since the 1960s, and thus factors that were unknown 40 or 50 years ago are now considered in evaluating pesticide safety.

More skeptical observers have argued that the regulatory systems that have developed since the 1960s for pesticides have been ‘reactive’ in that the industry and its products are controlled by a system set up in response to evidence of adverse, sometimes unexpected, impacts that have been found in products. Once a hazard to health or the environment has been demonstrated, new products in development are screened to ensure that they do not give rise to similar hazards. The regulatory system is thus built up slowly as new products exhibit different, sometimes unexpected, hazards. Decisions about the need for, and form of, regulation are taken on the basis of the best available scientific evidence and in relation to the relevant costs and benefits (Tait and Levidow, 1992).

An example of this process is the evidence that accumulated in the 1960s and 70s that commonly used organochlorine insecticides were harming wildlife (Moore, 1987). Thereafter, regulations were introduced to ensure that chemicals which were highly persistent in the natural environment (previously seen as a desirable attribute) would not be approved for use. Potential persistence in the environment then became a reason to reject a new pesticide from the research and development pipeline at a very early stage. A more recent example was the appearance of pesticide residues in drinking water in the EU. Consequently, the Drinking Water Directive (Council Directive on the Quality of Water intended for Human Consumption, 80/778/EEC) prohibited the use of any pesticide, residues of which appeared in drinking water at a concentration of greater than 0.1µg/litre. High mobility in soils, seen as an indicator of the potential of a chemical to reach drinking water supplies, became a reason for early rejection of a chemical from the product development pipeline.

This intensification of pesticide regulation has continued to the present day, although many other regulatory and policy areas have been subjected to de-regulation initiatives with a view to encouraging industry competitiveness. This has created a barrier to entry for small companies on the pesticide sector. Some interesting contrasts in impact on industry strategies can be found, however, between Europe and the US. The US Food Quality Protection Act (FQPA) 1996 had, according to interviews with agrochemical industry managers, fundamentally changed the way companies respond to regulatory signals from the US Environmental Protection Agency (EPA) in the regulation of pesticides (Tait and Chataway, 2000; Tait *et al*., 2006; Yogendra, 2004). The new safety standard – reasonable certainty of no harm – that is required to be applied to all pesticides used on food crops is linked to a system which expedites the approval of safer pesticides (www.epa.gov/oppfead1/fqpa) on a ‘fast track’ basis creating a new competitive advantage as an incentive for development. Such instruments selectively enable some companies (those that have such products in their development pipelines) to gain a competitive advantage over others and can in a very short space of time alter the behaviour of a whole industry sector in a positive direction.

In contrast, the European Drinking Water Directive (80/778/EEC) regarded all new chemical entities as equally hazardous. For an example, while one member of the strobilurin fungicides group with a favorable environmental and health related profile was the first product to be registered under the FQPA fast track system, this group narrowly escaped rejection at an early stage of product development because of the mobility in soils and hence the danger of falling foul of the EC Drinking Water Directive.

The regulatory systems currently in operation reflect accumulated evidence over decades as we have learned more about the hazards of different classes of chemicals, and removed some chemicals from approved lists, opening up opportunities for companies to develop new products to fill particular market niches.

In considering the interactions between regulatory systems and agrochemical company innovation strategies, the highly onerous regulatory demands on companies developing new pesticides have created a barrier to entry for small companies that might attempt to compete with the incumbent multinationals which has been increasing steadily since the 1970s. This means that, in the pesticide sector, there have been no innovative small companies developing products which could compete with the strategies of multinationals in pesticide development. Unlike the situation in the information and communication technology sector, one group of companies with a consistent set of innovation strategies and the ability to sustain investment without any commercial returns over very long lead times has been able to retain a dominant position in technological innovation for agriculture for the last fifty years., This dominance of the agrochemical industry over innovation in technology for agriculture had an important influence on public attitudes to GM technology (see below). This is particularly the case in Europe, where public concerns about the conventional farming systems, which formed the main market for products from the agrochemical industry, had been increasing steadily (Bauer and Gaskell, 2002).

Text box 2D, 5: Example 2: Regulation of genetically modified crops

Considering the second example of evolution of public control systems in AKST, even more fundamental differences than concerning pesticides, emerged between EU and US approaches to the regulation of genetically modified (GM) crops in the 1980s. This debate was one of ‘product vs. process’ (Tait and Levidow, 1992) with the US considering GM crops as inherently similar to existing *products* subject to existing regulatory systems, while the EU viewed the *process* of genetic modification as potentially leading to novel unpredictable properties requiring a new approach to regulation. The analogy most frequently used in the EU was the introduction of alien species with the attendant risks of uncontrollable spread in the natural environment (RCEP, 1989). This distinction has been a major contributor to understanding trade difficulties the US as with the EU.

In the early stages of development of GM crop technology, the difficulty for international harmonization of European and US regulatory systems arose at least n part from the fact that the two rgions chose different and largely incompatible analogies on which to base their regulatory systems for GM crops.

The European process-based approach to GM crop regulation, embodied in the Directive 90/220, was initially intended to be more precautionary than the US approach (although this notion is debated by US regulators), and also to be temporary, pending the generation of evidence on the safety of GM crops in use. However, the emergence in Europe of an advocacy coalition (Sabatier and Jenkins Smith, 1993) campaigning very successfully against GM crops has resulted instead in a regulatory environment based on a new revised Directive 2001/18 and subsequent regulations, which are extremely restrictive and are unlikely to be compatible with a profitable European industry sector producing both GM crops and pesticides. In future development and production of GM crops for global markets is likely to be based outside Europe, particularly in the US and potentially also in India and China. If the co-production of GM crops and pesticides, including strategies for using a combination of GM crops and pesticides to give effective insect pest and disease control, becomes the dominant industry strategy, as currently seems likely, then the multinational companies that currently have a strong research base in Europe are likely to move their headquarters to other parts of the world (Chataway *et al.*, 2004; Tait and Chataway, 2006, in press).

In Canada, the regulatory system requires crops with novel traits to be assessed for their environmental safety irrespective of whether they have been produced by genetic modification or conventional breeding methods (Morris, 2007). This applies for example to herbicide tolerant crops, which have been produced using either genetic modification techniques or conventional breeding. Environmental risks associated with the growing of conventionally-bred herbicide tolerant crops and herbicide tolerant GM crops are considered to be very similar if not identical (Morris, 2007; ACRE, 2006). In the EU conventionally bred herbicide tolerant crops can be introduced without prior environmental risk assessment. In contrast, the EU GM directive requires that herbicide tolerant GM crops are not only assessed for potential direct risks but also indirect and management-related risks. Some EU governments currently oppose certain herbicide tolerant GM crops solely because of their management-related impacts on broad-leaved weeds and associated wildlife (Hawes et al., 2003; Head et al., 2003 a,b; Roy et al., 2003; Beckett, 2004; Bohan et al., 2005).

Regulatory systems could be managed to give appropriate signals to companies developing the technology, to improve on the potential benefits for sustainable farming systems. The earliest products of innovative technologies have usually given only a hint of potential future benefits, and innovation progress relies as much on social learning as it does on scientific knowledge (Williams, 2000).

Text box 2D, 6: The International IP Architecture: Multilateral, Regional and Bilateral Rules

The architecture of the global IPR regime has become increasingly complex, and includes a diversity of multilateral agreements, international organizations, regional conventions and bilateral arrangements.

Multilateral treaties
Most of these agreements are administered by WIPO, and are of three types:

i. Standard setting treaties, which define agreed basic standards of protection. These include the Paris Convention, the Berne Convention and the Rome Convention. Important non-WIPO treaties of this kind include the International Convention for the Protection of New Varieties of Plants (UPOV) and TRIPS.
ii. Global protection system treaties, which facilitate filing or registering of IPRs in more than one country. These include the Patent Cooperation Treaty (PCT), and the Madrid Agreement Concerning the International Registration of Marks.
iii. Classification treaties, which organise information concerning inventions, trademarks and industrial designs into indexed, manageable structures for ease of retrieval. One example is the Strasbourg Agreement Concerning International Patent Classification.

Other non-WIPO international agreements with an IPR content include the International Treaty on Plant Genetic Resources for Food and Agriculture and the Convention on Biological Diversity.

Regional treaties or instruments
Examples of these kinds of agreement include the European Patent Convention, the Harare Protocol on Patent and Industrial Designs within the Framework of ARIPO, and the Andean Community Common Regime on Industrial Property.

Regional trade agreements
Regional trade agreements normally have subchapters governing IP standards. For example, the North American Free Trade Association, the proposed Free Trade Area of the Americas, the EU/ACP Cotonou Agreement.

Bilateral agreements
Specifically, these include those bilateral agreements that deal with IPRs as perhaps one of several issues covered. A recent example is the 2000 Free Trade Agreement between the US and Jordan, but there are many others.

Source: UNCTAD/ICTSD (2001)

Table 2D, 7: Prevalence of undernourishment in the total population (%) in different parts of the world

	1969-1971	**1979-1981**	**1990-1992**	**1993-1995**	**1995-1997**	**2001-2004 provisional/ temporary**
Developing world	37	28	20		18	17
US & Canada	<2.5	<2.5	<2.5		<2.5	<2.5
Eastern Europe				<2.5		3
Commonwealth of Independent States				7		7
Industrialized countries				<2.5		<2.5

Source FAOSTAT Database (http://www.fao.org/faostat/foodsecurity/index_en.htm; accessed 24 Jan 2007)