GLOBAL IAASTD CHAPTER 8

OPTIONS FOR ENABLING POLICIES AND REGULATORY ENVIRONMENTS

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Key Messages

8.1 Policy Options for Food Security

As new developments in the later 19th century broke the age-old relationship between population growth and agricultural prices, international agricultural prices went through a series of price falls that caused large farms to decline and that threatened farm progress. These developments in turn induced profound changes in the agricultural policies of 'western' countries. Redistributive land reforms streamlined the shift from large to small farms. Government sponsored research and extension services replaced large farmers and landowners as agents of innovation. Moreover, governments intervened to moderate the fall in agricultural prices, ensuring that at least the frugality of small farmers left some margins for investment. At first, these responses followed diverging pathways in different countries. In the late 19th century, most West European countries resorted to protection to shield their farmers from the fall in international agricultural prices. However, other 'western' countries kept to agricultural free trade in this period. Most of them had special advantages in the farm sector. Rather than resorting to protection, many of them introduced policies to encourage innovations. Overall, the domestic effects of agricultural protection seem to have been quite favourable. Earlier assertions that, e.g. in Germany, this policy would predominantly have entailed negative effects have been revised. Import protection seems to have contributed to rapid productivity growth in the farm sector, with positive effects on other sectors and limited negative first round effects on consumers. To be sure, protection alone did not enable farm progress. In France and Italy, where tenure relations gave little security to small farmers and agricultural research and education lagged far behind those in Germany, productivity growth in farming was sluggish in spite of protection. Nevertheless here too, support of farm incomes seems to have sustained the demand for industrial products – an important effect because French and Italian industries were still largely dependent on the domestic market. A second fall of international agricultural prices around 1930 made all western countries resort to protection. (Denmark and the United States briefly tried to return to free market policies in the 1950s, but these experiments were short lived and the outcomes disappointing.)

By then, all of them had engaged in government support of farm research, education and infrastructural programs, so that there was a broad policy convergence. The combination of price and development policies paved the way for a new agricultural revolution based on high yielding seeds, agri-chemicals and mechanization. This revolution was increasingly based on family farms, and was only possible because government intervention overcame their risk-aversion and disadvantages in fields like information and consolidation. Besides, the combination of scientific research and family farmers required some form of 'democratic' interface for being effective. The participatory county agent approach pioneered in the US in the early 20th century became the

model for extension services throughout the western world, foreshadowing the 'participatory' approaches that are now fashionable in developing countries.

Diverging responses in the developing world. The regime change that emanated from the 'western' world deeply affected other regions and countries, but the impacts varied depending on local conditions. Like western countries themselves, many countries in East and South Asia introduced supportive policies including price policies that shielded farmers from low world market prices. Like agricultural protection in Germany before WWI, that in Asia has been blamed for freezing farming structures, retarding growth, and harming poor consumers. These contentions are backed by standard equilibrium models, but the 'welfare losses' indicated by such models say nothing about how farm productivity, poverty or GDP would have evolved over time had farmers not been protected. The fact is that in the Japanese Empire before WWII, agricultural protection coincided with important productivity increases in agriculture, and that rural incomes contributed to industrialization as a demand factor. The same is true for South Korea and Taiwan in more recent decades. In both countries, the increase in agricultural protection after 1970 was followed by new increases in farm output and incomes, and may well have caused the continuation of agriculture's contribution to the domestic demand pull for industrial growth, even if the relative importance of this contribution declined (also cf. Timmer 1995). While farmers in Japan, Korea and Taiwan were protected, those in Asian colonies of European countries were not. Here one saw phenomena of stagnation and 'involution' (Geertz 1963) that reminded of Malthusian crises like those in Europe in the 14th and 17th centuries, but while these occurred because an agricultural revolution was exhausted, here an agricultural revolution was nipped in the bud. Independence was a historical watershed. Several new governments introduced supportive farm policies. Together with the high-yielding varieties from international research, these led to the Green Revolution, which became an engine of industrialization (see below). As a consequence, many countries have now become less dependent on agriculture, so that they can moderate their protection of it without endangering their economies.

In Latin America, large landowners kept to an open system of agricultural trade. Rather than calling for protection, they used their dominance to shift the burden to the rural poor. In the end, they evicted large numbers of workers with precarious rights to the land that they tilled to pave the way for a cost-cutting mechanization. This allowed a development of a kind, but one that involved more inequality and socio-political tensions than in other regions, as well as problems of crowding and resource degradation in poor areas that served as a refuge for displaced rural workers. Land reform and conflicting trade policy interests of large and small farmers remain vital issues in this setting.

In sub-Saharan Africa, the colonial scramble coincided with the decline in international agricultural prices. This limited the establishment of European-owned farms and plantations, leaving existing farming systems largely intact. Like in Asia, colonial governments failed to protect indigenous smallholder farmers. Relative abundance of land for some time provided an outlet for population growth, but this safety valve was gradually closed. Higher post-war prices induced new investment by smallholder farmers. In the 1960s, per capita incomes in Sub-Sahara Africa were higher than in Southern Asia, but continued population growth and new declines in the agricultural terms of trade led to a return of the vicious cycle of poverty and soil degradation, especially after 1980. Unlike in Asia, national independence brought no turn to more supportive farm policies. South(east) Asia had a millenniums old history of agricultural intensification, socio-economic differentiation, and state formation. It had created a political middle class with some eye for longer-term interests, and made that farmer dissatisfaction expressed itself as popular protest. Conversely, Sub-Saharan African societies were less differentiated, had property rights in people rather than material assets, and had more fluid and personalist socio-political relations. This was conducive to self-organization of interests in clientelist factions rather than in class-based structures. Politicians saw themselves obliged to remunerate large numbers of supporters with public sector jobs, while farmers were too weakly organized to prevent footing the bill.

Multilateral regulation of agricultural trade? When countries turned to protection, they did so because international prices declined. Unless combined with supply management, however, protection itself will further depress international prices by raising domestic production and thereby exacerbating the oversupply at the global level. In the 1930s, when falling demand causing agricultural surpluses in several countries and major exporting countries also introduced protection, supply control and managed trade became an important issue. It influenced the policy debate in the first post-war years, and led to a special position of agriculture in the General Agreement on Tariffs and Trade (GATT). In spite of its free trade philosophy, the GATT allowed countries to protect their farmers provided that they controlled their production and exports, as well as to engage in international commodity agreements to stabilize and support the international prices of primary commodity if needed.

Nevertheless, a balanced multilateral system of managed trade did not emerge. OECD countries were hesitant to cooperate with international agreements that would support the prices of tropical products that they imported. Although they formally endorsed UNCTAD's Integrated Programme for Commodities (1974) that sought to increase the number of commodity controls, they thwarted its implementation. In the 1980s, the few existing control agreements collapsed. Many economists see this as proof that free rider and rent seeking problems make commodity controls inherently unviable, but in reality, the resistance of importing countries may have been decisive.

Meanwhile, a coupling of protection to production and export controls as envisaged by the GATT was thwarted by the offensive kind of protection pursued by the US and the EU. In the 1980s, competitive dumping caused a trade conflict between these two powers. In 1993, a compromise between them led to the WTO Agreement on Agriculture that prescribed reductions in price support measures but exempted direct payments under certain conditions. In the following years, both powers shifted increasingly from price policies to direct payments. Other countries could not follow this approach because of the high government cost involved, so that the obligatory reduction in price supports entailed a reduction in the support to their farmers. The Agreement on Agriculture gave developing countries more room for maintaining price supports. However, the US, the EU, the World Bank and the IMF have pressured them (in bilateral trade negotiations and negotiations on financial support) not to use this room. This whole policy evolution was surrounded by a discourse which depicted this evolution as 'trade liberalization', harking back to realities of the mid-19th century. Model studies that show 'welfare benefits', but ignore the dynamics of agricultural markets and developing countries, play an important role in this discourse. Meanwhile the income support given to OECD farmers has hardly decreased. Direct payments allow the US and the EU to continue exporting large volumes for prices below their own cost of production in a way that no longer violates multilateral trade rules, while other countries are obliged to reduce their customs defenses.

Development policies and development aid. The diverging responses to the changes in agricultural world markets and the evolution of trade policies had a large influence on the vicissitudes of policies to stimulate farm progress in the developing world. In many cases, these started with efforts by colonial governments to introduce cash crops or to combat land degradation. As the same governments refused to improve prices or to redistribute land from white settlers to indigenous farmers, measures propagated by colonial officials often had little success because they went against the coping strategies of farmers.

In the first postwar years, higher prices made it more rational for farmers to adopt innovations. Moreover, western governments started to export their new model of family farm based development stimulated by redistributive land reform, co-operatives and government sponsored research and extension. Rather than supporting farm prices by tariffs or international commodity controls, however, colonial governments used institutions like marketing boards to tax farm exports to pay the expenses of their development policies. From the late 1950s, international agricultural prices declined again. At the same time, government intervention in developing countries to stimulate agricultural modernization increased, also supported by the growing flow of development aid that followed in the wake of decolonization and was reinforced by the Cold War competition between the western and communist blocks. This movement included the

establishment of international agricultural research institutes. The impact of these developments depended strongly on the divergence policy responses in the developing world that have been described above. The Green Revolution in Asia was facilitated by the prevalence of large alluvial plains and food patterns with rice, wheat and maize as main staples, but supportive policies, including price policies, were no less important. Indeed, all Asian Green Revolution countries had price stabilization, price support and/or input subsidies at the time that their Green Revolutions occurred. It was in this context that new participatory approaches like farmer field schools or participatory technology development, which continued the line of more successful extension methods in western countries, had their greatest impact. The Green Revolution has been criticized for its negative side effects but overall, the share of poor and undernourished people in South and especially East Asia has decreased, not least because agricultural growth became an engine of industrialization.

Sub-Saharan Africa shows an opposite picture. All national and international efforts have not prevented large parts of African farming to fall in a vicious cycle of poverty and soil degradation. Agronomists and other experts are struggling about which approach would be most suited to get agriculture moving – high or low external inputs, farmer field schools or training and visit – but the reality is that all these approaches have quite disappointing results. Poor soils, adverse climates and diversified food patterns with roots and tubers in addition to cereals have been pointed to in attempts to explain these poor outcomes. Indeed, an agricultural revolution should be more diverse than in Asian circumstances – a ‘Rainbow Evolution’ rather than a Green Revolution. Nevertheless, natural conditions and food patterns can hardly explain why, e.g., in many places with fertile volcanic soils and a predominance of maize, rural societies are likewise stuck in stagnation. The real explanation of the plight of the region is that, unlike in South(east) Asia, there has been no real breach with the farm policies of colonial times. Farm prices were not supported and public investment in infrastructure for smallholder based development remained limited. Export crops were taxed to pay the expenses of an agricultural development apparatus that now became populated by African graduates but whose approaches still reminded of colonial ‘betterment’. The effects were felt when oil shocks raised the costs of farm inputs in the 1970s, and even more when international agricultural prices fell once more in the 1980s. Unfavorable price ratios and lack of infrastructure limited farmer investment in land management, which thereby failed to make the increase in population sustainable. The resulting agricultural stagnation became the core of a complex poverty trap. It caused a flight off the land, but squeezed the demand for domestic industries and services. As a consequence, the rural exodus was not absorbed by non-farm growth, but fueled political markets based on the doling out of public sector jobs. State and semi-state bureaucracies increased, but falling export earnings and economic stagnation made this expansion bog down into fiscal crisis. Foreign lending gave briefly

respite, but the ensuing debt crisis soon forced governments to accept the conditions imposed by international donors. These were met, first by cuts on public services, then by reductions in public sector wages, and only in the last place by public sector retrenchment, so that farmers suffered from the neglect of roads and other public services.

In Latin America, unbalanced development entails mixed results. On the one hand, liberal-economic policies and repression of popular opposition have sometimes paved the way for export-led growth based on large farms that created new employment. The successful development of export horticulture in Chile is a case in point. Also, larger and smaller producers of coffee or cocoa sometimes succeed in using quality differences for exploiting niches for specialty products in importing countries. On the other hand, liberal-economic policies and low prices have driven many small farmers in illegal crops like coca, or turned them into new slum dwellers or illegal immigrants in the United States. Moreover, the wild capitalism of the latifundio sector and the desperation of marginalized rural workers cause a scramble for resources like those in the Amazon, leading to large-scale deforestation and depletion.

Since the days of the Green Revolution, the institutional setting of agricultural research has changed. The funding of public research institutes has declined. The new gene revolution is led by transnational corporations. The top ten of these corporations now spend three times as much on agricultural research as Brazil, China and India together, and ten times as much as all CG institutes. The research agendas of these corporations are steered by effective demand rather than social needs. It leads to massive investment in herbicide tolerance but underinvestment in traits like drought resistance that are vital for poor farmers in less-favored areas. While the germplasm produced by CG institutes was freely available for national research institutes, that of private corporations is protected by intellectual property rights and only selectively available for those who are willing to pay the price. As a consequence, agricultural innovation tends to bypass poor farmers and less-favored areas more strongly than the Green Revolution did. Other developments work in the same direction – e.g. the chain organization of cash crop production by traders and processors who are raising production standards to meet their own requirements or consumer demands.

Long term global food availability: continued abundance or new scarcity? The more socially excusive nature of farm progress and the failure to arrive at a balanced multilateral regulation of agricultural policies also involve risks for global food security in the future. Between now and mid-century, world population is expected to grow from 6.5 to 9 billion, demand for animal products to double, while the use of biomass for non-food purposes – especially functionalized chemicals – will strongly increase. As a consequence, the global demand for farm-produced biomass can

easily triple. The fact that, in the 20th century, supply has been overabundant does not guarantee that this new increase in demand can be met effortlessly. The plentiful space for reclaiming new fertile lands, tapping water reserves for irrigation, and boosting yields through agrochemicals and growth-resistant varieties, is gradually being depleted. At the global level, the biophysical potential for farm production is still adequate, but their full exploitation is rendered problematical by environmental constraints. Besides, more than 80 percent of this potential is situated in Latin America, Sub-Saharan Africa and former Soviet Union countries, where its exploitation is hampered by institutional problems. Additionally, in those parts of Asia where demand is expected to increase most strongly, the room for additional crop production is quite limited.

Therefore, an adequate increase in global supply will partly depend on new technologies. Unlike current ecological techniques, which reduce emissions while minimizing production losses, these new technologies must aim to reduce emissions while increasing land productivity. Investment in such technologies involves long gestation periods. This is also true for other investments that determine future production capacities, such as investments in human capital or the regeneration of degraded soils. To avoid unnecessary scarcity, such investments should be taken in time. However, with myopic expectations and financially constrained farmers, low current prices restrict the size of these investments. If, after some time, it were to become more difficult for the global supply of food to keep up with demand, this could lead to soaring food prices, wreaking havoc in net food importing poor countries. Such cobweb ('pig cycle') effects might be exacerbated if government support for agriculture were to be strongly reduced in a final phase of international overabundance. In this sense, the present dismantling of price supports, the continuance of disguised dumping by developed countries, the phasing out of fertilizer subsidies in developing countries and the worldwide reductions in support for farm research might pose serious threats. Besides longer-term cobweb effects, dismantling of price policies will also entail increases in short-term price volatility, which will likewise affect investment. Regrettably, no allowances have been made for such effects in the studies of long-term global food security that some established institutions have made.

Which agricultural policies will enable global food security and sustainable pro-poor growth?
Three main lessons can be drawn out of the above survey (Insert references, when above is moved to other chapters/significantly condensed). Firstly, under the evolutionary regime that has prevailed since the late 19th century, national and multilateral government intervention including price and income supports has become indispensable for a balanced development of the global agri-food economy. Secondly, different parts of the developing world are involved in different dynamic patterns, so that food security and sustainable pro-poor growth in these parts may require different types of intervention. Thirdly, it is not sure that the regime of abundant food

supply at the global level will continue in the coming decades, so that responsible policies will have to reckon with the possibility of increased scarcity. These broad considerations can be translated in a number of general principles that are important if agricultural policies have to enable global food security and sustainable pro-poor growth.

Policy options for developing countries:

- High- and middle-income countries could strongly increase their contribution to the funding of public international agricultural research. At the same time the agenda of this research could become much more focused on issues which are important for poor farmers and less-favoured areas but that are being under-researched by private corporations. Drought resistance, orphan crops, and light irrigation in rainfed agriculture are likely candidates. Private corporations could be required to give access to their germplasm and exceptions to intellectual property rights could be made for these purposes.
- Public investment in roads, irrigation, farm research, extension, rural schools, health centers and other hard and soft infrastructures for agricultural progress in poor countries and less-favored areas could strongly increase. For example, African countries could realize their commitment made in Maputo in 2003 to use at least 10 percent of their budgets for agricultural development. This investment could be co-financed by international development aid.
- Where co-ordination problems cause a lack of/minimize private investment in supply and marketing chains for agricultural development in less-favored areas, government participation can be needed to get things moving. This can mean that governments have to step back into some activities from which they have withdrawn in the frame of structural adjustment reform. However, sufficient room could be maintained for private competition to control bureaucratic tendencies, and governments could back out again as soon as private alternatives have grown strong enough.
- Rights of poor tillers could be strengthened to allow them to participate in and benefit from agricultural development. The priorities in this strengthening of rights follow from the different dynamic patterns in which parts of the developing world are involved. E.g., in Latin America with its strong inequalities in landownership, redistributive land reform and strengthening the land rights of poor farmers is a prominent issue. In Sub-Saharan Africa, however, priority can be given to corroborating local justice in ways that strengthen the rights of farm youths and women, to whom the burden of rural poverty tends to be shifted in gerontocratic structures. In emerging market economies in Asia, in their turn, social security regulations for farm workers can be most relevant.
- Developing countries could have further rights to support the incomes of their farmers (also by protective tariffs) if this is needed to get their agriculture moving as an engine of growth. Additional government revenue that is generated by tariff increases can or could be used to

enhance the public investment in hard and soft infrastructure for agricultural development. Any tariff increases on food imports should be accompanied by measures to compensate poor consumers. Road building – financed through tariff revenue and international aid – can be used as employment projects for this purpose. Another possibility is school meals and other institutional meals made from domestic foods. Such measures can also give an important additional demand impulse for agricultural growth. Early estimates indicate that home-grown school feeding programs could raise the turnover of food crop farmers in sub-Saharan Africa by some 15 percent.

- Participatory approaches are most suited as an interface between agricultural research and extension on the one hand, and smallholder farmers on the other hand. However, such approaches will only work when other enabling policy conditions (including public investment in infrastructure and supportive price policies) are also fulfilled.

Policies to reduce risks of strong rises in international food prices:

- Caution is needed in stimulating the demand for biomass for non-food purposes. A moderate increase in such demand that would cause some rise in international agricultural prices might stimulate agricultural development in poor countries. But a large increase in such demand could send international food prices skyrocketing. This could especially occur if government policies lead to large-scale production of biofuel. Preferably, the use of biomass for non-food should be limited to more efficient applications of biomass like functionalized chemicals. Rather than using seeds or tubers, second generation technologies for transforming residues and whole plants as could be developed. The conversion efficiency of biomass into chemicals could be greatly increased by fine-tuning and bio-refinery.
- Policy options exist for mitigating the increasing claim on farm-produced biomass for animal foods for affluent consumers. A tax induced shift from beef to pork, poultry or fish would already moderate the competition with food for the poor (as well as improve public health). The development of more attractive plant-based meat substitutes (e.g. on the basis of fungi rather than grains and legumes) could have a large effect. Besides, new production systems for phytoplankton could moderate the demand for farm-produced feed (and fishmeal, which already claims almost half of the world's fish capture).
- Where possible nature and biodiversity conservation could be combined with agricultural exploitation. Large-scale conversion of agricultural land into nature/biodiversity reserves could happen in ways that make it readily reversible.
- To reduce the risk that, in the longer term, strong rises in international food prices cause havoc in poor net-food-importing countries, high- and middle-income countries could increase their capabilities for agricultural production. Between now and mid-century, the global demand for food will double, while a larger share of suitable lands will be claimed for non-food purposes. The

types of low input agriculture that are currently being developed as 'organic' alternatives for high input agriculture will not be able to meet the rising demand for food in the future. Agricultural research can aim at technologies for ecological modernization that reduce emissions while increasing land productivity rather than at techniques that reduce emissions by decreasing inputs while minimizing production losses.

- Although countries may increase their capabilities for food production, they could make a restrained use of these capabilities as long as international markets are marked by abundant supply. (There is nothing contradictory in this: a reliable car has a strong engine as well as a strong brake.) High- and middle-income countries could have the right to support the incomes of their farmers to enable a precautionary policy of enhancing production capabilities with a view to any future increases in global scarcity, but only if they use these capabilities with constraint in order to avoid global overproduction.

Multilateral regulation of agricultural markets and trade:

- Simple 'liberalization' is not a viable concept for a multilateral system of agricultural trade in the current situation, and leads to an unbalanced situation of disguised dumping by rich countries and customs disarmament of poor countries.
- A multilateral system of managed trade based is needed to keep international agricultural prices within desirable price bands. In tropical export crops this means the establishment of international production controls based on export and production controls. In other crops, the introduction of supply management could start by imposing disciplines on developed countries to correct trade distortions that have been caused by decennia-long policies of offensive protection, e.g., maximum export quotas and minimum import quotas could be imposed on developed countries, with quotas based on historical trade volumes and tradable between governments. After a transition period, such disciplines could be extended to middle-income countries. Low-income countries could be exempted to create room for them to increase their production and exports.

8.2 Natural Resources and Global Environmental Change

"We are moving now into a new, post-industrial, third-generation agriculture (TGA). The challenge for TGA is to combine the technological efficiency of second-generation agriculture with the lower environmental impacts of first-generation agriculture. …. Policy tools, many of which are now available, must be further developed and integrated. Through a combination of regulation against pollution and degradation, the creation of markets for public goods through the rural development regulation, and enabling and educating consumers to opt for goods produced to high environmental standards, the environmental benefits of agriculture could be delivered to a high level alongside outputs of food and fibre." (Buckwell and Armstrong-Brown, 2004)

8.2.1. Resources, process of change and international, national and local policies

The broad history of the relation between natural resources, i.e. the natural world, and agriculture has been one of a slow transition from small patches of agriculture in a surrounding matrix of natural habitat, to one of small patches of natural habitat embedded in a matrix of agricultural or otherwise human influenced land – e.g. 73% of the land area of the UK is now agricultural (UK 2000 Land Use in the United Kingdom). This trend is likely to continue at the global level over the next 50 years.

Insert Fig. 8.1 Generalized schematic sequence of land-cover changes from before human settlement to the human domination of the landscape

The extent of this trend of extensification of agriculture and transformation of natural systems varies, but for simplicity, the world can be broadly divided into three domains – those were wild lands still predominate, those where an extensive frontier exists between transformed and untransformed land, and those where natural habitat remains only as a mosaic within a predominately transformed agricultural landscape (see Subchapter 8.3.2 below).

There is an obvious, but in fact poorly quantified, two-way interaction between agricultural land and natural systems that has changed significantly as the global “footprint” of agriculture has expanded. Natural systems provide “services” to agriculture both as sources of environmental goods (provisioning services) and also as sinks (regulating services), whilst agriculture now acts a major driver in natural resource degradation. Natural systems provide not only environmental goods and provisioning and regulating services. In Millennium Ecosystem Assessment terms, the most critical services natural systems provide to agriculture are "supporting services"--nutrient cycling, pollination, etc Over the past 50 years, agriculture has gone from being a relatively minor source of off-site environmental degradation to becoming a major contributor to natural resource depletion and degradation, acting through all five of the major recognized threats to global biodiversity, i.e. through habitat loss and fragmentation, invasive alien species, unsustainable use (over harvesting), pollution (especially of aquatic systems) and, increasingly, climate change. This has occurred primarily as a side effect (externality) of the Green Revolution. Although there is some evidence that, in the past, individual societies may have collapsed as a result of undermining their own natural resource base through unsustainable agricultural practices (Diamond, 2005), only since the Green Revolution has it been increasingly observed that agriculture is undermining its own resource base at the global level.

Tilman (1999) estimated that the (almost) doubling of world food production between 1961 and

1999 resulted in a 1.098-fold increase in cultivated land and 1.68-fold increase in irrigation, plus a 6.87-fold and 3.48-fold increase in the global annual rate of nitrogen and phosphorous, respectively. It has been predicted that another doubling of world food production will be required by 2050 (insert ref – FAO?). Based on a linear extrapolation of the recent past, achieving this would require an 18% increase in land under cultivation, a doubling of irrigated land area and a 3-fold increase in nitrogen and phosphorous fertilization. It is unlikely that this linear extrapolation of the past will occur, but it does provide a useful guide to what the major negative global impacts of agriculture might, and how these might be mitigated.

Policy responses to this major trend of natural resource degradation have occurred at international, regional and local levels, as has been documented in other parts of this assessment. An essential component of all necessary policy reforms for mitigating agricultural impacts must be to aim to integrate environmental, natural resource, and biodiversity concerns into policy-making at the highest possible level in order to achieve the necessary facilitation and leverage on lower-level policies. For example, in the European Union the revised EU Sustainable Development Strategy (EUSDS II) includes biodiversity conservation, but still lacks an overarching commitment to the necessary reduction in drivers that other sectoral policies could address in more detail with the stronger mandate provided by the EUSDS II. Further revision of the EU-SDS could provide better integration of the EU's internal and global commitments (WSSD, Doha and Monterrey) and provide better harmonization between different European sustainable development processes (Cardiff, Lisbon, Gothenburg and Johannesburg) and instruments (Extended Impact Assessment and Indicators for Sustainable Development).

High level integration can also be achieved, to some extent, via Multilateral Environmental Agreements (MEAs), for example through the agreed Programme of Work for Agricultural Biodiversity of the UN Convention on Biological Diversity (CBD). A list of agriculture-relevant MEAs is given in Box 8.1.

Insert Box 8.1 International conventions, regimes or instruments with potential to address negative impacts of agriculture

This CBD Agricultural Biodiversity work program focuses on (i) assessing the status and trends of the world's agricultural biodiversity and of their underlying causes, as well as of local knowledge of its management, (ii) identifying and promoting adaptive-management practices, technologies, policies and incentives, (iii) promoting the conservation and sustainable use of genetic resources of actual/potential value for food and agriculture, (iv) assessing the impact of new technologies, such as modern biotechnology in general and Genetic Use of Restriction Technologies (GURTs)

in particular. The work program also has cross-cutting initiatives for conservation and sustainable use of pollinators and soil biodiversity, studies the impacts of trade liberalization on agricultural biodiversity, identifies policy to promote mainstreaming and integration of biodiversity into sectoral and cross-sectoral plans and programs. But the CBD is a framework, or umbrella agreement that requires its constituent Parties to adopt policies and enact legislation for effective implementation of its Decisions.

Even if its Decisions successfully adopted and implemented at national level, there is a danger that the CBD, like many other MEAs, will be continually "running behind the future", as for example with the its 2010 Target, to significantly reduce the rate of biodiversity loss, which has proved to be a useful catalyst for action in some parts of the world (e.g. in the EU), but will not be achieved as a policy target. The scenarios of the Ecosystem Assessment (MA) and, to some extent, this assessment are an important step towards adding a "foresight component" to the implementation of ecosystem-related international treaties scenario analyses.

8.2.2. Policy options for reducing the impacts of climate change and the contribution of agriculture to CC

Agriculture contributes to climate change in four major ways:

- Land conversion and ploughing releases large amounts of stored carbon as CO_2 from original vegetation and soils,
- Carbon dioxide (CO_2) and particulate matter is emitted from fossil fuels used to power farm machinery, irrigation pumps, and from drying grain, etc., as well as fertilizer and pesticide production;
- Nitrogen fertilizer applications and related cropping practices such as manure applications and decomposition of agricultural wastes result in emissions of nitrous oxide (N_2O); and
- Methane (CH_4) is released mostly through livestock digestive processes and rice production.

The share of agricultural sector to total global GHG emissions is 10% for CO_2, 40% through CH_4 and 60% of N_2O making it a significant contributor with a good deal of potential for reduction in emissions in mitigation strategies. Each of these well-known sources of GHG can be mitigated to some extent (see Box 8.2).

Insert Box 8.2: Mechanisms and measures for increasing carbon sinks and reducing carbon dioxide and other GHG emissions in agricultural systems

Many of these mitigation options are “win-win” and should be responsive to policy interventions that remove entry barriers and reduce transaction costs.

For example, lower rates of agricultural extensification into natural habitats and the re-use/restoration of under-utilized or degraded land which has already been cleared, as well as the set-aside of unused agricultural land for secondary could be encouraged through the participation of farmers in emissions trading, Farmers can benefit financially depending on the amount of credits generated through carbon storage projects under some proposed legislation, as is already occurring in the USA. Despite some transaction costs associated with quantifying and maintaining stored carbon, farmers switching to no-till agriculture, for example as the result of use of Roundup ready GM crops, or using cover crops to reduce erosion, could profit financially by selling their credits in an emissions trading market. Agricultural N_2O and CH_4 mitigation opportunities include proper application of nitrogen fertilizer, effective manure management, and use of feed that increases livestock digestive efficiency, but to date, there is little policy or legislation that recognizes the ability of the agricultural sector to provide GHG reductions through N_2O and CH_4 mitigation actions.

Under the Kyoto Protocol Clean Development Mechanism, deliberate land management actions that enhance the uptake of carbon dioxide (CO_2) or reduce its emissions have the potential to remove a significant amount of CO_2 from the atmosphere in the short and medium term. The quantities involved may be large enough to satisfy a portion of the Kyoto Protocol commitments for some countries (but are not large enough to stabilize atmospheric concentrations without additional major reductions in fossil fuel consumption). Carbon sequestration options or sinks that include land-use changes (LUCs) can be deployed relatively rapidly at moderate cost and could play a useful bridging role while new energy technologies are being developed. A challenge remains to find a commonly agreed and scientifically sound methodological framework and equitable ways of accounting for carbon sinks. These should encourage and reward activities that increase the amount of C stored in terrestrial ecosystems but at the same time avoid rewarding inappropriate activities or inaction. Collateral issues, such as the effects of LUC on biodiversity and on the status of land degradation, should be addressed simultaneously with the issue of carbon sequestration in order to exploit potential synergies between the goals of UN conventions on biodiversity and desertification and the Kyoto Protocol. Such measures would also improve local food security and alleviate rural poverty (FAO, 2004).

8.2.3. Policy options for managing and enhancing genetic resources and agrobiodiversity

Historically, extensification of agriculture into natural habitat has been the main negative impact of

agriculture. The principal policy instrument for countering this trend has been the establishment of protected areas, although in reality, this has been very ineffective where prime agricultural land and high biodiversity compete, as can be seen by the under-representation of lowland, fertile land in the majority of current national protected area systems.

Although extensification of agriculture still represents a major threat to biodiversity in many countries, it is diminishing as a global trend, with 70% of the remaining available land for rain-fed agriculture lying in just seven countries (Angola, DRC, Sudan, Argentina, Bolivia, Brazil and Colombia) (Fischer et al., 2001).

Agriculture still benefits from many ecosystem services provided by wild lands, both at local, regional and even global levels. Maintaining sufficient wild land to continue to provide these services must be an integral part of any globally sustainable agricultural system.

Broadly, natural habitats around the world can be divided into three categories, each requiring different, but overlapping or integrated sets of policies to ensure their survival in the long-term. The first category can be defined as “wilderness”, where the majority of the land (or aquatic) area can still be classified as natural and anthropogenic land use has had a minor impact. With the exception of the major tropical rainforest regions of the Amazon, Congo, Indonesia and Papua New Guinea, the majority of these areas are in temperate regions and do not harbor high levels of biodiversity, although they may provide valuable ecosystem services, especially in terms of water supply and carbon sequestration. Establishment of protected areas in these regions is still feasible due to lack of pressure from alternative land use, but even in these areas, design must now consider the external threats arising from climate change, for example increased wild fires, and global transport of pollutants – this is especially important in the temperate and sub-polar regions where rates of climate change are currently fastest and globally-transported pollutants tend to be deposited and accumulate.

The second major category of land could be termed “frontier” where land potentially suitable for agriculture is close to an expanding agricultural system. Effective policies for conservation of natural resources in areas of agricultural expansion are difficult to design and implement. In most countries, nature protection policies are still based on the establishment of systems of protected areas on the basis of ecosystem representation and species richness alone, and there is an urgent need to also consider defensibility (*sensu* Peres and Terborgh, 1995) sustainability in terms of local community support, and resilience in the face of climate change as key components of protected area system design.

A key underlying feature of different attempts to soften the interface between natural lands and agricultural is large-scale, integrated landscape planning based on improved mapping (GIS) of alternative land-use values and the use of software to support multi-criteria analysis and decision-making. Increasingly, improved methods of measuring and mapping the total ecosystem value of natural land are allowing land-use planners and land-holders to make economic decisions which are based on a broader range of criteria than agricultural production alone. This in turn is allowing policy-makers to introduce land-use planning "rules" (zoning) and economic incentives to better conserve natural land in complex agricultural land-use mosaics.

At a relatively large scale, this kind of planning is increasingly emerging in the Brazilian Amazon (Campos and Nepstad, 2006) and Atlantic (Wuethrich, 2007) rainforests, where government and land-holders are slowly forging agreements on establishment of a complex mosaic of protected areas, sustainable use forests and agricultural land. This represents a shift in policy away from prescriptive land use decisions made by the imposition of protected area on unwilling land-users. Recently, Chomitz et al., (2006) have modeled the use of fixed payments, or auction bids for direct payments for conservation services such as native forest protection, reforestation, and restoration of riparian vegetation in Bahia, Brazil. Eligible landowners voluntarily decide whether to apply for participation, and the resultant conservation network emerges as a consequence of many independent choices about participation. Similar incentive-based schemes may be found in the US Conservation Reserve Program (CRP), the BushTender program in Austalia and the Costa Rica Environmental Services Payment program (refs in Chomitz et al., 2006).

In the more "crowded" landscapes of Europe and the west coast of the USA, where remaining natural land exists in an agricultural and urban matrix rather than the converse, similar trends towards land use planning based on ecosystem service valuation and "multifunctionality" are being explored.

In California, Chan et al. (2006) have used a spatially explicit conservation planning framework to explore the trade-offs and opportunities for aligning conservation goals for biodiversity with six ecosystem services (carbon storage, flood control, forage production, outdoor recreation, crop pollination, and water provision) in the Central Coast ecoregion of California, United States and found that, although there are important potential trade-offs between conservation for biodiversity and for ecosystem services, a systematic planning framework offers scope for identifying valuable synergies.

In Europe, agri-environment subsidies have been used as incentives to maintain and promote biodiversity-friendly land-use on agricultural land. Whilst it is clear that schemes do maintain land

under the management regimes specified, there has been some criticism that the schemes do not deliver all of the environmental and biodiversity benefits for which they were designed, especially as the scale of implementation becomes too small and fragmented (Whittingham, 2007). One way to avoid this is the adoption of regional planning approaches, as in the OECD environmental farm plan programs (Manderson et al., 2007) in order to generate more coordinated land use patterns across larger landscapes.

Chomitz (2007) recently summarized the policies needed for sustainable development at the interface between tropical forest and agriculture, and these neatly encapsulate the policy responses needed to promote the trends described above:

At the international level:

- Mobilize carbon finance to reduce deforestation and promote sustainable agriculture.
- Mobilize finance for conservation of globally significant biodiversity.
- Finance national and global efforts to monitor forests and evaluate the impacts of forest projects and policies - including devolution of forest control.
- Foster the development of national-level research and evaluation organizations through twinning with established foreign partners.

At the national level:

- Create systems for monitoring forest conditions and forest dwellers' welfare, make land and forest allocations and regulations more transparent, and support civil society organizations that monitor regulatory compliance by government, landholders, and forest concessionaires. The prospect of carbon finance can help motivate these efforts.
- Make forest and land use regulations more efficient, reformulating them to minimize monitoring, enforcement, and compliance costs. Economic instruments can help.

In wilderness areas:

- Avert disruptive races for property rights by equitably assigning ownership, use rights, and stewardship of these lands.
- Options for forest conservation include combinations of indigenous and community rights, protected areas, and forest concessions. Still, some forest may be converted to agriculture where doing so offers high, sustainable returns and does not threaten irreplaceable environmental assets.
- Plan for rational, regulated expansion of road networks—including designation of roadless areas.
- Experiment with new ways of providing services and infrastructure to low-density

populations.

In frontier areas:

- Equitably assign and enforce property rights.
- Plan and control road network expansion.
- Discourage conversion in areas with hydrological hazards, or encourage community management of these watersheds.
- Use remote sensing, enhanced communication networks, and independent observers to monitor logging concessionaires and protect forest-holders against encroachers.
- Consider using carbon finance to support government and community efforts to assign and enforce property rights.
- Encourage markets for environmental services in community-owned forests.

In disputed areas:

- Where forest control is transferred to local by communities, build local institutions with upward and downward accountability.
- Where community rights are secure and markets are feasible, provide technical assistance for community forestry.
- Make landholder rights more secure in “forests without trees.”
- When forest tenure is secure, use carbon markets to promote forest regeneration and maintenance.

Mosaiclands:

- Reform regulations so that they don’t penalize tree growing. Promote greener agriculture—such as integrated pest management and silvopastoral systems—through research and development, extension efforts, community organization, and reform of agriculture and forest regulations.
- Develop a wide range of markets for environmental services—carbon, biodiversity, water regulation, recreation, pest control— to support more productive, sustainable land management.

8.2.4. Policy options for managing water scarcity, water quality and the distribution of water

An estimated 510,000 km^3 of water falls to Earth as rain, snow and sleet each year. Roughly 400,000 km^3 falls on the seas and 110,000 km^3 falls on land, with very uneven temporal and spatial distribution patterns. Rain falling on land can be classified into two categories. The first, green water, is soil moisture available for root water uptake by plants and is the main water resource for rainfed agriculture. The second, blue water, is the stored runoff of rainfall in lakes,

streams, rivers, dams and aquifers (i.e. water-bearing layers of permeable rock, sand, or gravel that store and/or transmit water). It is the main water resource for irrigated agriculture. Of the 110,000 km3 that fall on the land annually, an estimated 35% result in blue water and 65% in green water (SIWI et al, 2005; Falkenmark and Rockström, 2005).

Out of the world's total land area of 13 billion ha, 12% is cultivated, and an estimated 27% is used for pasture. The 1.5 billion ha of cultivated land includes 277 million ha (18%) of irrigated land. An estimated 7,130 km^3 of water are used each year for crop production globally, corresponding roughly to 3,000 litres used to feed a single person for one day (Molden et al., 2007a). Most of this water consumed by crop evapotranspiration comes from rain (about 80%) and about 20% is from irrigation.

Apart from its use for irrigation, blue water is important as the freshwater resource sustaining aquatic ecosystems in rivers and lakes, and as a source of drinking water or for domestic purposes, industry or hydropower. It has been estimated that a minimum of 30% of the average streamflow of a water course must be maintained to ensure ecological health (Jury and Vaux 2005). The amount of blue water withdrawn for human use at the global level increased four-fold from over 500 km3 in 1900 to just under 2,000 km3 in 1960 and doubled to almost 4,000 km3 today. Seventy percent of this water is used for agriculture, mainly irrigation, although the part diverted for industrial (20%) and domestic (10%) purposes is growing rapidly (Molden et al, 2007a).

The amount of blue water withdrawn annually varies widely in different parts of the world, for example, from over 1,500 m3 per person in Turkmenistan, Uzbekistan, Kazakhstan, Azerbaijan, Krygystan, Tajikistan, Iraq and the United States down to less than 20 m3 per person in many African countries such as Benin, Uganda and Rwanda (AQUASTAT database).

Many countries are withdrawing water at rates that are not sustainable. Molden et al (2007a) report that 1.2 billion people live in areas characterised by physical water scarcity, where available resources are insufficient to meet all demands, including minimum environmental flow requirements. Molden et al (2007a) estimate that 7,130 km3 of water are currently used each year to feed the world's population and it is estimated that, without further improvements in water productivity or major shifts in production patterns, the amount of water consumed by evapotranspiration in agriculture will increase to between 12,000 and 13,500 km3 to feed the increased population in the year 2050 (de Fraiture et al, 2007).

In addition, whereas 49% of the world's population is estimated to reside in urban areas in 2005, this proportion is predicted to rise to 60% in 2030 (UN, 2006). There will therefore be far greater demands on the blue water withdrawn for human purposes for domestic use and for industry and the proportion remaining for agriculture is likely to decline. Jury and Vaux (2005) note that the economic value of water in industrial and urban uses is typically far greater than in agriculture (or for environmental uses), so “free” market forces will likely lead to reallocation of water resources from both the agricultural and environmental sectors to the urban sector.

The broad policy recommendations which can be made for improved water management in the agricultural sector have there roots in the same fundamental paradigm shift that is required for all aspects of sustainable development – full cost accounting and recognition of the multi-functionality and interdependence of landscapes. Reforms in water policy must therefore recognize both direct and indirect goals (Lohmar et al, 2003).

Improve investment in sustainable surface water delivery to stop aquifer water-mining. In general, around the world, declining investment in surface-water infrastructure in the late 1970s and early 1980s has resulted in growing reliance on and competition for ground water. Policy changes should increase investment in irrigation systems, especially those that target rather than new construction, and foster management practices that encourage financial self-sufficiency

Establish and strengthen the authority of agencies administrating large water systems that cross traditional administrative boundaries. These reforms are needed at all jurisdictional levels, from local to national level, and even at regional level.

Better integration of water use between agricultural and industrial users. Water use by agriculture can limit the amount available for other uses when water becomes scarce. Industrial and domestic use can also affect agriculture, for example, the discharge of untreated wastewater from urban areas into surface-water systems can decrease the quality of water used in irrigation.

Careful implementation of water pricing to induce water-saving adaptations where this does not increase farmer debt. Water markets are playing an increasingly important role in the developed world in allocating water on a regional basis. There are examples in which government has used markets or market-like arrangements to resolve vexing problems of allocation. .

Encourage water-saving irrigation practices and technology. Farmers have only begun to adopt water-saving practices. Low levels of adoption of water-saving may be because the knowledge and incentives are not in place for farmers to benefit directly by saving

water.

Reform of irrigation management to involve local stakeholders. The establishment of Water User Associations and contracting the management of lateral canals to individuals can improve water management by providing incentives for users and managers to conserve water and improve fee collection to increase irrigation revenues.

Change cropping patterns to reduce water demand and to tolerate limited water deliveries, even if irrigated acreage is maintained. High-value, water-efficient cash crops may expand acreage in the face of water shortages, since these are often more suited to water-saving irrigation practices, bring a higher return to water used in agriculture.

Further “coping” strategies proposed for addressing water scarcity include:

a) *Desalinisation*: Currently, the costs of desalinated water remain too high for use in irrigated agriculture, with the exception of intensive horticulture for high-value cash crops, such as vegetables and flowers (mainly in greenhouses), grown in coastal areas (where safe waste disposal is easier than in inland areas), but recent advances in membrane technology are reducing costs. At the global level, the volume of desalinated water produced annually, estimated at 7.5 km3, is currently quite low, representing about 0.2% of the water withdrawn for human use (FAO, 2006b).

b) *Urban wastewater*: Millions of small-scale farmers in urban and peri-urban areas of developing countries use wastewater for irrigating crops or forest trees or for aquaculture, reducing pressure on other freshwater resources. Surveys across 50 cities in Asia, Africa and Latin America have shown that wastewater irrigation is currently a common reality in three-quarters of cities (IWMI, 2006). Most domestic wastewater generated in developing countries is discharged into the environment without treatment but the dominant trend is for more wastewater treatment as countries develop national integrated water resources management plans or improved environmental policies, for example in Mexico, Brazil, Chile and Costa Rica (UNCSD, 2005). Israel currently uses 84% of its treated sewage effluent in agricultural irrigation and in a few cities, such as Windhoek in Namibia, the water is treated to a very high standard so that it can even be used as drinking water (UNIDO, 2006).

c) *Virtual water and food trade*: The import of food from water-rich countries allows water-poor countries to save water they would have used to grow food themselves, equivalent to the import of 'virtual water', and scarce water reserves can be used for more valuable domestic,

environmental and industrial purposes. Countries with limited water resources might also change their production patterns to prioritise production of agricultural commodities requiring less water and to import those requiring more water (FAO/IFAD, 2006). While the strategy of importing virtual water is appealing from a water perspective, it can have wider political and economic implications for importing countries.

d) Increasing agricultural yields: Any agronomic improvements to improve overall productivity will reduce the global "water footprint" of agriculture. This could be achieved by, for example, improving the efficiency of fertiliser use; preventing crop productivity losses due to insects, diseases and weeds; or reducing post-harvest losses due to insects, fungi and bacteria.

e) Improving the efficiency of water use in agriculture

Hsiao et al (in press) identified a number of key points at which efficiency gains could improve overall water use efficiency in irrigation agriculture. These include:

i) moving water from "reservoir", where water is stored temporarily, including lakes or rivers, to the farm gate. Efficiency could be increased by e.g. covering water channels or repairing any holes in the pipes.
ii) moving water from the farm gate to the field. The efficiency of this step could be increased by lining on-farm water reservoirs with plastic sheeting to reduce water leakage.
iii) moving water from the field edge to the root zone of the crop. Efficiency of this step could be increased by improving management of the existing irrigation system or changing to a better irrigation system, for example, via deficit irrigation, where water supply is reduced below maximum levels and mild plant stress is allowed but with minimal effects on crop yield (FAO, 2002).
iv) removal of water in the root zone by evapotranspiration.
v) use of the water removed by evapotranspiration for crop transpiration. Efficiency could be increased by promoting plant canopy growth to cover the soil (thus reducing water evaporation).
vi) Assimilation of carbon dioxide by photosynthesis. Transpiration efficiency is influenced by factors such as the species being cultivated (as different species carry out photosynthesis in different ways) or the location of the crop (e.g. the temperature/humidity where it is cultivated)
vii) Conversion of the assimilated carbon dioxide to crop biomass (i.e. the leaves, stems, roots, grains etc.). Biomass efficiency could be increased by e.g. growing the crop at lower temperatures (e.g. in a cooler location or part of the year) so that loss of the assimilated carbon dioxide by respiration could be reduced.

viii) Partitioning the crop biomass. Yield efficiency (harvest index) will vary according to the species involved e.g. it is almost 1 for fodder crops and about 0.5 for grain crops. It has increased over the last century as a consequence of genetic improvement.

8.2.5. *Policy options for managing the natural resource base of agriculture – soils, nutrients, water, pests*

Pests: invasive alien species. Invasive aliens species (IAS) are probably the second largest single threat to global biodiversity and can have devastating effects on both agricultural and natural systems at large scales after small isolated introductions. A major policy challenge from IAS is the fact that the vast majority of current and future IAS was either unknown species, or was unknown as pests, before their introduction to a new location. This is the main reason for the failure of past policies to deal with IAS, even those using the best available risk assessment methodologies (Keller et al., 2007).

Future IAS policies should be based on the following principles in order to mitigate this weakness.

- National IAS systems should be linked to regional and global databases of known IAS and their treatment;
- IAS control systems should be based on a pathways of entry approach (Introductions of IAS occur through various channels or "pathways", both intentionally and unintentionally. Primary pathways of intentional introductions into SIDS include horticultural products, food products, and exotic pets, the use of non-nativeorganisms in aquaculture and for restocking of marine and inland water systems for commercial and recreational fisheries; scientific research; horticulture; trade in pets and aquarium species; biocontrol agents; and ex situ breeding projects. Pathways of unintentional introductions include ballast water and ballast sediments, ship hulls, packaging materials and cargo containers, garbage and waste, international assistance programs; tourism; military activities, and unprocessed materials, such as timber.)
- where detection and control effort is focused on the most likely points of entry into a country (or region).
- Risks posed by pathways of IAS prior to introduction and establishment should be addressed and mitigated both before the IAS reach the border and at the border (Preventing introductions before they occur is the most effective and cost-efficient approaching to addressing IAS issues. Removing IAS once they have become established requires significantly more financial, technical, and personnel resources than preventing their introduction; and, often, complete removal is not even possible.)
- An operating principle of the system should be that it is based on a "white" list of approved species for deliberate introduction, and that any species not on the "white" list must pass through a risk assessment process before being approved for entry.

A number of policy initiatives have been undertaken for specific major pathways of introduction including:

Ballast water: The International Convention for the Control and Management of Ships' Ballast Water and Sediments was adopted under the IMO in 2004. The treaty's preamble specifically cites the CBD's objectives and a number of its relevant decisions on IAS addressing the sustainable use of biodiversity and marine resources (Decision IV/5) and the guiding principles on IAS (Decision VI/23). The treaty requires, among other measures, that each ship develop and implement a ballast water management plan to control IAS introductions through ballast water and sediment discharge.

Solid Wood Packaging Material (SWPM): The International Plant Protection Convention (IPPC) has developed a standard (ISPM-15) to address the broader pathway of unprocessed wood widely used as packing material, in crates, dunnage and other forms. The standard, which has been adopted by a large number of countries (see http://www.ispm15.com/), requires that such wooden packaging material be treated through kiln-drying, chemical pressure impregnation or fumigation with methyl bromide. Future policy changes might replace the use of methyl bromide, a known ozone depleter, or promote the use of substitute materials (e.g., particle board, plastic, aluminum) that cannot harbor IAS, and are more recyclable.

Importation of living plants and plant material: Many attempts are being made to address plant-related pathways of invasive species. One voluntary initiative, based on the Missouri Botanic Garden`s St. Louis Declaration, is developing and implementing self-governed and self-regulated codes of conduct for nursery professionals, government agencies, the gardening public (specifically Garden Clubs), landscape architects, and botanic gardens/arboreta, designed to stop use and distribution of invasive plant species. Working with these respective industries, the process has generally appealed to the responsible use and import of horticultural products by the private sector to minimize the introduction of IAS. There is an urgent need for the IPPC to more effectively address, perhaps through aa quarantine/sterilisation-based ISPM, based the problem of "hitchhikers" on horticultural products, which are potential IAS, but may not be considered plant pests per se (e.g., spiders, ants).

- Aquaculture: the U.N. Food and Agriculture Organization has a Code of Conduct for Responsible Fisheries, which includes a section addressing aquaculture that encourages use of legal and administrative frameworks to promote responsible aquaculture, including discussions with neighboring states prior to the introduction of nonindigenous species, minimizing the impacts of nonindigenous or genetically altered fish stocks, as well as minimizing any adverse genetic or

disease impacts. While the Code serves as a useful guide, it is not focused on specific prevention, management and control measures related to IAS within the field of aquaculture and fisheries.

- Clean Cargo, Green Freight: A group of transnational companies developed the “Clean Cargo, Green Freight” initiative under the umbrella of Business for Social Responsibility. The process has developed an environmental performance survey designed to incorporate environmental criteria into their ocean shipping activities, while also addressing emissions related to climate change. While only a few of the criteria, such as those on ballast water, relate directly to IAS pathways, sections on hull coatings, container management, waste management, facilities, environmental management, and awareness and training, could be expanded to include IAS concerns.

Given the role of trade in the production and transport of goods, approaches to regulating pathways of IAS should consider relevant trade rules and agreements. The World Trade Organization’s (WTO) Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) defines the basic rights and obligations of WTO members regarding use of sanitary and phytosanitary measures to: protect human, animal or plant life or health from the entry, establishment or spread of pests, diseases, disease carrying organisms; and prevent or limit other damage from the entry, establishment or spread of pests. Members can take measures to the extent necessary provided that they are: based on scientific principles; maintained with sufficient scientific evidence; and consider economic factors while minimizing negative trade effects.

The WTO recognizes the IPPC, the International Office of Epizootics (OIE), and other relevant international and regional organizations as authoritative standard-setting bodies. To promote harmonization in international trade, the WTO supports use of these standards by its members to facilitate commerce and customs procedures, although countries can establish higher levels if they are scientifically justified. Generally, the IPPC addresses measures regarding pests and any plant, plant product, storage place, packaging, conveyance, container, soil or other potential carrier of pests, which are to be based on a pest risk analysis, addressing both environmental and economic factors. The IPPC also involves a number of regional plant protection organizations, which address issues of regional coordination and geographically specific plant pest issues. The OIE addresses measures related to animal health and food safety, which serve to: inform states of animal diseases and means to control them; coordinate studies on the surveillance and control of animal diseases; and harmonize regulations for trade in animals and animal products among member states.

Insert Figure 8.1. Generalized schematic sequence of land-cover changes from before human settlement to the human domination of the landscape

Insert Box 8.1. International conventions, regimes or instruments with potential to address negative impacts of agriculture

Insert Box 8.2. Mechanisms and measures for increasing carbon sinks and reducing carbon dioxide and other GHG emissions in agricultural systems

8.3 Trade and Markets

Agriculture and sustainable development. This sub-chapter considers policy options for structuring trade regimes and market relations so that they may be compatible with and support development, poverty alleviation and environmental protection objectives. We start from the premise that trade and market policies with the objective of supporting the rural farm sector and rural livelihoods are central to effective development strategies. The objective of this subchapter is to review policy options that could institutionalize mechanisms to make trade better address the IAASTD objectives of improving rural livelihoods, protecting the environment and promoting sustainable development.

Agriculture is widely agreed by many observers to be a critical driver of development in many countries (Hazell and Dialo, 2005). Rural poverty acts as an obstacle to development by diminishing the domestic market for domestic industry (Rosset, Collins and Lappe, 1998). Moreover agriculture can provide multiple public goods including food security, employment, and the conservation of natural resources including for example, biodiversity and watersheds (McCalla and Nash, 2007).

Major global market trends, along with multi-lateral, regional and bilateral trade agreements, are rapidly changing the market environment in developing countries. Small-scale producers need to find increasingly competitive and innovative means of engaging with markets if they are avoid a continued situation of receiving extremely low incomes and being locked into long-term poverty.

Market power in agricultural production, processing and distribution both shapes global trade and investment rules and is shaped by those rules. The downward pressure on tariffs, for example, has opened up markets in ways that favor enterprises that can do business on a global scale. The policy trend away from government involvement in markets, in the form of commodity boards, quantitative restrictions on imports, price stabilization policies and capital control, among other

measures, has changed the nature and accessibility of markets for farmers, especially small-scale farmers, around the world.

In globalized commodity chains, farmers are small players; most value added is post-farm-gate. For example, for each pound of melon produced by a small Salvadoran farmer for example the farmer reaps approximately 0.6% of the revenue; the rest accrues off farm. Seventy-five per cent of the value goes to US shipping, wholesaling, advertising and retailing. (Conroy, Murray and Rosset, 1996)

Increased trade flows at these prices, the result of a steep 40 year decline in aggregate agricultural commodity export prices, is neither economically sustainable nor desirable for realizing development objectives. Adding to this situation is that the anticipated increase in a limited number of commodity prices as a result of interest in bioenergy carries significant policy dilemmas for food insecure countries tempted to use food crop hectares for bio-energy crop production.

There are likely to be significant trade-off between various policies to promote agricultural development, such as the reduction of agricultural subsidies and increased investment in roads to help rural farmers, and environmental and social impacts such as increased tropical deforestation and increased agricultural land concentration in some parts of the developing South.

The possible trade-off between agricultural liberalization and increased energy consumption for agricultural transport is frequently noted. Similarly and trade-offs between increasing commodity prices and diverting productive agricultural land to biofuel production will need special attention by policy makers and other interested stakeholders.

Winners and losers from liberalized trade: evidence to date. Although the conclusions and related policy options derived from research on trade and market policy are notoriously controversial and susceptible to manipulation (Banerjee et al., 2006) there is significant agreement in the literature on a number of key issues.

First, the gains from all trade scenarios including those produced by the World Bank (Anderson et al, 2006) are projected to be relatively modest. There are both net winners and losers under different scenarios. The poorest countries are among the net loser under all scenarios; moreover not all developing countries benefit equally from liberalized trade. (Polaski, 2006; Anderson et al, 2006; Jaramillo and Lederman, 2005). “In per capita terms, Anderson et al. find that the benefit to the developing countries is more than $17 per person per year, or almost $.05 per person per

day. In high-income countries, the benefit of complete liberalization would amount to nearly $200 per person per year, or $.53 per person per day. (Wise, 2004)" The cost of displacement of rural agricultural livelihoods and labor force is not taken into account, since the model assumes full employment and the ability of rural labor to immigrate to the cities and find employment, an assumption far from reality in most countries. Lost tariff revenues are significant (estimated losses range up to $63 billion for developing countries following the most "ambitious" scenario for the non-Agricultural market Access negotiations (Cordoba and Vanzetti, 2005).

Second, it is generally agreed that among developing countries about 90% of the gains from the current Doha scenarios would come from liberalization of trade in manufactured goods (Polaski, 2006; Anderson et al, 2006).

Third, within developing countries the distribution of benefits and risks from increased trade is highly uneven. "[T]here is a general consensus that the trade agreements, reforms and policies adopted throughout Latin America and the Caribbean within the last ten to fifteen years have had uneven impacts, with many of the benefits concentrated in the hands of the elite few, while the poorest often bear the brunt of the ills wrought by greater exposure to the world market." "The fact is that trade liberalization has not reduced poverty nor inequity. And clearly there are winners and losers." (IADB, 2006)

Estimates of gains that might be received by developing countries include incomes that will be received both by the poor, and by other income groups and business interests in the same countries. "The billions of dollars that are projected to flow to Brazilian agriculture if trade were fully liberalized include gains for the country's poorest rural workers, and for its wealthy ranchers, plantation owners, and agribusiness." The analyses published don't tell us how much of these gains may help alleviate poverty, versus being captured by local agribusiness and elites (Ackerman, 2005).

Fourth, increased global trade tends to exacerbate several kinds of environmental impacts. Several different classes of environmental impacts related to increased agricultural trade are frequently noted, including environmental damage caused by long-distance transport; increased use of synthetic inputs; and increased specialization and monoculture production which can decrease agrobiodiversity. Moreover, trade agreements can constrain individual countries' abilities to adopt stronger national environmental (and food safety) standards than those harmonized international standards that are deemed trade-legal; this can exert a chilling effect on the adoption of stronger national regulations.

Some of these impacts derive from the failure of markets to account for and internalize environmental and social harms in the price of traded agricultural and other products. For example, growth in global trade depends on high fossil fuel use in production and transportation that contributes to climate change/crisis; there are currently very few market signals and mechanisms to either internalize this (and other) environmental externalities, or to signal the need for a policy change. The end of cheap energy, climate change and worsening water shortages may require policies to significantly change the course of traditional trade liberalization (Broad and Cavanaugh, 2006).

8.3.1 Governance issues

This subchapter addresses a suite of governance issues, in trade and environmental decision-making, including the democratization of global trade regimes, as well as international competition policy to govern corporate power over commodity markets and promote more equitable distribution of agricultural rents that could help drive development and improve rural livelihoods. The subchapter also reviews policy options for international instruments (agreements and intuitions) to assess the impact of proposed trade agreements and emerging technologies against the IAASTD goals; these processes, including strategic impact assessments of proposed trade agreements and comparative technology assessments, could help educate policy makers and stakeholders, increase transparency, and assist in making decisions that would support development goals.

8.3.1.1 Governance of trade and environmental decision-making

It is widely noted that the economic and environmental costs and benefits of globalized trade are not equitably distributed; the weight of the evidence indicates that the lion's share of economic benefits accrues to the developed countries, while the developing world shoulders the social and environmental burdens. Since many developing countries have abundant natural resources and cheap labor, trade liberalization has fostered a shift toward labor and resource-intensive sectors such as mining, logging, and export crop production. These sectors generate significant environmental "externalities." The results of ignoring the true environmental and social costs of production include the marginalization of rural communities, and excessive resource consumption, production and pollution (Wood, 2001).

If trade negotiation processes were made more transparent, social and environmental concerns would likely be better represented in the resulting agreements. The principles of good governance, such as representation, transparency, accountability, access to information and systematic conflict resolution should be fully internalized and implemented by international trade and environmental institutions (Stiglitz, 2006). Developing countries, which often lack personnel

and institutional capacity to deal with the complexity of trade negotiations (some don't even have a Geneva mission) are at a distinct disadvantage negotiating for the interests of their rural sectors in these fora, and often lack capacity to analyze important and highly complex issues, to develop negotiating positions and to respond quickly and effectively to their various negotiating teams. Civil society participation is limited from negotiations through dispute resolution process, much of which takes place behind closed doors.

Policies to strengthen developing country negotiating capacity in trade talks are important. Trade capacity development, as a part of "aid for trade" packages, are one option. Consideration may also be given to establishing national and regional teams of experts with the necessary authority to analyze the interests of their stakeholder groups and to establish appropriate negotiating positions. The negotiators need to be directly linked the policy analysis groups and to the line Ministries of Trade, Agriculture and Finance, such that informed decisions can be made rapidly and effectively.

Another option to help increase transparency and multi-stakeholder participation in the rule-setting process, and democratize domestic trade policy formulation, is to develop CSO consultative committees to support negotiators, giving farmer organizations, business and NGOs the opportunity to provide valuable input and support negotiators. A number of countries, for example Kenya, the Philippines and India, have created national consultative committees to the WTO. (Murphy, 2006)

Finally, observers frequently note that globalization has constrained the state's ability to make unilateral policy decisions to promote sustainable development (Panayatou, 2000). Moreover there is no comparable global environmental organization with the profile and enforcement mechanisms of the World Trade Organization. Without effective global environmental governance, nation-states, subject to the pressures of globalization, may drift towards a low-level environmental policy convergence that is insensitive to local ecological conditions and does not respect the diversity of preferences and priorities across and within nations (Myers, 1998; Zarsky 1997). The creation of a Global Environmental Organization has been proposed as one policy approach to address this significant global governance deficit (Esty, 1994).

8.3.1.2 International competition policy and anti-trust: governing commodity markets to promote development goals

Vertical and horizontal concentration in global commodity markets is a primary cause of market distortion. Possible policy responses include an international review mechanism for proposed

mergers and acquisitions among agribusiness companies that operate in a number of countries simultaneously (Stiglitz, 2006), the establishment of international competition policy, and the re-establishment of state trading enterprises.

One of the major anti-competitive effects of globalization has been a rapid concentration of market power away from producers into the hands of a limited number of trade and retail companies (Vorley, 2004). Corporate concentration in food and agriculture sectors continues to increase. In many cases, major supply chains are now dominated by four to five trans-national trading companies and their market share is growing. What looks like buying and trading between countries is often the redistribution of capital among subsidiaries of the same parent multinational corporation (Shand, 2005). As a result, the negotiating power within agricultural chains, over the past 20 years has moved rapidly away from the producer end of the market chain. The first level of consolidation was made at the wholesale level through a series of mergers, acquisitions and take-overs that reduced the number of international traders from hundreds of family based enterprises to a handful of international trade houses that dominate particular commodities, such as Archer Daniel Midland, Unilever and Cargill.

This situation means that even when farmers organize and aggregate, produce quality goods, and sell collectively, they have insufficient volumes of sale to negotiate effectively with four to five giant corporations. There is increasing concern that lack of competition in the marketplace is having seriously negative social effects on agricultural producers; the most vulnerable are the poorly organized, resource poor farmers in developing nations. This is an issue of major political concern and policy options other than breaking up large organizations, such as happened to Standard Oil in the United States, are unclear. Standard Oil though, was under the jurisdiction of the United States Government. In the era of globalization though, it is no longer clear which legal regimes can apply to transnational corporations and their global operations.

Insert Figure 8.2. Market concentration offers fewer opportunities for small scale farmers

Vertically integrated corporations can use their market power to depress prices for inputs and simultaneously raise prices for final products, this corporate concentration along the agricultural and agri-food value chains which has a significant impact on international commodity prices. These same corporations can have significant political influence upon government agricultural sector policy making and trade policy. (Wise, 2004; Murphy, 2006)

One approach to address this imbalance in trade relationships is the establishment of international competition policy in the form of multilateral rules on restrictive business practices.

Increasing integration and concentration throughout the supply chain allows multinational agribusiness to act as a near cartel, modify commodity demand-price relationships, and increase market power of the transnational trading, processing and retain companies which can set near monopoly rules in which small farmers continue to lose share of food rents (IISD, 2005.) A potential model for this approach is the French law (*Loi Galland*) which prohibits selling at a loss and "excessively low prices."

Another policy option that is widely noted is the reintroduction of price bands as a means of cushioning the impact of world price instability (Vorley, 2005). For example Chile's Free Trade Agreements with EU and Canada allowed it to keep its agricultural price band which was designed to stabilize import costs of agricultural staples (including wheat, sugar, oil) through adjustment to tariffs on such with the objective of allowing a fair rate of return to Chilean farmers even if they were competing with heavily subsidized US farmers (Choudry, A. 2004). In contrast the US-Chile Free Trade Agreement committed Chile to phase out its agricultural price band system. An international competition policy framework might also include creation of an independent UN agency to address some of the issues that UN Center for Transnational Corporations used to address (Vorley, 2005).

Finally, the re-establishment of state trading enterprises (STEs) is a widely noted policy option. Export state-trading enterprises offer a competitive counterweight to concentrated export markets. STEs have real costs and it is widely acknowledged that they have been marred by corruption and cronyism in some countries. Nonetheless, properly overseen and controlled by farmers organizations, they offer important benefits, especially in developing countries where the private sector is under-capitalized (Stiglitz, 2006). Nonetheless, STEs can potentially provide a useful counterbalance to the market power of global agribusiness thereby increasing competition. STEs may be only market for producers in remote areas of developing countries, and governments can insist that STEs provide this service, whereas they cannot demand it of private corporations (Murphy, 2006).

Current WTO rules require that governments complete questionnaires about any state trading enterprises (STEs) operating in their country, but no similar requirements apply to transnational agribusiness, although they may control a significant share of global trade in a particular commodity. This information generation requirement could be expanded to include any company – private or public – with, for example, more than a given percentage of the import or export market. This information could be gathered by the WTO or under the auspices of the UN Conference on Trade and Development (UNCTAD) which has a long-standing mandate to monitor restrictive business practices. (Murphy, 2006)

8.3.1.3 Strategic impact assessment and comparative technology assessment

There is often a dearth of information on the potential social and economic benefits and risks of proposed trade agreements and emerging technologies alike. Policy approaches to redress this issue include Strategic Impact Assessment of trade agreements and Comparative Technology Assessment for emerging technologies.

SIAs have provided early warnings as well as research evidence that failing to mitigate negative environmental effects can substantially reduce net economic and welfare gains from trade (IISD, 2005). In this way, these assessments can provide critical information to governments and stakeholders allowing them to consider whether or not to reject or mitigate a trade policy proposal that is likely to worsen poverty, inequity or environmental degradation in certain sectors.

Strategic impact assessment (SIA) of trade agreements, which have been undertaken for regional agreements such as NAFTA as well as multiple EU trade agreements, aim to give negotiators a fuller understanding of potential environmental impacts in their own countries, such that they may be taken into account alongside the economic and social considerations on which trade negotiations have traditionally been based. The fuller information on environmental issues enables negotiators to make more reliable trade-offs, in those cases where the effects do not provide win-win outcomes for national and international economic, social and environmental concerns.

The European Commission for example has defined the goal of SIA as generating information to integrate sustainability into European trade policy by assessing a proposed trade agreement's potential impacts on sustainable development. SIAs, which are public documents, inform negotiators and interested stakeholders of the possible social, environmental, and economic consequences of a trade agreement; provide analysis that will help maximize benefits of the agreement through better management of environmental, social and economic resources; and inform the design of policy options, including capacity building and international regulation, that may maximize the benefits and reduce the negative impacts of the proposed trade agreement. (George and Kirkpatrick, 2003)

Another noted policy option to increase information and transparency is the establishment of an intergovernmental framework for the comparative assessment of new technologies as they evolve from initial scientific discovery through to possible commercialization.

For example, observers have noted that rapid developments in nanotechnologies and nano-material production may out-compete developing countries' primary commodities in international markets in the near and mid-term (ETC Group, 2005). All stakeholders, perhaps especially including developing country governments that are negotiating market access for their agricultural commodities and raw materials in various multilateral, regional and bilateral agreements, could be provided with information on how future technology development may affect them and the markets that are essential for their economies.

The potential benefits and risks of nanotechnologies present an example of the benefits for the realization of the IAASTD goals that a technology assessment agreement or agency might afford. There has been considerable reporting and analysis of the potential benefits of nano-scale technologies for developing countries, particularly with regard to water and energy. The potential health and environmental risks of this new technology platform, as well as nanotechnology's potential impacts on commodity markets and the social and economic disruption that may cause, are less well studied. Nanotechnologies are still very new; nonetheless if a new engineered nano-material outperforms a conventional material, including for example cotton textiles, copper or rubber, that are key commodities for developing country economies, significant economic dislocation may result. (ETC Group, 2005)

Emerging nano-scale technologies require scientific, socioeconomic and societal evaluation in order for governments to make informed decisions about heir risks and benefits. To keep pace with technological change and the potential associated socio-economic, health and environmental impacts, comparative technology assessment could help policy makers and stakeholders monitor and assess the introduction of new technologies.

One policy approach might be to reinvigorate the Capacity of the UN System to Conduct Technology Assessment for Development. The UN Commission on Science and Technology for Development has become a subsidiary body of the Economic and Social Council, where it operates with greatly reduced staff and funding. This commission could be strengthened, or another specialized UNE agency could be given the mandate to both conduct technology assessments and build capacity in developing countries to assess technologies, with the goals of promoting poverty reduction, health and environmental protection, and sustainable development. (ETC Group, 2005)

Another policy option could be the establishment of a legally-binding multilateral agreement on comparative technology assessment, potentially negotiated through a specialized agency such as UNCTAD, the ILO ECOSOC's Commission on Sustainable Development. The objective of such

a convention would be to provide an early warning and assessment framework capable of monitoring and assessing emerging technologies in transparent processes and their potential benefits as well as costs and risks for human health, the environment, and poverty reduction and development. At the same time, such an agreement might help to generate information that would help educate citizens and stakeholder groups, via participatory and transparent processes, support broader societal understanding of emerging technologies, encourage scientific innovation, and facilitate equitable benefit and risk-sharing. Alternatively, a specialized Technology Assessment Agency could be created, within the UN system to conduct comparative technology assessments of new and emerging technologies.

8.3.2 Subsidies and dumping: the globalization of market failure

Price stability is an important factor in determining farmer's capacity to invest and innovate rather than pursue low-return, risk-averse behavior (Murphy, 2006). While reducing or eliminating agricultural subsidies in some commodities may be important (especially for a limited number of notable crops such as cotton and coffee), there is a significant current of analysis that suggests that lifting these subsidies, will not be likely to raise producer prices significantly enough to bring relieve from import surges and alleged agricultural dumping in developing countries so as to raise international commodity prices and benefit small-scale farmers (Wise, 2004). This logic holds out a bundle of policy options, including ending agricultural dumping, reducing global commodity overproduction in key crops, and reducing market power of agribusiness conglomerates, implemented together, will be better able to boost rural livelihoods and address the IAASTD goals.

Moreover, there are important potential trade-offs to consider when evaluating policy options to address agricultural subsidies. For example, reducing agricultural subsides in some northern countries where they are significantly captured by large-scale producers, may change the economic calculus and shift additional production to certain regions of the developing South, particularly in Latin America. Forest protection policies in many of these countries may not be sufficiently strong to resist the increased economic pressure to expand the agricultural frontier and increase tropical deforestation. Note that these concerns also apply to other policy interventions that may work to increase agricultural rents including increased road building and other market access measures that tend to increase the pressure on forests (Angelsen and Kaimowitz, 1999).

8.3.2.1 The impacts of agricultural subsidies

The agricultural subsidies the literature deals with a large and diverse set of issues from their definition and measurement (Wise, 2004) to their impact on trade flows (Anderson, 2005).

However, the major debate centers on the demands of eliminating all subsidies in developed countries. Proponents of subsidy elimination refer to the fact that for developed countries agriculture is a very small share of the economy and employment, yet subsidies and other supports are highest for the sector, “skewing the benefits of agricultural trade in their favor” (Watkins and Von Braun, 2002).

The case of cotton is used as the showcase of the damage created in developing countries by subsidies in the US. The cotton case is appealing because cotton is not a food crop and also because it is mainly an export commodity for developing countries. However, the negative impacts of low prices in grains and oilseeds, affect a much larger number of countries and farmers in developing countries. Critics prefer to ignore these crops, because higher prices for producers may imply higher consumer prices too.

Subsidies are best addressed at a commodity specific basis, as there are widely noted differential impacts on cotton and sugar farmers for example, versus other small-scale farmers In US 25,000 cotton farmers divide between $3 and $3 billion in cotton subsidies. In globally integrated markets, international prices affect domestic prices across the globe, even for small farmers who grow only for the domestic market (Stiglitz, 2006). Nonetheless, cotton subsidies which impact global prices and create negative externalities affecting West African and other cotton farmers, are distinct from other agricultural subsidies, in developing countries for example aimed at stimulating domestic milk production for the local market or protecting a nascent industry that does will not have impacts on global prices.

The origin of today’s subsidies in the US and Europe –the major culprits - dates to the 1920’s and the post WWII era respectively. The use of agricultural subsidies in developed countries is tied to their efforts to increase the production capacity of their agricultural sector. Paradoxically, many developing countries during this period were following pro-urban developing policies based on low agricultural and food prices.

The modern agricultural subsidy literature is filled with illustrations of the damaging impacts of the subsidies in developed countries, and how their elimination would benefit mostly developing countries (Anderson, 2005) The basic assumption is that subsidies generate overproduction, and their elimination would reduce agricultural production in developed countries. However, very little effort has been putted in providing evidence on the validity of these two key assumptions. If agriculture fits that diagnostic, then the prescription would be correct, otherwise the prescription maybe irrelevant.

The evidence points in another direction: the short-run impact of global subsidy reform will largely depend on whether a country is a net importer or exporter of the products concerned. Countries such as Argentina, for which products subject to export subsidies in some WTO members constitute a large share of exports (29 percent) and a small share of imports (3 percent), are likely to benefit greatly from a benefit of export subsidies. Conversely, countries such as Bangladesh that export virtually no products that are subsidized in industrial countries but import a substantial share of such products (13 percent of imports) are unlikely to benefit in the short run from removal of export subsidies (Ng, Hoekman, and Olarreaga, 2007). "Summing up, the pattern of trade suggests that removal of export subsidies by industrial countries is unlikely to have a large positive impact on developing countries as a group. There will be a number of significant gainers, but also a number of losers." (Ng, Hoekman, and Olarreaga, 2007)

8.3.2.2 Options for addressing agricultural subsidy issues

Agricultural markets are unique; agriculture is an ecosystem based enterprise, in which the production capacity is initially determined by the abundance and quality of natural resources. The data show that these resources are highly concentrated in very few countries: Argentina, Australia, Brazil, Canada, European Union and the United States (FAO, 2005). Moreover, human activity influencing the natural endowment –agricultural research (Pardey, 2001), farmers' support, and investment in infrastructure- has also been concentrated in these countries. The result is increase concentration of the agricultural production capacity in the very few countries. So the relevant question becomes, in the cases where subsidies are used, what would be the impact of their elimination of the redistribution of the production capacity?

The answer to this challenge begins by acknowledging that the overriding problem in agriculture is that markets do not self-correct (Ray, 2003). The self-correction issue is so important in the case of crop agriculture because market disruptions occur so frequently. Weather-based fluctuations in yields are an obvious market shock. A longer term, more predictable force that affects agricultural markets is that productivity growth tends to outstrip the traditional slower growth in food demand. Given that food is essential for life, it is urgent that the productive capacity of agriculture continues to stay well ahead of immediate needs.

The mere presence of low prices is not the problem. What matters is how consumers respond in terms of the amount they are willing to buy and how producers respond in terms of the amount they are willing to produce next season. If consumers bought more of the lower priced goods and producers cut their production, excess inventories would quickly vanish and prices would arrive at profitable levels once again.

Domestic demand for agricultural products grows with income and population and unlike the demand for most other product categories, doubling a consumer's income will have a minor impact on his demand for food.

In the agricultural sector, productivity-enhancing technologies are quickly adopted, increasing supplies and putting downward pressure on prices. The lower prices, in turn, become further incentives to adopt more cost-reducing technologies, and prices continue their slide. In this way, production agriculture is under constant price pressure, with periods of brief reprieve generally the result of disasters or other random events.

Even when individual farmers go bankrupt, total output changes very little. In contrast to other industries, where a plant closure means a reduction in industry size because the land and other assets are sold to a different industry, crop acreage typically remains in production. It is merely tilled by someone else. A farm sale does not typically reduce the size of the agricultural industry. In fact, output per acre may actually increase because the new owner is a better manager or is better capitalized (Ray, 2003).

If this adjustment could take place in the agricultural sector, there would be no fundamental price and income problem. This is exactly the way it works in most product-producing industries: consumers buy more and producers provide less in response to a drop in prices or increase in inventories or a drop in sales. Prices rise and profitability re-appears. But as we have seen, neither the quantity of crops demanded nor the quantity supplied is significantly responsive to changes in price. Total annual output –use of production capacity- remains relatively constant irrespective of prices, the level of subsidies, or other sources of revenue. To establish an agricultural policy based on the assumption that free market adjustments will occur within a reasonable time is not only naïve and ill advised, it simply will not work.

Although the above logic is not explicitly recognized in most subsidy elimination studies, many of them fail to show significant changes in commodity prices as a result of subsidy elimination (IFPRI, 2003; Anderson, 2005). Moreover as it is expected, the largest adjustment in countries like the U.S. in is land values and not in crop prices or production (Fabiosa, 2005) .

Canada and Australia have established track records of fewer government controls and freer markets. Evidence clearly indicates that removal of and reductions in subsidies have not led to significant drops in production. In fact, production increased in several cases.

In the 1990s, a 35% cutback in Canada's support programs was implemented over a three-year period. Most notable was the erasing of all subsidies for grain transportation in 1995. This reduction in subsidies resulted in less than a one-percent decline in farmland use.
The Canadian experience drives home yet again that cropland will remain in production, despite major subsidy cuts. The mix of crops farmed did change significantly but the total area in production did not (Ray, 2003).

The Australian support for wool production collapsed in 1991. As a result farmers converted significant pasture acreage to crop production. Farmers continue to produce as much as they can, despite continuing low world prices. Since 1991, planted areas of wheat, coarse grains, and oilseeds have increased more than 56 percent (Beare, 1999).

Australia's and Canada's experience provides further evidence for the observation that farmers will remain in agriculture and continue to produce as much as they can—even in the face of declining prices and declining subsidies—as long as they can.

8.3.2.3 Agricultural export dumping

Much analysis has been devoted to analyzing the causal links between Northern agricultural policies and the chronically low commodity prices that are undermining developing country farmers' livelihoods. Agricultural dumping, also known as predatory pricing, is when a company sells at below cost to undercut and drive out the competition. Dumping makes it difficult or impossible for farmers in the developing south to compete, even in their local markets, which perpetuates poverty for many small farmers in developing countries.

The literature sometimes gives the impression that removal of export subsidies and trade distorting domestic support would suffice to end dumping (e.g. Watkins and von Braun, 2003). But as noted above, significant evidence suggests that subsidy reduction is only a part of the problem (Wise, 2004). Even with significantly decreased EU and US agricultural subsidies, DC smallholders may not be primary beneficiaries; lion's share of gains in Latin America for example may go to small number of large scale agroexporters and may lead to concentration of land in local elites and corporations that are best positioned to access export markets (ECLAC, 2005).

Econometric simulations suggest that removal of trade distorting subsidies would increase agricultural commodity prices, e.g. for cotton an average of 4 percent to 13.7 percent, depending on policy scenario assumptions, defined baseline and other factors. (Baffes, 2006). It is questionable, however, if such a price increase from the depressed agricultural commodity prices reported by FAO (2005) would suffice to reach the "normal" price, which, according to the WTO,

is the zero degree of trade distortion. (Documented deviance from the "normal" price can trigger an anti-dumping remedy under the General Agreement on Tariffs and Trade (GATT) 1947, Article VI.)

Mexican consumers have seen little welfare benefit from the 70% decline in maize prices after the adoption of NAFTA, which obliged the country to liberalize their corn markets. The oligopoly in corn importing and processing allowed intermediaries to capture the lion's share of the welfare gains from lower maize prices; prices to the consumer remained flat (Nadal, 2000). Similarly when milk prices fell by 40% in GB after deregulation, in practice consumers saw few price declines remained high; they were captured by intermediaries in the production chain.

Chronic over-production of many commodities have depressed prices and increased dumping. The definition of what is a "normal" price, resulting from the comparison of the price of disputed product when consumed in the country of export with the product's export price, is problematic for agriculture. Agriculture commodity export prices are reported as "global" as they are transmitted through futures and options contracts, as well as "spot" cash contracts. (UNCTAD, 2006), so defining a "normal" price through the GATT comparative method is difficult.

Anti-dumping cases, as opposed to cases concerning violations of commitments for notifying domestic support or other measures under the Agreement on Agriculture (AoA), typically assume initiation by and evidentiary criteria for an industrial petitioner, e.g. an automobile manufacturer, to a government (Bown, 2006). Nor does the definition of dumping as "the sale of a commodity in a foreign market at less than fair value" (USDA, 1988) point to a dumping calculation methodology. Bilateral anti-dumping investigations hint at a methodology when they investigate the producers' cost of production (CoP) and compare it with Freight on Board (FoB) export prices. For example. a U.S. anti-dumping investigation of the Canadian Wheat Board examined the CoP of 27 Canadian producers[1] (U.S. Department of Commerce, 2003). Dumping margins may more

[1] For example, proposals by the Institute for Agriculture and Trade Policy (IATP) for a plurilateral commitment from major exporting countries not to allow trade at prices below CoP and for OECD member countries to publish full CoP figures annually have not acquired government support even for discussion at the WTO. (Full CoP would include the primary producer's production costs + government support costs [Producer Subsidy Estimates] + transportation and handling on a per unit basis.) Publication of full CoP figures, when compared to FoB export prices would enable calculation of the percentage of the price that is dumped on world markets. (IATP, 2005) IATP has acknowledged the difficulty of determining transportation and handling costs and the possible double-counting in the full CoP calculation that could occur as domestic support payments inflate land values, particularly for rented land. Further refinements of the dumping calculation methodology have been made in the context of determining the extent to which industrialized animal production receive input subsidies from below CoP feed grains. (Starmer, Wittman and Wise, 2006)

But government reluctance to discuss a methodology for calculating dumping margins is not due simply to the aforementioned methodological shortcomings. Since we assume that governments do not wish to enable trade by companies at below CoP to seek competitive advantage by dumping, there are at least two reasons why a plurilateral approach to calculating dumping margins has found little support. First, a plurilateral approach, -- particularly if limited to the OECD countries that have the information infrastructure to report CoP data for major agricultural exports-- can be circumvented by companies that export from countries that have not agreed to transparently and annually report the full CoP components. It might be possible to prevent some of this circumvention by adding to a plurilateral dumping

usefully be measured against production costs and a social optimal profit, than against easily manipulated domestic prices.

A second objection to a plurilateral anti-dumping commitment under the WTO aegis is that any finding that a committed member had traded at below the CoP would be subject to the traditional GATT remedy of countervailing duties in the amount and for the period of time that an importing country was subject to a dumping percentage of the FoB price. Yet the traditional GATT remedy provides relief too little and too late, especially for countries too poor and/or vulnerable to retaliation to pursue the dispute settlement process. A Special and Differential Treatment, quasi-anti-dumping remedy, such as a one year use of a Special Safeguard Mechanism under the AoA, is a poor substitute to stem the tide of highly subsidized, but still legal, import surges that that can undersell domestic agricultural production.

If, as FAO forecasts, most developing countries will spend precious hard currency to remain or become net food importers (FAO, 2003), as liberalization continues to largely benefit developed countries, then the importance of preventing dumping before it occurs is all the greater. Anti-dumping remedies are applied only after the fact of dumping has been established. As a WTO African Group communication states, the multilateral system needs to agree and implement more policy tools than tariff and subsidy cuts, in order to raise agricultural prices to the point where dumping is less feasible. Though rebuffed by developed countries, the African proposal to explore supply management mechanisms may be a more direct way to achieve the production control mechanisms common to other economic sectors than the failure thus far to control supply through subsidy reduction. (African Group, 2006) If, too, as FAO anticipates, bio-energy production changes global agriculture (FAO, 2006), the concept of strategic energy crop area reserves could have supply management effects that would reduce dumping.

A range of options are permitted under the AoA to help themselves from dumping. These include the imposition of countervailing duties and other protective measures in agricultural exports from other countries are being dumped at below the cost of production. But as noted above, proving that dumping is taking place is complex and open to challenge; many developing countries simply lack the institutional capacity to do avail themselves of these options effectively.

Since the market mechanisms alone are unable to induce a significant adjustment in the production and consequently exports of agricultural countries, for developing countries to benefit alternative policy approaches beyond lifting subsidies will be needed, including the

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commitment a clause to require CoP reporting from any WTO member whose trade in a given agricultural product reaches an agreed percentage of world market share and/or value.

implementation of policies in the large exporting countries that would result in a an effective reduction in exports of agricultural commodities. This is to develop domestic and international instruments with the purpose of managing the use of the production capacity of agriculture in the major agricultural countries.

Another solution to chronic over-supply and resulting low world prices for crops is to find other non-food uses for commodities. If the support to farmers in the North were to be shifted towards the production of energy dedicated crops, an interesting set of opportunities would arise to address this imbalance. The shift of cropland currently used in the production of food to produce bio-energy crops would reduce the gap between the capacity to produce food and what the market can absorb at reasonable prices.

8.3.2.4 Supply management

Over-production of tropical commodities such as coffee, sugar and cacao among others, largely response to structural adjustment policies which directed countries to prioritize agricultural exports, caused prices to plunge in the international markets, (Fig. 8.3). On average, prices of tropical products (taking dollar inflation into account) are only about one seventh of those prevailing in 1980 (UN General Assembly). Essentially, less income is earned as more commodities are produced.

Insert Figure 8.3 Long term trends of non oil commodity prices

At the same time, retail prices of products made from coffee (roasted and instant coffee) have increased substantially over the same period. This phenomenon also applies to many other primary commodities produced by developing countries – cocoa, sugar, cotton, gold, copper, maize, spices, hard fibers, and other. Figure 8.4 shows the relative changes in the prices of processed versus raw material prices over the past 20 years.

Insert Figure 8.4. Price changes (%) of key commodities between 1980 and 2000.

Given that these commodities represent the bulk of exports from developing countries, it is clear that this phenomenon represents a major cause of poverty in these countries and this view is substantiated by the flows of income shown in Table 8.1, in which farmers receive a fraction of the value of the price paid by final consumers in industrialized nations. Before such schemes can be developed a key question is concerned with the magnitude of the losses are being incurred by poor countries? A conservative estimate from UNCTAD places foreign exchange losses for key commodities of 67 countries between 1995-2000, at approximately $40 billion. An OECD report acknowledges that “there is concern not only that oligopolistic retailing and processing structure

will lead to abuse of market power but that the lion's share of the benefits of any future reforms in the farming sector may be captured by the processors and retailers…" (Lahidji, Michalski et al, 1996).

Insert Table 8.1. The money trail.

Policy options to help meet the IAASTD sustainability and development objectives include a bundle of mechanisms to stabilize and increase prices. Supply management mechanisms should be investigated, market by market, to determine their potential to do this. One critical policy issues is whether the objective should be price stabilization or price increases (Lines, 2006).

A re-evaluation of international commodity supply management is one policy approach to increasing incomes for the rural poor. To address the continued slide in global commodity prices an increasing number of development groups and policy analysts are suggesting that supply management can provide a viable means of dealing with this chronic problem. In the OECD supply management is used to regulate the supply and demand of more than 50 goods on the world market. Although supply management has been used effectively to maintain profitable prices of agricultural goods in many OECD countries, there is considerable reluctance to support this process using overseas development aid to support farmer in developing countries. In contrast, most development assistance for agriculture is still used to support production based activities which arguably makes the supply situation worse rather than better. This is an uncomfortable dilemma for development agencies purporting to use their funds to support economic growth and not the supply of cheap commodities to large wholesale and retail houses. The view on supply management held by most institutions and conventional economic perspective is that supply management has been tested and is too costly and prone to problems of free-riding and quota abuse. However, it is also the case that supply management is being used in many commercial markets, given this success a new approach to supply management, that is regulated through the private sector rather than Government, may be an effective and fundamental solution to a growing world problem.

A variant on this policy approach is to refocus global commodity supply management on the concept of sustainable development. The option suggests that the International Commodity Agreements (ICAs) could be reformed to reduce price volatility, building on the coffee, cocoa and sugar lessons of the 1980s. (Some observers criticized the ICAs for increasing prices and stimulating unsupportable increase in production which contributed, along with structural adjustment programs another factors, to the crash in prices of tropical commodities.) One proposal for coffee is a commodity agreement involving both producer and consumer states, in

which consumer countries levy a border tax which is earmarked for habitat protection, sustainable production and producer cooperation in the countries of origin (Dickson, 2003; Vorley, 2005).

8.3.2.5 Special product disciplines and safeguards for developing country agriculture

Multilateral trade regime is currently based on the principle of “reciprocity for and among all countries” with the principle of reciprocity among equals, but differentiation between those countries in markedly different circumstances. Extending “special and differential treatment” to developing countries if meaningful and obligatory (not voluntary as is currently the case) may be an effective policy approach to support the development goals. The European Union for example followed this approach by unilaterally opening up its markets to the poorest countries of the world, and eliminating most tariffs and trade restrictions without demanding any reciprocal concessions. (Stiglitz, 2006; Stiglitz and Charlton, 2007)

Developing countries have proposed allowing for protection of food crops that are important for the country’s food security crop production through the designation of “special products”. The creation of a special products safeguard mechanism would give developing countries a much need tool to protect agricultural markets against import surges that undermine national productive capacity (Stiglitz, 2006).

The WTO July Framework Agreement of 2004 acknowledges that developing countries will need to designate some products as **special products** based on livelihood security, food security and rural development concerns. Developing countries are allowed to designate a portion of their agricultural tariff lines as special products. Much analysis indicates that raising productivity levels and developing new skills among large numbers of subsistence farmers will be a difficult process that in many developing countries will require much longer than the anticipated implementation period for the Doha round (Polaski, 2006). To be an effective policy option for addressing the IAASTD goals them, the right to designate special products may need to be open ended.

When they signed the AoA some developing countries bound tariffs on important food security and other sensitive crops at very low levels, increasing the vulnerability of their farmers to the drop in global commodity prices. At the same time many DCs did not reserve the right to use emergency safeguard measures. The experience of the GATT round shows that following trade liberalization agricultural imports in developing countries have risen more rapidly than have exports, leading to import surges and a deterioration of net agricultural trade.

The implementation of related proposals on safeguard measures that may be applied by developing countries may also be considered. Safeguards are temporary tariffs that can be

applied by a country when it faces an unpredicted surge in imports of a particular import. These measures aim to provide tariff options to developing countries so that they may support rural livelihoods. The formula for applying safeguards under some regional and bilateral trade agreements can limit their effectiveness (see e.g. CAFTA) and may need to be revisited if safeguards are to effectively address rural livelihood issues (Stiglitz, 2006). Few developing countries have the resources or institutional capacity to apply the measures in the general safeguard agreement. Numerous observers have proposed special safeguards mechanism under which developing countries may could introduce tariffs or other protection for agricultural products in the future (Polaski, 2006).

To address the IAASDT goals, special products and safeguard measures should enable developing countries to promote domestic production and distribution of “food security” crops, those that are either staple foods or the main source of income for low-income or resource poor farmers. This could be an effective aspect of special and differential treatment for developing countries (Priyadarshi, 2002).

8.3.2.6 Fisheries subsides

Fisheries subsidies and revenue generating concessions extended by developing countries to foreign fleets are threatening both the viability of wild fish stocks and livelihood of fishing communities. These are among the most commonly identified “perverse subsidies”, i.e. those that are harmful to the environment and the economy, distort prices and trade, make it impossible to internalize costs of environmental and social externalities, and divert finance dollars from more sustainable investments, along with subsidized water and energy (Myers, 1998).

Fishing subsidies are many and varied, including tax breaks for new vessels, to payments for breaking/scrapping old vessels, from direct income support to construction of new port facilities. The policy challenge is to identify those subsidies that support practices that are harmful to the sustainability of the resource, and those that are beneficial. Some types of subsidies may promote good fisheries management or safety. Positive subsidies can also be used to help reduce fleet capacity, or implement management tools, and help fisherman transition to sustainable fishing techniques. Carefully targeting beneficial subsidies can be important components of incentive based approaches to environmental management (Harlan, 2002; Saladin, 2003). In developing countries well design and targeted subsidies can also enhance local artisanal and community-based small-scale fishing industries, or provide safety nets to protect fishers in a rapidly liberalizing sector (Saladin, 2002).

The demand for fish and fishery products continues to rise dramatically (Delgado et al., 2003). Developing countries account for a large part of both the production and consumption, including production for aquaculture which now accounts for almost a third of total production; seafood is now one of the most traded commodities in the world (FAO, 2004). Production from natural fisheries has slowed or stagnated, largely due to continued over-fishing, in many cases leading to precipitous drops and near collapses of multiple fisheries. In contrast to most other commodities, the price of fish and seafood has increased over the last half decade. For many developing countries the fisheries sector is a major source of export revenue, a key part of national food and nutritional security, and an important source of rural livelihoods (Shorr, 2004 and FAO, 2004).

Subsidies to the fishing industry worldwide are estimated at between US $14 billion and $20 billion in 1006, representing about 20 to 25 percent of world revenues. The recent trend, especially in developed countries and also in some developing countries, is to shift the emphasis toward environmental protection. For example, although total fishery subsidies in Cape Verde remained substantially unchanged between 1999 and 2000, there was a fall in subsidies for ice purchase and an increase in decommissioning grants (WTO, 2005).

Bilateral fisheries access agreements between developed and developing countries are a common part of trade relations/agreements. While these agreements have the potential to help build capacities in developing countries, they can also fuel over-exploitation of fisheries resources in developing country national waters by foreign fleets that are provided access under the agreement

Negotiations on regulating fisheries subsidies have attracted considerable attention at the WTO, but other areas that are key to the fisheries sector, including market access, non-tariff barriers, and measures taken under multilateral environmental agreements, have not been addressed. Many stakeholders in the debate, foremost among the m the fishing communities whose livelihoods are at stake, have been marginalized form the discussion (ITCSD, 2006).

The fisheries sectors in many of the poorest countries face many of the same trade barriers to diversifying production and exports towards value-added processing products as agricultural products. These barriers include tariff escalation, stringent standards, and rules of origin requirements, among others. Fisheries subsidies in developing countries have contribute to market distortions, reducing developing countries' ability to compete with subsidized fleets (ITCSD, 2006).

8.3.3 Agricultural trade and the environment

This subchapter addresses policy options to help internalize the environmental costs of agricultural practices and agrifood production and correctly and fully value, and implement schemes to pay for, the environmental benefits of sustainable production methods.

Other related trade issues and agricultural trade and environment linkages are beyond the scope of this subchapter, but warrant mention as important factors for policy consideration. These include the trade in services which affects water and energy provision as well as banking and rural credit options; the relationship between multi-lateral agreements that employ trade sanctions as compliance mechanisms and the WTO disciplines; and the impact of trade agreements on domestic foods safety, agricultural production and environmental policy making. An exploration of these issues, which are being debated in many fora, is beyond the remit of the IAASTD, although they will surely have significant impacts on the policy environment in which ASKT may advance the IAASTD sustainability and development goals.

The environmental impacts of agricultural trade that are the focus of this subchapter stem at least in part from the globalization of market failures, and the lack of market mechanisms to internalizing the environmental externalities of production and account for the positive externalities (Boyce, 1999). For example, trade liberalization leading to the displacement of traditional jute production in Bangladesh by imported synthetic fibers is one example, and the displacement of traditional corn varieties (agrobiodiversity) in Mexico displaced by imported hybrid corn imports from the US are two examples.

For example nearly the entire price advantage enjoyed by synthetics over jute would be eliminated if environmental externalities were factored into the price (Boyce, 1999). At the same time, traditional producers receive no compensation for the positive environmental externalities – biodiversity conservation for example – associated with many forms of traditional production. Similarly, heavily subsidized US corn production, which requires significant energy and agrochemical inputs which cause significant environmental externalities, is sold at below the cost of production in Mexico, displacing traditional corn production in the small and medium farmers who plant diverse traditional varieties (Wise and Nadal, 2003).

In these examples, economic integration works to links imperfect markets in environmentally destructive ways. Trade agreements bring two distinct kinds of production into direct competition – with vastly different environmental impacts – with significant ramifications. In both cases the market price for the modern, Northern product fails to internalized/account for the significant environmental externalities.

The positive environmental externalities that are present in many forms of traditional agriculture, including soil stabilization and low input use, are not assessed nor accounted for; as trade liberalization subjects these farmers to deregulated international competition, these positive externalities may be lost, replaced in the global accounting by the negative externalities of high-input modern corn production practices used in the US (Nadal and Wise, 2004).

8.3.3.1 Internalizing environmental externalities: food-miles and carbon footprints

One approach to address environmental issues is to remove obstacles to incomplete markets. A significant part of environmental degradation can be attributed to a lack of mechanisms to value ecosystem goods and services properly, leading to either negative or positive externalities. This is due in part to inefficient property rights systems, regulatory failures, and the influence of special interests (Busse, 2004).

There is growing recognition of the need to integrate environmental concerns into agricultural policies. Some OECD countries adopted economic measures, including environmental taxes on agricultural inputs as a part of a policy package to reduce the environmental impacts of pesticides, fertilizer and manure waste. Denmark, Norway and Sweden for example have introduced taxes on pesticide use, as incentives to reach pesticide use reduction targets. Similarly, the Netherlands imposed an excise manure tax. And the recent reforms of the European CAP may be interpreted as a move towards rewarding farmers, not only as producers of food, but as caretakers of natural resources and environmental services. The way European support for organic agriculture as a de facto policy instrument to this end, is one important aspect of this recognition (see eg. Halberg et al. 2006 CABI).

Many critical ecosystem services are under-valued or un-valued; there are no market signals that would spur technological development of alternative supplies (Najim, Runnals and Halle, 2007). Charges to internalize cost of transportation energy expenditure in globalized agriculture, such as “food mile” taxes are one policy approach. The global trade in agriculture relies on long distance transport and ever increasing energy use and inputs in each stage of the increasingly long-distance and lengthy supply chains. It is highly polluting, impacts climate change, and distorts agricultural product prices. Food mile taxes could help internalize the social and environmental externalities of transport, including the climate impacts, pollution, and the cross-border movement of pests and livestock pathogens, among others. Food mile charges, along with tax incentives (a kind of payment for environmental services) to encourage businesses and government to institute sourcing of local, organic food, may begin both internalize costs and stimulate alternative market sourcing (Jones et al, 2001).

A related policy option seeks to internalize the energy costs of agricultural production via the application of a market standard related to the level of carbon emission required to supply a product to the consumer. This issue is rapidly gaining political weight as it has implications for green house gas levels and global warming. As such this issue is likely to have major effects on market access for tropical suppliers, who maybe hit hardest unless they can prove that their supplies can be more carbon efficient that local supplies. However, the statement by Wall Marts, the largest global retailer, that it intends to make all of its outlets carbon neutral within 10 years, means that all suppliers must take this position seriously.

Policy approaches to assist small-scale producers to articulate their carbon rating will be key, especially as an over-simplified response may be to simply ban long haul agricultural goods, and provide greater support to local food systems and season procurement policies that could end year round supply of off-season goods. In some cases though, an integrated analysis of energy costs and GHG emission from distant developing country production as compared to local northern country production will be favorable for developing country production. For example a recent analysis showed that Kenyan flower production exported long distances to the European market nonetheless generated fewer GHG emissions that hot-house flower production in the Netherlands (DFID, 2007).

8.3.3.2 Payments for agro environmental services

Ecosystem services, although widely acknowledged (if not appreciated) remain largely unaccounted, un-priced and outside the domain of the market. These services include climate regulation, water provision, waste treatment capacity, nutrient management, watershed functions and others.

PES mechanisms recognize the ecosystem service provided by sustainable agriculture practices and other resource conservation measures the environmental and social services as public good. PES is a policy approach that recognizes the multifunctionality of agriculture and creates mechanisms to value and pay for these non-productive benefits and promote clean technologies such as organic production, watershed management, soil conservation, and other sustainable agricultural and agroforestry practices. In principle, payments for environmental services (PES) such as watershed management, biodiversity conservation and carbon sequestration, can advance the goals of both environmental protection and poverty reduction (Alix-Garcia, de Janvry et al, 2005). Moreover, the must vulnerable segments of society in developing countries, especially small-scale farmers and rural communities, depend on these services directly and indirectly for their livelihoods.

PES is an approach that, like economic instruments used for pollution prevention, seeks to support positive environmental externalities through the transfer of financial resources from beneficiaries of the services to those who protect or steward the environmental resources that provide the service. PES schemes often focus on environmental services provided by forest conservation, reforestation, sustainable forest extraction, and certain agroforestry and silvo-pastoral practices (IISD, 2005) . Carbon sequestration services are also involved in several PES schemes, both to increase active absorption through reforestation or to avoid carbon emissions through forest conservation.

This subchapter reviews PES schemes that may benefit rural communities and promote conservation of water, agrobiodiversity, and biodiversity resources by compensating local communities for protection of these environmental services.

A key objectives of PES schemes is to generate stable revenue flows that can help ensure long-term sustainability of the ecosystem that provides the service; and to structure the arrangement so that small farmers and communities, not just large landowners, may participate and benefit (this may involve increased transaction costs, and tends to be more effective where farmers for example are well organized). The literature indicates that for PES schemes are to be an effective vehicle for strengthening livelihoods of poor rural communities, though, they must be designed with that objective prioritizes. Examples in Latin America show that community participation and equitable rules are key; promoting rural livelihoods must be a stated objective of the PES program otherwise the lion's share of benefits will go to wealthy landowners. In one example in Costa Rica 70% of PES for carbon sequestration in one year went to a single wealthy landowner (Rosa, Barry et al., 2004).

PES revenues can be generated by user fees, taxes, subsidies, and grants by IFIs and donor organizations and NGOs. Long standing programs, including those established by New York City and Quito, Ecuador, which levy increased fees on water users to fund watershed conservation are well known. A similar, smaller programs in the Cauca Valley of Colombia works on a similar principle; farmer associations organized a PES program which levies additional water use fees to promote the adoption of conservation measures on over one million hectares and maintain dry-season water flows. (Mayrand, and Paquin, 2004)

PES schemes may also include measures to assist local communities with market development and revenue diversification as part of the compensation, or payment, package for the environmental service protected and provided. For example, in Brazil, rubber tappers receive payments for forest conservation services they provide through their management of forest

resources. In the US the Conservation Reserves Program provides funding to farmers to remove sensitive lands from production, prevent land degradation and preserve biodiversity.

Other projects promote the adoption of improved silvopastoral practices in degraded pasture areas that may provide valuable local and global environmental benefits, including biodiversity conservation; payment-for-service mechanism are being employed to encourage the adoption of silvopastoral practices in three countries of Central and South America: Colombia, Costa Rica, and Nicaragua. The project has created a mechanism that pays land users for the global environmental services they are generating. Another example is the Coffee and Biodiversity project supported by the GEF and the World Bank in El Salvador, which provides marketing and technical support as a proxy for direct payments, to promote biodiversity protection and habitat creation on shade-grown coffee plantations via niche marketing of "shade-grown," song-bird friendly coffee. (Pagiola and Agostini, 2004).

Supportive national policy environments are important. For example, in 1997 Costa Rica reformed its forest law to allow land users to receive payments for specified land uses, including new plantations, sustainable logging, and forest conservation. The amended law recognizes four types of environmental services – carbon sequestration, biodiversity conservation services, hydrological services, and scenic beauty and ecotourism. The law also introduced a fuel tax to finance forest conservation and established an agency (Fonafifo) to raise funds and manage the PES scheme. Similarly, the Ecuadorian National Biodiversity Policy recommends the establishment markets for environmental services, and the establishment of the mechanisms for water and watershed conservation, coastal protection, global climate changes services, and compensation to landowners – importantly, both individuals and communities (Mayrand and Paquin, 2004).

Finally, another variant of a PES scheme is the BioCarbon Fund which has been established by the World Bank to buy certified emission reductions from land-use, land-use change, and forestry projects admissible under the Kyoto Protocol. The Fund is designed to target agricultural and forestry projects that enhance other ecosystem services, such as biodiversity and watershed protection, while improving the livelihoods of local people. Example projects include conservation agriculture, such as shade-grown coffee, agroforestry to restore degraded areas, improved agricultural practices, such as shifting from subsistence farming to organic agriculture, and reforestation (Kumar, 2005).

8.3.4 Bioenergy

Potential non-market benefits in terms of energy security, GHG emission reductions and rural development may justify subsidies for biofuels in certain cases. However, subsidies are expensive and funds devoted to biofuels policies are not available for other policy objectives. Decision makers need to carefully weight full costs against realistically achievable benefits. Biofuels are rarely competitive with other forms of energy and all major producing countries support their biofuels industries through a complex set of federal and state-level policies. The most common forms of support are reductions on excise taxes that are designed to foster consumption by reducing the cost of biofuels relative to conventional fuels. On the supply side, these policies are often complemented with direct production support, e.g. payments of Euro 45/ha for energy crops grown on non-set aside land in the EU and subsidized credit for producers in Brazil and the US. In addition, biofuels also benefit indirectly from highly distorted agricultural markets in OECD countries – e.g. the U.S. maize sector, the primary ethanol feedstock in the country, received US$ 37.4 billion in subsidies between 1995-2003 (UNCTAD, 2006). In many countries, subsidies are accompanied by blending mandates, e.g. the E.U. set a voluntary 5.75 percent biofuels target for 2007, supported by several mandatory targets at the country level. Restrictions on biofuels imports are also a common form of support. In most cases this is achieved directly by setting import tariffs but sometimes different national biofuel standards can go beyond technically justifiable quality standards, becoming de facto trade barriers. (Worldwatch Institute, 2006). As a consequence, of these distortions trade in biofuels still makes up only a small fraction of production volumes. Moreover, the differential treatment of ethanol and biodiesel under international trade rules – ethanol is classified as an agricultural product, biodiesel is classified as a chemical/industrial product – has important implications on international market access and also affects how the fuels would be treated under a proposed WTO category of “environmental goods and services” (IEA, 2004; IEA, 2006a; Kojima et al., 2007; Kopolow, 2006; UNCTAD, 2006; USDA, 2006).

Together, these forms of policy support generate substantial economic costs – reducing funds available for other policy goals. In fact, subsidies have a direct influence on government budgets, both in the form of direct payments to producers and in the form of tax reductions or exemptions. Current levels of subsidies are considerable. For example, Kopolow (2006) estimates that total annual subsidies to liquid biofuels in the US amount to US$5.1-6.8 billion, corresponding to US$0.38-0.49 and US$0.45-0.57 per liter of petroleum equivalent ethanol and biodiesel, respectively. Moreover, taxes on fuels represent a significant source of government income in many developing countries and reductions are often difficult to compensate. While blending mandates are attractive to policy makers because they do not directly affect government budgets, they too create considerable economic costs. In fact, blending mandates affect consumer welfare by leading to increases of average fuel prices (through mixing in higher cost biofuels) and prices

of agricultural products and production factors (e.g. land). In addition, blending mandates create inefficiencies by guaranteeing a market for biofuels producers irrespective of costs and limiting competition. This reduces incentives to develop more efficient and cheaper production – an effect that is reinforced by trade barriers.

When subsidies are granted to biofuels, they should be tied to objectively observable positive externalities. Biofuels policies set incentives for producers which directly affect the extent of externalities – the primary reason for granting the subsidies in the first place. In the case of current policies in the EU and the US it is apparent that these incentives are rarely closely linked to the externalities they are allegedly supposed to provide. In fact, the majority of policies in OECD countries create incentives to maximize production of 1st generation biofuels, irrespective of quality and quantity of externalities. Consequently, many biofuels are produced with intensive use of energy inputs, leading to low energy balances and GHG emission reductions while contributing to depletion and contamination of water resources and soil erosion (see chapters 3 and 4). The limited incentives for product and process improvements are further underlined by the fact that between 1987 and 2002 only 1.6 percent of total public funds for energy RandD in IEA countries were devoted to biomass energy (including biofuels, bioheat and bioelectricity) (IEA, 2006b). In 2005 bioenergy RandD received about US$ 300 million in public funding in all IEA countries, compared to more than US$ 3 billion that were devoted to output based production subsidies for ethanol in the U.S. alone (IEA, 2007; Kopolow, 2006).
When biofuels are granted public support, it is important that policies are designed as to maximize incentives for the actual delivery of positive externalities, e.g. by tying subsidies to objectively observable benefits (e.g. to GHG emissions) and increasing RandD.

Policies are required to reduce the social and environmental externalities of biofuels production. Sustainability standards are the most popular approach but developing effective standards that balance environmental and social interests with access to export markets for developing countries is a challenge. Given the potentially destructive social and environmental effects of large-scale biofuels production, the development of sustainability standards is being discussed in different private and government supported forums. In the absence of universal governmental regulations and enforcements, standards are viewed as key to limiting negative effects (O'Connell et al., 2005; Reijnders, 2006; WWF, 2006). However, besides disagreements on the definition of these standards – with large differences of opinion between industrialized and developing countries –uncertainty persists on how effective such standards can actually be. For example, considering that biofuels are fungible export commodities, their effectiveness would depend on the participation of all major consumers. Moreover, qualifying for standards and obtaining certification can be a considerable financial and

institutional burden for poor producing countries. It is therefore essential that developing countries are included and supported in the process of the development of sustainability standards to assure that environmental and social considerations are balanced with the broader needs of developing countries – including considerations about access to the markets of industrialized countries.

Liberalization of biofuels trade could increase the efficiency of global biofuels markets, shifting production to the most efficient producers – many of which in developing countries. However, in the absence of effective safeguards the resulting expansion of production in these countries could magnify social and environmental costs. The wealth of trade distortions present in biofuels markets today create gross inefficiencies in which production is often concentrated in heavily protected industries. Liberalization of biofuels trade promises to reduce these inefficiencies by increasing competition and closer aligning production with comparative advantage. As a consequence, new export opportunities for some developing countries could open up (Coelho, 2005; Dufey, 2006; Faaij and Domac, 2006; Kojima et al., 2007; UNCTAD, 2006). However, as long as biofuels are not directly competitive with petroleum fuels on a cost basis, exports are highly dependent on political support in importing countries (e.g. through blending mandates). This makes biofuels markets risky for exporters, considering that the policy support is dependent on complex political dynamics (involving considerations about energy security, the environment and national rural sectors). In addition, in the absence of effective environmental and social safeguard measures, an expansion of production in developing countries could exacerbate social and environmental costs, ranging from rising food prices to deforestation and depletion of water resources.

Promotion of RandD, development of technical standards as well as better access to information and finance are needed to better exploit the potential of bioelectricity and bioheat in developing countries. There is considerable potential for bioelectricity and bioheat to contribute to economic and social development. Several actions can be undertaken to promote a better exploitation of this potential (Bhattacharya, 2002; Ghosh et al., 2006; Kartha et al., 2005; Kishore et al., 2004; Stassen, 1995).

- *Promoting RandD:* Improving operational stability and reducing capital costs promises to improve the attractiveness of bioenergy, especially of small and medium-scale biogas digesters and gasifiers.
- *Development of product standards and dissemination of knowledge:* A long history of policy failures and a wide variety of locally produced generators with large differences in performance have led to considerable skepticism about bioenergy in many countries. The

development of product standards as well as better knowledge dissemination can contribute to increase market transparency and improve consumer confidence.

- *Local capacity building*: Experience of various bioenergy promotion programs has shown that proper operation and maintenance are key to success and sustainability of low-cost and small-scale applications. Therefore, local consumers need to be closely engaged in the development as well as the monitoring and maintenance of facilities.
- *Access to finance*: Compared to other off-grid energy solutions, bioenergy often exhibits higher initial capital costs but lower long-term feedstock costs. This cost structure often forces poor households and communities to forego investments in modern bioenergy – even when payback periods are very short. Improved access to finance can help to reduce these problems.

8.3.5 Capturing value in commodity chains: strategies for increasing incomes for the rural poor

As a means of developing pro-poor procurement, initiatives such as Fair Trade and environmentally linked production systems, such as organic and eco-friendly production, were introduced as alternatives to the mainstream commodity markets. Whilst these models offer smallholders better terms of trade, the market share for these trading systems has been slow to grow and still only occupies a small percentage of global trade. Nevertheless, the principles were proven and a new generation of business models needs to be designed that can provide windows for the less endowed producers to enter mainstream markets through trading platforms that promote greater stability of demand (Berdegue et al., 2005).

Developing countries face the problems of tariff structure, especially escalating tariffs, when trading with virtually all trading partners; there are also a range of tariffs which target products according to their origin, product value and safety.

This subchapter presents a number of trade and market policy options to reform tariff structures and promote investment in local value-added agricultural processing. Strategies range from capacity building programs that enable smallholder organizations to engage with markets more effectively, to fair trade and other pro-poor business procurement models that provide more equitable conditions for small-scale farmers, and finally include taking the strategic approach of changing international trade policies, that would allow for smallholders to compete with Organization for Economic Cooperation and Development (OECD) farmers in a less distorted marketplace.

8.3.5.1 Tariff structure, tariff escalation and adding value locally

Observers have noted the unfairness in WTO rules whereby the “poor man’s instruments for agricultural protection (tariffs) are restricted while rich man’s instruments (direct payments) are exempted.” (Koning, Calo and Jongeneel, 2004)

Tariffs represent about a quarter of tax revenue in DCs and other taxes are hard to collect in poor countries, esp. with large informal sectors (Bhagwhati, 2005; Panayatou, 2000). This compounds the effects of structural adjustment programs which weakened the institutional capacity of DC governments to carry out basic functions such as tax collection, enforcement of laws, and provision of basic health, sanitation and education services (IADB, 2001; Jaramillo and Lederman, 2005).

The current multilateral agricultural product tariff structure works against developing countries in two major ways. First tariffs on manufactured goods are four to five times higher than those for raw agricultural commodities making it harder for nascent manufacturing industries in developing countries to compete. Second, and of more concern for this subchapter, is that as the level of processing or value adding increases for a given product, the level of import tariff also increases. This is known as “tariff escalation;” levying much higher tariffs on processed agricultural products makes it more difficult for developing countries to promote and gain from value added local agroprocessing industries that could provide much needed off-farm rural employment (Wise, 2004).

To address the reality of growing difference between the raw and retail prices and formal and informal markets suggests obvious strategies. Countries producing primary products should brand and package their own processed goods and sell it directly into western industrial plants and supermarkets. However, tariff escalation makes local value-added production much less profitable.

Therefore if developing countries were to invest in value addition at source, the value added product, i.e., processed coffee, would attract a higher import duty. The level of duty is often dependent on bilateral agreements between producing and importing countries with levels set to protect domestic processing markets and employment. Many processed products are protected by a high tariff wall around the main consuming markets. Current tariff structure is a disincentive to investment to create value-added agroprocessing in the developing south, which would help create rural jobs and boost the rural economy, because developed countries use escalating tariffs. Escalating tariffs discourages development by placing higher tariffs on manufactured goods than on raw commodities and materials. Elimination of escalating tariffs would help encourage value added agro processing in developing countries. (Stiglitz, 2006) Reducing or

eliminating tariff escalation would greatly facilitate off-farm diversification in developing countries (Koning, Calo and Jongeneel, 2004).

Although value addition to primary goods offers a major income opportunity for developing countries, in many cases this is not being achieved as many OECD markets have retained a combination of basic and escalating tariffs that prevent market entry of value added goods. Even with EBA options, lack of investment in processing capacity has prevented many least developing countries from being in a position to take advantage of this option. Consequently, most value addition to agricultural products still takes place in the importing OECD countries, where the value of processed goods continues to rise. Unfortunately even the domestic markets for value added goods, in many developing countries, are also supplied by OECD goods due to poor quality associated with domestic brands. This problem is being exacerbated by the recent rise in supermarket retailing and formalising marketing. Nevertheless, supermarkets and other formal markets provide an important opportunity for increased sales of local higher value goods. For the rural communities this situation requires serious investment as it is the case that even within developing countries, (80%) of value addition is generated off-farm, due to lack of rural financial services, know how and infrastructure.

Most analysts believe that the prices of primary agricultural commodities will continue to fall in the foreseeable future. Unless the mix of industrial activity is changed, economic growth will not occur. The “Everything But Arms’ initiative”, the “Africa Growth Opportunity Act” and other similar market-access measures now offer LDC countries the opportunity to attract investment into the region to improve the quality and range of products and, more importantly, to produce added-value products made from locally produced raw materials. Every effort should be made to capitalise on these opportunities by promoting inward investment now that many tariff barriers to added-value products have been removed in the main consuming markets.

Consideration should be given to strengthening the role of existing export and investment promotion organisations to include the preparation of detailed investment plans and packages in added-value products that will attract greater foreign direct investment (FDI). Tax regimes should be modified where necessary to encourage this form of investment. Vertical diversification may represent the only option for poor countries to avoid the economic damage caused by falling raw commodity prices.

8.3.5.2 Micro-finance

Almost all intensive agroforestry systems require rural credit; this credit will not flow from commercial sources, so policy action is needed (Najim, Runnals and Halle, 2007). Microfinance

programs and banks present are a key alternative strategy for many developing countries' agricultural market infrastructure.

Because so much of the developing South's agricultural output is generated by small-scale farmers and other microentrepreneurs, microfinance (as the set of financial services whose scale matches the needs of micro and small producers) is the mechanism by which agricultural producers are able to expand their production, buy fertilizer and other inputs and technologies, and smooth seasonal fluctuations in household and enterprise income and introduce flexibility into small-farm/microproducer investment and asset building.

Agricultural microfinance includes the products and services offered by financial institutions, but also includes credit and other services offered by value chain actors. Value chain actors respond to different drivers of credit supply and demand than financial institutions do, they can accept more risk, and they have more information than financial institutions have about the risks and likely benefits associated with particular agricultural endeavors. They also extend credit in different ways than financial institutions do, for example through advance purchases, grace periods for payments for inputs, and embedded services that carry no direct costs.

Additionally, newer financial services and products, such as crop or rain insurance, are critical to reducing the risk associated with adopting new technology, innovating production and marketing methods, and so on; and credit terms tailored to agricultural production and marketing, such as loan repayment terms that track with seasonal crop production, are critically important to enabling agricultural producers to take advantage of economic opportunities.

Where they are available, rural equipment leasing schemes (Rosner, 2006) and other supplier credit, as well as remittance services, can address some market failures in formal rural credit. And in addition to credit, crop, weather and geographic-based insurance, emerging products and transitional crop microfinance can help create safety nets small-scale farmers in the developing South.

8.3.5.3 Fair trade

In an attempt to offer an alternative set of trading standards to mainstream commodity markets and provide greater equity in international trade, initiatives such as Fair trade were developed to provide long-term business channels for to support rural communities. Fair Trade was introduced in the 1970's – 80's as a way of differentiating products based on site of origin and type of supplier, i.e., smallholder farmers. Consumers buy Fair traded produce such as Café Direct coffee and Tropical Wholefood fruits at premium prices in the knowledge that the margin for

producers is higher than products sold through mainstream commodity markets. Although Fair trade is a well known brand, the market has been slow to emerge and many of the major retailers have transformed this concept into their mainstream businesses, which has had the effect of "crowding out" the initial brand.

Fair Trade represents a promising market-based approach to addressing sustainability and development objectives in the short and long terms. Fair Trade promotes trade in commodities certified for upholding high social and environmental standards which guarantee favorable and stable returns to disadvantaged farmers and agricultural workers. Fair Trade has a proven track record in alleviating poverty and hunger and bolstering ecological sustainability and rural livelihoods across the Global South. Over five million farmers, farm workers, and their families across 53 countries in Latin America, Africa, and Asia currently benefit from Fair Trade with many more seeking to enter these markets (FLO, 2007).

Sales of Fair Trade certified products are currently valued at US$1.4 billion per year and are growing at 36 percent annually (FLO, 2006). Though this represents a relatively small share of the world market, items certified as Fair Trade comprise one of the fastest growing segments of the global food market (for a business perspective on this growth see Kroger, 2004; Roosevelt, 2004). Fair Trade is no longer a niche market (Krier, 2005; Raynolds et al., 2007). Fair Trade certified products are now sold by large mainstream food processing corporations (such as Proctor and Gamble and Nestle), giant retailers (such as Carrefour, Costco, and Sam's Club), and fast food chains (such as McDonald's and Dunkin' Donuts). Market research suggests that there is a very large pool of potential Fair Trade consumers. In the United Kingdom, the ethical food market is currently valued at US$ 3.2 billion per year (Co-operative Bank 2003). In the United States, 68 million consumers with purchases of US$ 230 billion per year are identified as "Lohas" (lifestyles of health and sustainability) shoppers (Cortese, 2003).

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the world market, items certified as Fair Trade comprise one of the fastest growing segments of the global food market (for a business perspective on this growth see Kroger, 2004; Roosevelt, 2004). Fair Trade is no longer a niche market (Krier, 2005; Raynolds et al., 2007). Fair Trade certified products are now sold by large mainstream food processing corporations (such as Proctor and Gamble and Nestle), giant retailers (such as Carrefour, Costco, and Sam's Club), and fast food chains (such as McDonald's and Dunkin' Donuts). Market research suggests that there is a very large pool of potential Fair Trade consumers. In the United Kingdom, the ethical food market is currently valued at US$ 3.2 billion per year (Co-operative Bank 2003). In the United States, 68 million consumers with purchases of US$ 230 billion per year are identified as "Lohas" (lifestyles of health and sustainability) shoppers (Cortese, 2003).

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8.3.5.4 Niche marketing, certification, and markets of origin

Niche Marketing: Marketing products through boutique outlets of excellence offer another means of differentiating smallholder products into high value sales outlets by appealing to the desire for high quality, novelty and exclusivity. One of the most famous of these niche markets is the highly

successful coffee franchise, “Starbucks”, which buys the highest grades of limited coffee lots, from specialty growers. Value addition in the niche market area is particularly remunerative as the seller is capturing a limited supply option. Whilst niche marketing is successful for a limited number of producers, the size of these markets is small by definition and in many cases it is the better endowed farmers who tend to benefit. Unless these markets are well managed, niche markets can become tomorrow’s commodity as many suppliers are drawn to produce the previously exclusive product. Nevertheless, niche marketing is a growth area and is highly rewarding for the successful and most innovative suppliers.

Mark of Origin or Appellation: An approach that has been widely used in France as a means of locking in added value is via protection of specific spatial areas, such as a defined geographic area know to produce a high quality brand, or an area that has traditionally developed a specific type of food processing. The classic examples of this are the wine denominations that allow buyers to purchase products based on geographic location, grape variety and year. Whilst this has proven to be very effective in areas that respect such legal definitions, the products are generally based on long term consumer loyalty and cultural standards. As such this system is unlikely to be applied to mainstream products unless this strategy is used in combination with other standards such as air-miles and or carbon footprints.

Certification: Another approach to locking in access to higher value markets is to join a certification scheme such as those offered for organic production and rainforest production. All of these movements aim to capture a premium price for producers who can provide evidence that they are meeting and have been monitored to prove their compliance with specific ethical standards. Again, whilst the area of certification is gaining appeal, the system is extremely expensive and unless charges can be passed onto consumers the ability of poor smallholders to comply with such regulations is limiting.

8.3.5.5 New “business models” and private sector sustainable trading initiatives

While the Fair Trade approach has proven the concept, many observers feel that this approach now requires upgrading to have a more influential role in mainstream market channels. That is to design new procurement models or standards that will be adopted by the remaining wholesale and retail corporations that currently have such dominant market share. Many retailers and manufacturers may operate buying models that result in adverse effects for small farmers that are not intended or even realized and in many cases their understanding of the impact of their buying practices on local rural economies in developing countries is very low.

This suggests that new models are required that would enable buyers to measure their development impact while maintaining the flow of safe products at agreed standards of quality would profoundly improve their understanding about how to provide effective pro-poor business

models. Such models must include the capacity for dialogue between supply chain partners where not just product information but also business context is provided. These lessons, once learnt, can inspire corporate agencies to develop and improve so they can provide a compelling and sustainable vision of fair buying. In this text new business models describes a set of best practices that corporate buyers can adopt to pro-actively establish more equitable procurement rules, standards, commitments and information systems.

These business models aim to build on previous approaches such as fair trade, niche and certification platforms, to provide methods that can be more readily applied to mainstream trading operation. The new business models will be designed to (a) increase market access by developing innovative ways to reduce the costs of certification and standard compliance for groups of smallholders and (b) improve financial sustainability through buying relationships that better balance risk, responsibilities, and benefits among the chain actors and (c) are sufficiently flexible to enable both buyers and sellers to respond to marketing dynamics. These new models are likely to be developed around combinations of the following mechanisms such as:

- duration of contracts (setting out prices, volumes, and delivery schedules)
- payment terms
- information sharing (mechanisms that support regular two-way communication)
- forecasting capacity (the ability of producer to forecast orders accurately)
- loyalty to suppliers
- fair implementation of standards and
- capacity building to increase business skills for producer organizations

Most recently, Unilever in association with other wholesale, retail and food processing companies has established the “Sustainable agriculture initiative” which seeks to develop direct links between these major buyers and organised farmer groups. This approach aims to establish long term contract options with suppliers of quality produce. This is being done because the trading houses want to secure their supplies into the future. One of the problems with declining global prices and associated loss of Government led extension and market co-ordination of agricultural goods has been that quality and volumes have fallen as farmers stop growing coffee, cocoa and other traditional high value crops. This initiative was recently supported by another private sector consortium entitled the Sustainable Food Lab, which is seeking to work with the private sector to introduce new trading standards and business models. The attraction of working with the large trading houses is their enormous purchasing power in the market and the fact that they may be able to replace the function that Governments used to play in co-ordinating the market. The key question with such developments is how will benefits be shared and given the stringent quality and traceability criteria that will be required, will the poorer segments of the farming communities

be able to meet the entry price to compete in such markets.

8.3.5.6 Market services, education and research in support of small-scale farmers

Establishing an Agricultural Market Analysis Unit. An Agricultural Market Analysis Unit could be established and supported in developing countries. This unit would be concerned with co-ordinating and developing policy on the development of market-orientated strategy in agriculture and setting policy guidelines for agricultural research. The Unit should also co-ordinate its activities with relevant regional bodies. It should be staffed with appropriately qualified economists and market experts. The Unit should work closely with the private sector and, especially, with those private-sector support groups working to stimulate production for growth markets.

Establishing a National Market Education Program. Many actors in the agricultural sectors in poor developing countries are still not familiar with the idea of competitive markets. A National Market Education Programme could be established targeted, primarily at farmers, traders and agricultural product processors. Such a programme needs to be linked to the Agricultural Market Analysis Unit (see above). Market Information Services (see below) and run in conjunction with other stakeholders including Ministries of Agriculture, Education and Trade, farmers' and traders' associations and other private sector actors and with extension services.

The programme needs to set targets for training farmers to understand how competitive markets work, to take advantage of market information and to inform them of the difficulties and opportunities associated with market conditions. Issues addressed need to include the stimulation of collective activity to improve economies of scale, linking supply variety and quality to market needs, negotiation of sales and inputs and the use of credit and business management. The programme should have a limited duration and should be administered efficiently as a separate unit within a national agricultural development reform programme.

*Establishing a Market Information Service***.** Many typical, small and medium-scale farmers, traders and processors in poor developing countries have limited access to information about prices and market conditions of the commodities they produce. Farmers find themselves in a weak bargaining position with traders which results in lower-than-market farm-gate prices, high transaction costs and wastage. Market Information Services need to be established at local, national and regional level to gather, process and disseminate market information in the appropriate language of intended recipients. Such services need to be fully co-ordinated with each other and involve full participation of stakeholders.

The aim of these services should be to stimulate more competitive markets. They are likely to be supported by the agricultural industry itself as they are in more developed countries, once competitive markets become more established.

Strengthening agricultural research and extension and services to provide market information and marketing assistance. To assist developing countries to compete successfully in the world economy, however, research and extension institutions need to develop or acquire new skills and expertise in market analysis and market linkage. Producers need to ensure that there are viable markets for any existing or new products. They need to ensure that the quality and packaging of those products meet the requirements of customers both on the domestic and export market. Research and extension services have a vital role to play in this effort and must be prepared to reform quickly to meet the challenges of globalisation.

In many respects national research programmes have succeeded in their goal to achieve food security, the current emphasis should now be to develop dynamic and commercially orientated research that supports improved market analysis, market access and added value processing. Extension services should now focus on assisting producers to trade more effectively within a liberalised market. Special attention should be given to aspects such as linkage of production to markets, access to credit and collective marketing which will enable the millions of atomised, small-scale farmers to gain from economies of scale in their input and output markets.

Government research services need to work closely with the private sector which is increasingly developing its' own research capacity, particularly in regard to higher value commodities and research related to issues and problems further up the value chain.

8.4 Food Safety, Animal Health and Plant Health

The management of food safety, animal and plant health issues along the farm to fork continuum requires a level of coordination and integration that is not provided by the current international policy and regulatory framework for agriculture. Instead, these three issues are largely addressed in terms of international standards elaboration through parallel programs developed by the Codex Alimentarius Commission, World Animal Health Organization (OIE) and the International Plant Protection Convention (IPPC) for food safety, animal health and plant health respectively. These standards and related sanitary and phytosanitary measures are implemented and enforced to a greater or lesser degree through an array of often uncoordinated national initiatives variously managed by ministries such as agriculture, health, environment, forestry, fisheries, trade, commerce and international affairs. Related to this lack of coordination, or perhaps because of it, alternative regulatory mechanisms such as third party standard and

certification systems mandated by private sector retailers, in response to increased consumer demand for improved food safety and food quality, have been implemented. Much of the cost burden for meeting these private regulatory requirements is borne by primary producers.

This sub-chapter seeks to examine some of the key issues affecting agricultural production and food consumption in the context of international policy and regulation with particular attention to Codex, OIE and IPPC. It begins with food safety as an overarching policy objective and then explores the related and integral contributions of animal and plant health policy to achieving a safe and wholesome food supply. The subchapter supports the concept of biosecurity as a unifying framework that deliberately integrates these three sectors within a policy and regulatory environment that recognizes the importance of agricultural sustainability from farm to fork. Outlined in the sub-chapter are new policy options that should be explored in order to achieve the IAASTD goals.

8.4.1. Policy challenges and options for food safety

8.4.1.1 Surveillance challenges

Recognizing that about a third of developed country populations and likely a greater portion of developing country residents are affected by foodborne illness each year, in 2002, the World Health Organization published its strategy for food safety. The lack of reliable data or data that are comparable between countries on the prevalence and severity of food borne disease, despite several WHO initiatives to develop global and regional surveillance and outbreak reporting systems, continues to impede the development of evidence-based food safety interventions in many WHO member countries (WHO 2002, 2005). However, in the EU compulsory equally performed surveillance in all member states (base line studies) for salmonella in swine and poultry production and qualitative and quantitative risk assessments are currently performed to overcome these problems as a base for targeted intervention (EFSA, XXXX). This was the basis for the relatively fast and successful interventions to prevent outbreaks of BSE/TSE in both animals and humans and similar actions are also on the way for surveillance of other zoonoses in the EU (EFSA, XXXX; WHO/OIE, XXXX).

Epidemiological uncertainty about the origin, prevalence and severity of much foodborne illness makes it difficult to target resources and do comprehensive and pro-active food safety control planning. Although more than 200 known diseases are transmitted by food, under-reporting of foodborne illness, the portion of food born illness caused by unknown pathogens, and other factors, such as water sanitation, that obscure the origin of foodborne illness, make it difficult to estimate the burden of existing foodborne illness, much less the evolution of future pathogens. Pathogens featured in today's headlines, such as Listeria monocytogenes or E. coli O157:H7, were not identified as major causes of foodborne illness 20 years ago (Mead et al, 1999). However, for most food borne infections effective preventive interventions can be done in the lack

of the exact epidemiological knowledge that for some infections may never be obtained. Additionally, it is already known that the majority of food borne infections in most countries are caused by few pathogens e.g., in the EU Salmonella and Campylobacter account for ca. 95 % of reported cases of zoonoses in 2004 (EFSA 200). In developing countries actions for clean water and heat treatment of food in combination with measures for basic sanitary and hygienic routines would have a significant health improving effect without immediate support of detailed surveillance. Diarrhoeal diseases are the leading causes of illness and death in less developed countries, killing an estimated 1.9 million people annually worldwide and are almost all caused by food or waterborne microbial pathogens (Schlundt et al., 2004). This is a logical reflection on the fact that globally > 1billon people, and in Sub-Saharan Africa > 40%, lack access to clean drinkable water and 2.4 billion do not have basic sanitation (UN 2006). In practice this means that these people have to drink water with faecal contaminated by humans and animals and their intestinally excreted pathogens.

For countries with weak surveillance and outbreak detection systems, estimating the burden of food-borne illness is even a more daunting challenge, despite the assistance provided by WHO's Global Salm-Serv, Global Outbreak and Response Network (GOARN), International Food Safety Authorities Network (INFOSAN) and the FAO/OIE/WHO Global Early Warning System and Response for zoonotic disease surveillance (Flint et al., 2005). Further complicating the future of food-borne disease surveillance is the likelihood that as a result of climate change, new pathogens will emerge, particularly in fish and shellfish raised in water whose quality is degraded or contaminated. (Rose et al., 2001).

The timeliness and efficacy of preventative or prophylactic food safety interventions depend on accurate, comprehensive and timely surveillance information. The above outlined factors of uncertainty in calculating the burden of food borne illness are compounded by weak national surveillance systems upon which the international systems depend. Given the reluctance or inability of governments, particularly in least developed countries, to finance the development of such surveillance systems as part of national health system planning, for smaller and contiguous developing countries, strengthening or starting regional surveillance systems is a viable option. Since welfare benefits from agricultural trade are not expected to increase for most developing countries as a result of the WTO Doha Round of negotiations (Polaski, 2006; World Bank 2006, Bouet et al., 2004), it is unlikely that the costs of foodborne disease surveillance systems and food safety interventions can be paid from trade revenues. Therefore, in what follows we assume that some form of public finance will be required for capacity building in surveillance and other food safety activities. Furthermore, public finance may be involved in helping to insure against global food-borne illnesses risks that are not and perhaps cannot be insured by private firms.

8.4.1.2 Financing a public good

The globalization of the food and feed trade enables a broader and more rapid transmission of food-borne illness, particularly from high-risk microbial pathogens of animal origin (OIE, 2006; FAO, 2005). Development of surveillance data often becomes a priority only if a food contamination incident or zoonosis threatens trade, e.g. BSE and avian influenza. Such threats to trade usually focus only on emerging diseases and less to those that are prevalent and continuously causing the major problems. Yet the costs of foodborne illness far exceed those that can be recovered from inspection fees or other forms of trade related food safety financing, even when the origin of an illness can be traced back to a specific source. Whereas the costs of food safety measures can be internalized to some extent in the cost of a product, there is no adequate mechanism for financing the public health costs resulting from transborder foodborne illness. FAO and WHO recognize that "[f]ood safety is an essential public health issue for all countries." But the normative framework and technical assistance planning for food safety in developing countries is largely a function of trade policy, or more broadly of the economics of private markets (FAO/WHO, undated). Donor interest in and exporting country demand for SPS related assistance tends to be triggered by the threat of trade disruption or to ensure that food imports are safe (World Bank, 2005).

Although food safety is characterized as a global public good, economic analysis of food safety interventions often is framed largely in cost/benefit terms of market failures, in this case, the failure to internalize such negative cross border externalities as foodborne illness. Attempts to mitigate these externalities on an ad hoc emergency basis "is a costly and unsustainable form of assistance" (World Bank, 2005). The role of public food safety management is defined in terms of serving the market, without, however, a financing mechanism designed to enable the development of food safety as a public good and taking into consideration the full and considerable cost for food borne infection e.g. loss of labour time and cost for medical care . New proposed public finance mechanism (e.g. Kaul and Conceição, 2006) \\could be adapted to the provision of food safety, both on a global and regional basis, as a global public good.
A World Bank study has argued cogently for a more proactive and preventative supply and demand approach to providing capacity building for food safety to facilitate trade. (World Bank, 2005) But such capacity building need not be limited to trade facilitation. Consideration should be given to establishment of national or regional food safety trust funds invested to ensure a continuous funding mechanism to gradually build the national or regional surveillance systems upon which effective food safety interventions depend. The trusts could be financed from an increase in ODA and from an increase in agri-food corporate taxes. Alternatively, governments

can continue to respond ad hoc to food safety emergencies or threats to trade without proactive food safety planning on the basis of effective and timely surveillance.

8.4.1.3 Implementing food safety standards for domestic public health benefits

In theory, trade related food safety standards and control measures may also be applied readily to domestic food safety programs. In practice, according to developing country official respondents to survey input into the FAO/WHO Food Standards Programme Evaluation, developing countries adopt few international food standards into domestic legislation because they lack the resources and technical capacity to implement and enforce the standards (Evaluation, 2002).

The unmet challenge remains, how to apply food safety measures not only for traded products but for the great share of global food production that is not traded internationally, particularly against new food borne pathogens or against existing pathogens whose prevalence or severity has increased? The challenge of applying standards domestically for public health benefits is even greater in countries where food safety control systems are not integrated into the public health system but are instead largely confined to export establishments and import inspection. Policy options, outlined below, to meet this challenge should take into account capacity building challenges.

Despite the proliferation of international public and private standards, compliance with which is required for market entry, there are relatively few studies of sanitary/phytosanitary (SPS) compliance costs for developing country agricultural exports (Pay, 2005). These few quantified studies indicate that existing levels and kinds of trade related technical assistance are far from providing the necessary facilities, such as accredited laboratories for measuring pesticide residue levels, to enable SPS standards implementation and enforcement (e.g, Larcher Carvalho, 2005). Notwithstanding this technical capacity shortfall to implement the SPS requirements of trade agreements, the view that “aid for trade” should be a binding, scheduled and enforceable part of trade negotiations for least developed countries (Stiglitz and Charlton, 2006; Sutherland et al., 2004) has not received support from developed country WTO members. While “best endeavor” capacity building can be helpful, the trade-off in depending largely on private sector SPS infrastructure investment is that WTO members not integrated into transnational corporate food supply chains likely will be unable to ensure that their agricultural exports meet SPS requirements. Governments should consider expanding current “aid for trade” pledges to include the financing of specific SPS infrastructure requested by WTO members with documented incapacity to finance that infrastructure from domestic sources. In the absence of adequate funding, proliferation of unfunded negotiating mandates may result in attempts to avoid SPS rule compliance. Furthermore, domestic adoption of international standards will not be enhanced by a

simple increase in current capacity building initiatives, since there is a considerable disjuncture between the sanitary-phytosanitary technical assistance requested by developing countries, particularly for SPS infrastructure, the assistance provided by donors that is often limited to training to understand SPS rules. (Evaluation XX)

8.4.2. Policy challenges and options for animal health

Over three quarters of the human diseases that are new, emerging or re-emerging at the beginning of the 21st century are caused by pathogens originating from animals or from products of animal origin, in particular species used for food production. These emerging zoonotic diseases continue to be a significant future global challenge for both human health and animal welfare. The policies to manage this challenge have been intensively studied and recommendations have been made to the international community with the objective of improving preparedness. Methods of controlling and responding to zoonoses have been proposed, through developing and strengthening surveillance systems and identifying risks, including the economic, sociological and political implications and the need for intersectoral collaboration has been emphasized (e.g., WHO, 2004). There is an even greater challenge for developing countries to fully meet the requirements of policies for the animal health sector when considering that the policy environment is changing due to continuously increasing needs and ambitions in the industrialized countries.

8.4.2.1 Major epizootic diseases and impact on trade

The effectiveness of current policies (eradication and SPS standards for maintaining disease free status) applied in industrialized countries to prevent outbreaks of the major epizootic diseases (DG SANCO 2006, Leforban and Gerbier, 2002) means that many developing countries will continue to be excluded from accessing the high-value international markets. This is because eradication of important animal diseases, a core principle of the OIE who determine the animal health standards within the SPS Agreement, is not considered achievable in these developing countries in the foreseeable future because it requires significant efforts and investments in surveillance and veterinary service to meet eradication and control policies (Scoones and Wolmer, 2006).

International debate on this dilemma has focused on an increased implementation in developing countries of other policies such as using a risk- and commodity-based approach that allows an alternative to the total restriction in trade of animals and animal products (Brückner, 2004; Thomson et al., 2004; Perry et al., 2005, Thomson et al., 2006). The concept is that different commodities pose very different risks for the spread of pathogens. For example, deboned meat has a reduced risk in relation to whole carcasses and is applied by certain countries to facilitate

import from certain FMD infected countries (DEFRA, 2005). Similarly, policies that limit import restrictions to certain export producing areas (regions) instead of restrictions on whole countries or continents are also recommended. Such regionalisation is considered as a useful additional tool in maintaining trade flow by limiting import restrictions in the case of new outbreaks of animal diseases, and also allowing import from individual countries or regions based on their improvement of the animal health status food products (DG SANCO 2006). Instead of focusing on achieving the high value export from African countries to Europe and the U.S., Scoones and Wolmer (2006) suggest focussing more on bilateral agreements between developing countries that protect exporting countries and producers. A third alternative for African countries is to focus local trade and markets to supply the growing local and regional demand for meat (Kulibaba, 1997; Diao, 2005; Scoones and Wolmers, 2006). These alternative policies for developing countries emphasize benefits to their producers by using food safety and animal health standards needed for the local and regional market.

8.4.2.2 Zoonoses as food borne infections - policies for integrated approach

In the U.S., it is estimated that Campylobacter causes 2 million cases of foodborne infections annually and Salmonella is estimated to cause another 1.4 million infections, the latter at a total estimated annual cost of US$ 3 billion annually (WHO, 2005b; USDA ,2007). In developing countries the situation is likely to be at least of the same magnitude. The vast majority of these infections primarily originate from animal production so the overriding aim for the animal health sector is safe food and consumer protection (Schlundt et al., 2004). A problem is that these infections usually cause no or very limited economic losses to animal production. Thus, efforts are needed to implement policies with economic incentives for producers to improve hygiene in their animal production in order to decrease the input of potential pathogens to the food chain. The need for integrated approaches is emphasized when interventions are needed along the whole food chain. Of particular interest are challenges posed by the increasing global demand for protein as animal feed, in response to the increasing global demand for meat (Morgan and Prakash, 2006). Meeting that demand e.g., increased soybean production in Brazil, has resulted in deforestation and environmental degradation from high pesticide use and significant problems with pesticide residues in the soy products produced (Klink and Machado, 2005). In addition, many countries have experienced an increased risk of Salmonella contamination in soy meal, which constitutes an important route for introducing Salmonella into animal production when used as animal feed (Hald et al., 2006; EFSA, 2006). A pandemic spread of Salmonella occurred when contaminated fishmeal from South America was exported to the U.S. and Europe, causing more than one million human cases in the U.S. alone (Clark et al., 1973; Crump et al., 2002). Salmonella contamination has become a significant challenge to the global marketing of animal feed and food products (Plym- Forshell and Wierup, 2006).

8.4.2.3 Endemic diseases – the major challenge and potential

Categorization of livestock diseases is critical for the determination of public intervention, as highlighted in the recent assessment of the EU animal health policy (DG SANCO, 2006). International and national policy and legislation focuses on the control of the major epizootic diseases and, increasingly, on the food borne zoonotic diseases. Economic compensation in case of outbreaks, surveillance and other measures are generally limited to these, so-called, listed diseases.

However, as illustrated in Fig. 8.5 endemic diseases comprise the majority of animal diseases and, in developed countries, continuous implementation of disease prevention measures directed against these endemic diseases is necessary for efficient production. The economic importance of endemic diseases is recognized and in many developed countries a number of the endemic diseases have been successfully eradicated. Such programs have been found to be very cost effective (e.g., Valle et al., 2005). The increasing focus on reducing antibiotic use to prevent resistance and on animal welfare further emphasizes the importance of control and/or eradication of animal diseases (Wierup, 2000; Angulo et al., 2004; OIE, 2005a).

INSERT FIGURE 8.5. PRINCIPLE CLASSIFICATION OF INFECTIOUS ANIMAL DISEASE PANORAMA

Control of endemic animal diseases should also be important in development. In 1991 FAO determined that control of animal diseases and the promotion and protection of animal health are essential components of any effective animal breeding and production programme. However, despite remarkable technical advances in the diagnosis, prevention and control of animal diseases, the condition of animal health through the developing world remains generally poor, causing substantial economic losses and hindering any improvement in livestock productivity (FAO, 1991). Consequently, in addition to efforts to minimize the negative effects of the major epizootic and food borne diseases, policy should also focus on the prevention and control of endemic diseases, even though the producer is generally considered to bear responsibility for this aspect of animal production. Such actions should also have a direct strengthening effect on food security and, in this respect, it has been emphasized that a focus on safe food in the context of strengthening export capacities of developing countries should come second to the primary objective of improving food safety for local consumption (Byrne, 2004).

8.4.2.4 Animal welfare – an opportunity for extensive production

The protection of animal welfare and the demand for a sustainable animal production system, which is increasingly being considered in animal health policies, opens opportunities for the

extensive livestock production in many developing countries in contrast to the intensive livestock production systems in many sectors of the industrialized world (OIE, 2005; Kyprianou, 2006)

8.4.2.5 Veterinary services: a global public good

The veterinary services of developing and transition countries are in urgent need of the necessary resources and capacities that will enable their countries to benefit more fully from market access opportunities in trade agreements, while at the same time providing greater protection for human and animal health, animal welfare and reducing the risks linked to zoonoses (OIE, 2004; Thomson et al., 2006). It is of utmost importance that the ongoing initiatives from OIE and others to support veterinary services, in particular in developing countries, continue. OIE emphasizes the need for veterinary services to support access of animals and their products into national markets, indicating the importance of animal health control in a safe and secure food supply. A challenging factor is the limited availability of veterinarians trained in veterinary public health (WHO, 2002) which in developing countries has opened for discussions on the need of para professionals such as community animal health workers (Scoones and Wolmer, 2006).

8.4.2.6 Priority setting for disease control technologies

Historically significant resources have been directed at tools for eradication policies and research often focus on the production of a vaccine that simply should be the key to success. These resources are also often directed to diseases that gain special attention in relation to international trade, diseases that might be of less economic importance in an endemic situation in a developing country (Scoones and Wolmer, 2006). However, effective vaccines are available only for a limited number of infections and therefore preventive actions needs to come into focus. Many important diseases have thus been successfully controlled through simple preventive hygienic methods. A more bottom- up priority setting approach can therefore be recommended as suggested by Scoones and Wolmer (2006). Mokaila (2005) highlights that a recommendation to boil milk could more simply and cheaply limit human health risks due to Brucellosis than a comprehensive vaccination control program in a cattle population where the disease caused relatively limited production losses.

8.4.3. Policy challenges and options for plant health

Food availability depends in the first instance on the actual production of food, which is influenced by agroecological production potential as well as by available production technologies and input and output markets (FAO 2005). Plant pests are key constraints to achieving the true yield potential of food and fiber crops, particularly in tropical and subtropical regions where conditions necessary for the reproduction of pests may be present year-round (Table 8.2). In addition to their direct and deleterious effect on the yield and quality of plant products, plant pests can also

pose an absolute barrier to imports when countries apply phytosanitary measures to regulate the entry or plants, plant products or others materials capable of harboring plant pests.

8.4.3.1. The challenge of international phytosanitary standards

International phytosanitary standards recognized as authoritative by the SPS Agreement can be a positive driver in developing countries. When applied to high value food products, these have played a beneficial role in stimulating improvements to existing regulatory systems and the adoption of safer and more sustainable production practices (World Bank, 2005). More commonly, however, international phytosanitary standards are considered as barriers to trade that particularly discriminate against developing country stakeholders who can neither afford to meet the high costs of compliance associated with these nor participate effectively in their development by international standard setting bodies like the International Plant Protection Convention (IPPC) (e.g., Simeon, 2006). Governments, institutions and farmers may respond to such standards in a number of ways: support or participate in programs that will address the management, control or elimination of the pest problem; find alternative foreign markets for nationally produced goods; focus on increasing domestic demand for trade-prohibited plants and products; or exit production, with or without compensation and/or incentives to promote diversification into other crops.

Governments generally divide resources applied to address phytosanitary considerations in two ways: 1. to meet the phytosanitary requirements of importing countries (export certification); and 2. to meet domestic phytosanitary requirements, including those applied to imported agricultural products. In both developed and developing countries these regulatory tasks are typically addressed through an array of plant protection and quarantine (PPQ) programs. Core services of traditional PPQ programs include activities such as: detection and control or eradication of plant pests of quarantine or economic significance; undertaking pest risk analyses; and managing import, export and/or domestic certification programs. These programs are being challenged by increases in the volume and kinds of agricultural products being traded internationally, the number of countries exporting such products, and international travel which creates more opportunities for the rapid introduction and spread of new pest species (FAO 2003).

8.4.3.2. Opportunities through regionalism

For some countries, particularly those with limited resources applied to national PPQ programs, regional or sub-regional programs may be a workable alternative. Regional initiatives could be used to harmonize standards where trade between the participating member countries for specific plant products is significant and where a different, less restrictive or less economically punitive standard may be sufficient versus that which is in place internationally. Regional efforts could be

made to pool scientific resources (human and institutional) to collectively manage plant pests and implement surveillance programs. For example, adequate surveillance data are important so that an exporting country can demonstrate that its plants and plant products are free from prohibited pests but many developing countries lack the capacity for surveillance and pest risk assessment required to demonstrate compliance with the import requirement. Surveillance data are also necessary to ensure that domestic phytosanitary measures are equivalent to those applied to imported commodities so that discrimination against imports based on pest exclusion is not supported. Efforts to collect these data for key pests that affect movement of plant material from or within a specific region may be best addressed by establishing harmonized protocols for data collection and then pooling resources to acquire the necessary information to demonstrate pest-free status. Initiatives to promote meaningful, results-based regional cooperation to address plant health issues will require incentives to promote cooperation both within and between national agricultural systems. Where regional regulatory programs may be government to government, these should also actively encourage the inclusion of other stakeholders, especially the private sector and producer groups.

8.4.3.3 Biosafety and plant protection

With the ratification of the Cartagena Protocol on Biosafety, many governments are in the process of developing or implementing national biosafety regulatory programs. With the rapid adoption and global trade of transgenic maize, soybean, cotton and canola the primary focus of these new programs is typically the regulation of transgenic crops. National, bilateral and international support for the establishment of biosafety regulatory programs has favored the creation of new regulatory entities under ministries other than agriculture. Given the shared nature of many of the regulatory functions of PPQ and biosafety programs (e.g., risk assessment, monitoring and inspection activities) and the inclusion of Living Modified Organismss in ISPM No. 11 (Pest Risk Analysis for Quarantine Pests, Including Analysis of Environmental Risks and Living Modified Organisms), there exists an opportunity to apply new resources available for biosafety regulatory capacity building to strengthen existing PPQ programs so that the objectives of both can be achieved without building redundant administrative services. This could be achieved under the umbrella of “plant biosecurity” to include plant health, plant biosafety and also invasive alien plant species.

8.4.3.4 Meeting the plant health needs of small holder farmers

Control of plant pests that are important from a trade perspective may be of little or no significance to small-holder farmers who are not exporting their plant products. Instead, their priorities are likely to be management of local pests that will have a direct impact on their harvested or post-harvest yield. Policy makers could ensure that the small-holder farmer, whose

fields may be an inoculum source of a trade-prohibited pest, is provided with incentives to assist in the management of such pests so that export certification of the commodity in question can still be achieved. This could come in the form of support that links breeding or pest management programs designed to address the priorities of the small farmer with activities that will also assist in the management of the prohibited plant pest. Similarly, a government could strengthen the capacity of regulators to enforce compliance with internationally relevant phytosanitary standards but couple this with direct support for the primary producer where production practices may have to be modified so that pest exclusion goals can be attained.

An alternative policy option is to realign public sector AKST funding to support research explicitly directed to improving small-holder, diversified farming practices that promote improved yields and enhanced food quality through sustainable pest management practices. These could variously include IPM, organic farming, and improved plant breeding programs, including the development of pest resistant varieties through marker assisted selection or recombinant DNA techniques. National prioritization of the needs of resource-poor farmers may be more important in the future as scientific and agricultural technology spillovers from developed countries that are adapted by developing countries may be less available as the agricultural research agendas of developed countries move away from the interests of the poor and support for the CGIAR and other IARCs continues to decline (Alston et al. 2006).

8.4.3.5 The private sector and third party certification

The private sector has responded to enhanced consumer awareness and concern about food safety by developing their own phytosanitary (and sanitary) standards, enforced through third party certification (TPC; Hatanaka et al. 2005). This means that participating primary producers have to meet an array of requirements that go beyond those mandated in government regulations, such as implementing traceability programs or participating in accreditation programs that add expense and complexity to more traditional production systems. While there are examples of developing country farmers who have benefited from TPC (Hatanaka et al. 2005), arguably these private sector standards discriminate against resource poor farmers who cannot afford the high costs of participation. In response, governments may decide to align their public sector investment to ensure that AKST is applied to assisting producers to meet only statutory phytosanitary standards, through agricultural research, extension and/or education systems. Iindividual farmers or commodity-specific producer associations would have to use their own resources meet additional private-sector requirements. Alternatively, governments could strategically invest in AKST that will promote the participation of small-holder farmers in TPC, through the provision of education programs and technical assistance. This may also provide a stimulus for the development of off-farm employment opportunities through the provision of services such as third-party accreditation of farms or production systems. Internationally, the

private sector in developed countries, which is driving TPC, should promote the harmonization of private sector standards and streamline accreditation, especially where these apply to plant products produced in developing countries (Jaffee 2005).

8.4.3.6 Climate change and plant health

A significant consideration for policy makers tasked with addressing plant health issues is the impact that climate change will have on plant production. Climate change can affect plant health by: modifying the encounter rate between host and pest by changing the ranges of the two species; introducing new hosts, vectors and/or pests; causing social changes such as shifts in agricultural labor; and shifting land use patterns that will alter the potential for populations of plants and pests to migrate to fragmented landscapes (Garret et al., 2006). In response to this, policy makers will be challenged to decide if investments in development and deployment of AKST will be anticipatory (e.g., inclusion of climate prediction in forecasting models of plant disease) or reactive (e.g., deployment of resistant varieties after the emergence of a new epiphytotic). Action to mitigate the impacts of climate change on crop production will require integrated strategies developed and implemented in a participatory fashion. Coherent policies should be developed cooperatively through non-traditional partnerships within government (e.g., Ministries of Agriculture, Energy, Trade, Health and Commerce) and with significant guidance from academic, agricultural, non-governmental and private sector players.

8.4.4. The way forward

Recognizing that food safety, animal health and plant health are global public goods, new mechanisms to support the development and, most importantly, implementation of proactive and preventative policies and programs to facilitate compliance with SPS standards should be explored. Internationally, donor support could be targeted to specifically assist those countries that cannot adequately finance SPS standard implementation nationally but attention should also be paid to ensuring that trade facilitation is not the only driver of SPS program delivery. The application of AKST to address yield and quality losses associated with pests or pathogens that are of domestic, but not international, importance may have more impact on reducing hunger and poverty, and improving nutrition and health, particularly in the least developed countries, than applying these resources exclusively to accessing international markets. For small developing countries, the possibility of regional food safety "trusts" to provide a continuous funding source for shared SPS related surveillance programs, infrastructure and personnel should be considered. An international SPS insurance mechanism that would supplement or replace current ad hoc funding to detect and mitigate transborder food contamination incidents, zoonoses and plant health contagion should also be considered.

Internationally, policy and regulation related to food safety, plant and animal health needs to be better integrated to more effectively utilize the limited resources that are applied to SPS issues. Confining Codex, OIE and IPPC to work within their constitutional mandates may be of less relevance today given the globalization of agriculture and trade, the application of new and converging technologies in agriculture, e.g., agri-nanotechnology. Furthermore, the efficacy of working within the traditional international mandates is challenged by the emergence of alternative regulatory mechanisms that integrate food safety, animal and plant health related standards and production practices in on-farm HACCP plans and other retailer-driven certification programs and in alternative guidance provided by Good Agricultural Practices and Good Manufacturing Practices. Revising SPS-related policy and regulatory measures within a biosecurity framework may be one option for promoting cross-sectoral interventions designed to promote coordination, limit duplication and identify potential areas of conflict that may arise from inconsistencies among international agreements and standards that, when translated into action, result in adverse impacts on agricultural productivity and rural livelihoods.

Insert Figure 8.5. Principle classification of infectious animal disease panorama.

Insert Table 8.2. Actual production and estimated losses for eight crops during 1988-90, by pest and region

8.5 Policy Options for Development: Property Rights and Partnerships

The generation, dissemination and maintenance of knowledge increasingly depend on the rights that can be claimed on it, and thus on the 'owner' of that knowledge. Knowledge can be in private, communal, and public domains. Until recently, rights over knowledge, technologies and resources in agriculture have been governed by the 'law of the land'. Traditional knowledge and, e.g. genetic resources, were broadly shared in most agricultural communities, restricted mainly by cultural and physical boundaries. Agricultural knowledge, science and technology is now generated and maintained in agricultural practice, and in public and private institutions. Globalization implies that new AKST can be developed in public or private entities in one country and applied in another. The interactions between these domains have changed the perception of ownership over knowledge by farmers, private institutions, governments, etc. The rights systems that derived in turn have an impact on the roles of these institutions. Public research institutions in both industrialized and developing countries, that used to develop knowledge for the public good, increasingly face the choice whether to protect and commercialize their knowledge instead of making it freely available to all. National policies, such as those leading to the Bay-Dole Act in the USA, lead to increased commercialization strategies for publicly developed knowledge and technologies. Also reduced public expenditure in agricultural research and the expansion of public-private partnerships in agricultural research tend to stimulate the protection of knowledge by public research institutions.

This is a crucial issue in that it deals with public action models that could ensure the transition from knowledge to action. It will be dealt with in this subchapter where particular place will be given to systems of rights that relate to the recognition of the modes of access to, use and appropriation of the different tangible and intangible goods are essential for reaching the Millenium Goals that set the development agenda for the years to come. Given the challenges set by these goals as an “object” for international policies and the role that can be legitimately expected from AKST systems therein, one needs to establish how top-down knowledge, norms and regulations expressed in terms of public policies are articulated within the variety of local cultures, and how particular interests can be expressed at different levels that constitute the different spaces of collective action. The design of systems of rights and the forms in which these are implemented are exemplary of interactions between various levels of organization ranging from international conventions and commitments to local forms of interpretation with or without the filter of national policy and legal systems. The ways in which results produced by the AKST system are used, exploited and disseminated, when they are not central to the re-composition of these systems of rights, systematically encounter them on the ground. Information can take very different forms. For example, Dasgupta and David (1992) propose readopting the classical distinction between explicit and incorporated knowledge. Explicit knowledge is also referred to as ‘codified knowledge’ which is expressed in a format that is usually standardized and compact, so as to permit easy, low cost transmission, verification, storage and reproduction. On the other hand, incorporated knowledge can be embedded in persons and communities (scientists, technicians, practitioners, lay people, etc.) or in instruments or in machines. This knowledge takes the form of know how, rules of thumb and technical automata; all of which play an essential part in the interpretation of results and the setting up and conduct of experiments. Codified statements, bodies, machines, substances are a few of the messengers that are put into circulation and that make those who appropriate them act. Thus the ways in which they have been produced are clearly altering previous ways of acting.

The question is posed according to different policy options. Private goods are defined in Economic textbooks as those that are rival in consumption and that have excludable benefits or costs. Public goods are defined as having the opposite characteristics: as being non-rival in consumption and having non-excludable benefits. They are often classified as market failures and as justified cases for government interventions: the provision of private goods is assigned to the market, and public goods to the state. The public domain appears as a residual category, with states performing tasks that markets cannot. But things are note so simple: both contribute, among others, to the public and private domains. Moreover, the properties of goods can change from being public to private and from private to public. Yet many knowledge elements are made

exclusive and private through property rights. In the form in which society often likes to see them, they fall into the private domain, as non rival but exclusive goods. On the other hand, scientific knowledge – except when embodied in physical products like molecules, which are patented – is probably more a non rival and non exclusive good, situation reinforced by new technologies of information and communication and the considered as a global human made common (Kaul et al., 1999).

The public or private status of the “objects” concerned, the inducement to individual accountability or to collective action, the forms of appropriation of goods, whether material and immaterial, the interpretation and importance accorded to intellectual property rights, are not specified in identical ways in different policy options, as illustrated in the first part.

This subchapter is organized in 5 parts:

- The first discuss the status of scientific knowledge as a public/private good at the global level;
- The third describes the different types of formal rights regarding knowledge and materials containing information (notably genetic resources) and shows how the recognition of locally expressed knowledge is played out at national and international levels and meets scientific knowledge;
- The fourth concentrates on the potential impact of the implementation of a set of right regimes on the acquisition, development and use of proprietary knowledge in developing countries notably on relevant institutions in agricultural research and extension;
- The fifth explores how informal knowledge, used at local level to manage natural resources (such as water, soils, biodiversity, forests, etc.) can be formalized and taken into account in formal forms of regulation, according to the assessment of their consequences at several levels of organization and scales (space and time);
- It concludes with a discussion on the different kinds of partnership that can be used for AKST development and dissemination.

8.5.1 Public research and the generation of public goods

Public agricultural research has been important in food security and rural development. In industrialized countries, this role has diminished in favor of privately managed and/or funded research leading to proprietary technologies. At the same time public research is more and more often resulting in privately controlled knowledge. Public research institutions have to decide how to deal with these developments as opportunities to protect knowledge increase and access to innovations, local knowledge and genetic resources becomes restricted through different regulatory systems. An issue is whether to protect their innovations and use these rights purposely in technology transfer, i.e. vis-à-vis different end-users and intermediaries (e.g. seed

producers). In addition they need (negotiation and legal) capacities to obtain access and systems to administer the use of knowledge and materials in their institute.

The issues involved here are the status of knowledge and the nature of “public/private good” of scientific and technical knowledge. Knowledge in the public domain can be taken advantage of by others than those who produced it. In this type of system, the marginal cost of supporting agricultural development through research is low, but the investment costs are borne by few. Public investment in research is justified by the facts that the impact of research for development may be measurable only in the long term, the success of research may be unpredictable as is the lifespan of new products, and the size of innovation markets (recommendation domain) is difficult to assess beforehand.

As recalled above, both codified and incorporated knowledge can be treated as goods. Texts, scientists, samples and measuring instruments can all be exchanged, stolen, hidden, or lent out. Anthropologists and sociologists have studied the forms of production of scientific knowledge (Fuller, 1993; Callon, 1994) in order to analyze this characterization of ‘science as a quasi-public good’ vs a ‘private good’, as stated by economists. Rules, practices, cultural forms, and relationships vary from one collective to another. By relentlessly pursuing the task of charting diversity within an activity – science – that is generally accused of creating uniformity and destroying the wealth of traditional cultures, anthropology has stated that science is a public good, which must be preserved at all costs because it is a source of variety, by inciting to creativity and imagination and not only to effectiveness. It causes new states of the world to proliferate. And this diversity depends on the diversity of interests and projects that are included in those collectives that reconfigures nature and society. Without this source of diversity, the market - with its natural propensity to transform science into a commodity – would be ever more doomed to convergence and irreversibility. In the end, it would negate itself.

Others on the other hand claim that intellectual property systems such as patents, are meant to bring knowledge in the public domain, by its requirement to publish the invention in such a way that persons skilled in the art can reproducer it, and through the temporary nature of such IPRs, which guarantee that the invention is available to the public after the expiry of protection.

In regard of policy, the issue concerns public versus private use of AKST and public versus private generation of AKST, probably highlighted by the increasing need of infrastructure and high specialization of expertise required to carry on advanced research in biology and biophysical processes. More and more public/private partnership are forged with different arrangements

concerning the status of the results. Innovation – a change in order to solve a constraining situation - is both a key for human development and a tool for competitiveness!

This is why one talks in this situation of “global public goods” (GPG) and why the accountability of public research is engaged, as stated by J.Stiglitz at the World Bank. The question arises how to define international priorities for the production of such goods in world-wide schemes (e.g. in the CGIAR) that deal with competing stakes such as economic development in developing countries, poverty reduction and environmental protection and climate change. In its 2001 Report on human development, UNEP reminds that “Third World countries should not remain indefinitely the hostages of research programs dictated by world trade demands and the production of global public goods.” The issue is evidently that of a more balanced distribution of scientific and technical competencies across the world, taking into account interactions between knowledge and other public goods. Here the problem is no longer a matter of resorting to technology transfers; for some, such as J.M. Chassériaux (2004), it is even “natural to think that it is the African researchers who will have the clearest vision of the relative importance of the problems that demand their competencies and of the practical conditions in which the solutions found can be put into practice.” A significant source of concern for poorer countries is the widening knowledge divide resulting among other factors from the trend towards the protection of scientific knowledge, and products and processes such as ‘plant varieties’, genes, natural substances and biological technologies and information. How can such knowledge be applied to benefit also the least favored countries and communities in the South? The introduction of private, communal and national rights creates a wide range of challenges for public research.

8.5.2 Multilateral negotiations on right systems on traditional knowledge and genetic resources

How to protect and license the use of intellectual property (IP) and traditional knowledge (TK) continues to be fiercely debated in World Intellectual Property Organization (WIPO), the WTO negotiations to amend the Agreement on Trade Related Aspects of Intellectual Property (TRIPs) and in various civil society forums. How to implement national sovereignty over genetic resources and ensure their sustainable use and arrange for Access and Benefit Sharing (ABS) is likewise controversial within the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Seed that farmers use represent an important AKST issue, where the information embedded in the genetics of the seed as well as the associated farmers’ and scientific knowledge about seeds represents a significant part of AKST. This assessment presents some major negotiating positions as they may affect future uses of AKST for achieving IAASTD goals. Of particular concern is whether intensively patented AKST, such as agricultural biotechnology products, will dominate developing country

AKST investment and research agendas, to the neglect of types of AKST that is based in unprotected TK and used by small landholders (Herren, 1998).

WIPO and WTO. Proposed binding WIPO norms to protect TK and GR from unauthorized and unremunerated misappropriation (i.e. "bio-piracy") have been rejected as a threat to WTO IP rules (e.g. WIPO, April 2006, paragraph 211). A developing country proposal to amend TRIPs Article 29 to require disclosure in patent applications of TK and/or GR used in the development of patented products (WTO, May 2006) has likewise been rejected by patent-rich developed countries, but is included in some national laws. Disclosure proponents argue that disclosure is required by TRIPs to improve patent quality (Article 27.1), prevent abuse of the patent system and promote the public interest (Article 8), provide social and economic benefits to WTO members (Article 7) and to make TRIPs supportive of the CBD, particularly its ABS provisions (Articles 1 and 15). Disclosure opponents, particularly the United States, contend that ABS is best implemented through contracts that offer a one-time cash payment in exchange for the rights to patent products developed from an agreed number of GR samples, e.g. IPRs for products developed from 10,000 GR samples in exchange for $1 million plus testing equipment offered "significant benefits" to mega-biodiverse Costa Rica (WTO, March 2006). Disclosure opponents further argue that disclosure would create "legal uncertainty" about patents granted prior to adoption of a disclosure requirement, with consequent economic damage to patent holders whether or not they could supply documentation to fulfill a disclosure requirement.

Norway has proposed an amendment to the disclosure requirement that could allay some of the anxiety about the "legal uncertainty" created by retroactively applied disclosure while helping to implement TRIPs more fully. (WTO, June 2006). Norway would require disclosure notification to the TRIPs Council and WTO members would not allow patent applications to be granted until disclosure documentation was furnished. Failure to disclose TK and GR used in patents already granted would not be linked to revocation of those patents but would be disciplined outside the patent system. To ensure that TRIPs is mutually supportive of other relevant multilateral treaties, Norway proposes that WIPO's Patent Cooperation Treaty and Patent Law Treaty should include a disclosure amendment, that the disclosure provisions be "fully compatible" with the ITPGRFA and that patent offices notify declarations of origin of GR and TK to the CBD Clearing-House Mechanism. The Norwegian proposal provides a formal structure to more fully implement IP agreements while providing a framework for enabling the remunerative and sustainable use of TK and GR. While Article 9 of the ITPRGFFA recognizes the principle of farmers rights' over TK and GR for AKST, the treaty's implementation does not yet provide an effective mechanism to realize those rights through enforceable control over TK and GR.

Genetic resources in agriculture. Challenges to bring the private rights of IPRs in harmony with the collective rights over traditional knowledge and local genetic resources are further complicated by the rights based on national sovereignty over the physical genetic resources established in the CBD. Apart from conceptual and legal challenges, this has led in the past years to practical problems in the exchange of genetic resources, which affects the agricultural use of genetic resources in plant ad animal breeding more that any other type of use. The International Treaty provides a number of practical solutions for this type of use within the overall framework of the CBD. The multilateral system for access and benefit sharing should facilitate the use of genetic resources in plant breeding of almost all important food crops and forages. Important steps have been taken in the sharing of benefits derived from the use of these resources in a multilateral way through the conclusion of the Standard Material Transfer Agreement, but the funding strategy of the IT PGRFA still shows some significant gaps. The IT PGRFA confirms the Farmers' Right of protection of traditional knowledge which established a link with the debate in WIPO, the right of benefit sharing linking it further to the CBD, and the right to participate in decision making at the national level on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture. The IT PGRFA refers the implementation of these rights to the national level, and there may be a long way ahead for national policy makers to implement these Farmers' Rights while avoiding conflicts with IPR, Biodiversity and Seed regulations with the right of farmers to save, use, exchange and see farm-saved seed.

Traditional knowledge and genetic resources at stake. However, IP regimes alone, no matter how comprehensive, fully implemented, and mutually supportive of other multilateral treaties, are insufficient to enable development of the agricultural institutions and products needed to fulfill IAASTD goals, e.g. improving national seed systems to enhance food security and nutritional objectives, and poorly designed and implemented regimes can be detrimental to these objectives (World Bank, 2006). Furthermore, apart from the challenges of establishing substantive international TK norms the problems to develop effective enforcement mechanisms of such norms may be even bigger. The trustees of TK and *in* situ GR used in AKST are often indigenous and collective groups. Because enforcement of any norms to protect, sustainable use and license the use of TK and GR requires a well-functioning and harmonious relation between national governments and the governance structures of these groups, where such relations do not exist, enforcement becomes problematic. Insofar as effective indigenous and community trusteeship over TK and GR requires access to land, negotiations with governments to ensure that access will likely be part of TK and GR trusteeship administration between indigenous groups and national governments (UNEP, 2003).

A review of technical papers in support of the WIPO negotiations has proposed that an "international enforcement pyramid" be constructed from existing practices to enable developing

countries to control and sustainable use TK and GR. (Drahos, 2006) The “enforcement pyramid” would integrate indigenous and national government practices and would be coordinated by a Global Bio-Collecting Society under the aegis of WIPO, FAO and the CBD. Further complicating the construction of an effective enforcement mechanism for TK and GR are differences between indigenous customary law and governance, and national governments, particularly where indigenous territories cross national boundaries. (IIED, 2006).

WIPO negotiations for a Substantive Patent Law Treaty (SPLT) present a framework for IP protection and enforcement very different from an enforcement pyramid based on national and indigenous group enforcement practices for TK and GR protection. The SPLT is part of a Patent Agenda to create and enforce a “global patent” with mechanisms far more specific and powerful than the TRIPs enforcement provisions (Article 41.) (WIPO, 2001) Under the SPLT, patent holders in the WIPO members that own more than 98 percent of all patents (de Paragua Moniz, 2005), -- the United States, the European Union and Japan -- would reduce the time and transaction costs of having their patents accepted. SPLT would mandate specific enforcement mechanisms in all WIPO member states. The U.S., EU and Japan are the main SPLT advocates and cooperate on measures to expedite patent granting and enhance patent enforcement (e.g. “EU-US Action Strategy for the Enforcement of Intellectual Property Rights”, Brussels 20 June 2006) and “New Basic Patent Policy,” Ministry of Economy, Trade and Industry, Government of Japan 19 October 2006).

The risks and benefits of the draft treaty have been vigorously debated in WIPO forums (e.g. Open Forum on the Draft Substantive Patent Law Treaty”, WIPO (March 1-3, 2006). Some IP scholars are concerned that the SPLT could negatively affect public AKST and access to publicly held GR, particularly in countries where rules on plant variety protection do not yet limit farmers’ rights to save or exchange seed. (e.g. Tvedt, 2005). The SPLT may also limit developing countries to shape their patent laws to their own specific needs, taking into account the development stage that they are in. SPLT is thus seen as supporting the Trade agenda rather than supporting innovation in developing countries. Developing countries have charged that the SPLT reduces WIPO’s mandate to enforcement and have proposed instead a Development Agenda that would subordinate enforcement to the negotiation of development IP objectives, including binding rules on TK and GR protection (WIPO, August 2004). There is no consensus on further advancing the Patent Agenda or the Development Agenda.

Nevertheless, elements of the draft SPLT are being carried forward in Bilateral Investment Treaties (BITs) and so-called TRIPs plus Free Trade Agreements (FTAs), and these elements could affect AKST research, applications and investment. Recent FTAs require the patenting of

biological resources, thus overriding the patenting exemption in TRIPs Article 27.3, and require countries to become member of the Union for the Protection of new Varieties of Plants (UPOV), thus closing the door for alternative breeder's rights protection systems, including earlier versions of the UPOV Act that are more compatible with farmers' seed systems (World Bank, 2006). These FTAs also prohibit parties from citing resource constraints as a legal defense for non-enforcement of IP obligations (Fink and Reichenmiller, 2005). BITs with many of these parties define IP and GR in ABS agreements as "investments" and allow a very broadly defined "investor" to sue states for non-enforcement of investor rights, no matter how resource constrained the developing countries parties may be (Correa, 2004).

Some needs in IP economics. Decision-makers evaluating the risks and benefits of committing to multilateral and bilateral IP and TK disciplines do not have the economic simulations (often econometric modeling) that agricultural and non-agricultural market access negotiators can use. Such simulation studies for IP and TK might help decision makers assess multilateral and bilateral IP policies in an overall terms of trade framework. From an ex post perspective the cost of TRIPs implementation and the additional cost of patented agricultural inputs would be difficult to justify in light of the aggregate 53 percent price drop in agricultural export commodities from 1997 to 2001 (FAO, 2004). Nor can the econometric outlook of for commodity prices resulting from the most likely terms of the WTO Doha Round -- an aggregate 2.8 percent price increase from a 2002 baseline over the anticipated 2007-2015 duration of the Doha Round implementation -- provide much trade rationale for adopting IP obligations. (Bouët et al., 2004). The trade rationale for investment in patented AKST becomes weaker still when taking into account the costs of state liability for non-enforcement of IP as "investment" in BITs and individual producer liability for violating patent holder rights, e.g. of agricultural biotechnology firms. The justification for developing country assumption of AKST related IP obligations apparently then resides not in trade revenues, but in the food security promises of a Second Green (or Gene) Revolution. Such food security promises may however not materialize taking into account developments in bioenergy.

The economic value of licensing TK and GR is uncertain and there is no agreed method to do it. As part of a project to measure GR erosion and to suggest how royalties paid to source countries might provide incentives for GR conservation, FAO estimated that a one percent royalty on sales of patented seeds incorporating indigenous TK and GR would return about $150 million per annum to the source countries, most of them developing countries (FAO, 1998). The contribution of indigenous TK and GR to creating the vigor in new varieties upon which global food security depends has been treated as a priceless public good, not even valued once it is privatized. Economic estimates of the value of TK and GR in the global agrifood system are lacking. Likewise lacking are cost estimates for the conservation of TK and GR for indigenous crops and

landraces. Such estimates are pre-requisites for informed negotiations to establish TK and GR licensing royalties that ensure agrobiodiversity reliance and the economic well-being of agrobiodiversity trustees. Finally, the global cost of withholding access to genetic resources due to national access regimes are insufficiently researched. Given the interdependence of countries on genetic resources (Flores –Palacios, 1997) and the fact that exchange of agricultural genetic resources among developing countries is much more frequent that transfer from South to North (Fowler et al., 2001), such costs are likely to be borne to a large extent by developing countries.

Challenges for public research. In sum, the interlocking multilateral and bilateral IP, TK and GR arrangements outlined here present difficult questions for decision makers, including:

- how to prevent the misappropriation of TK and GR that can lead to further genetic erosion
- how to enhance patent quality, particularly for AKST investment
- how to harmonize national, community and private rights systems over genetic resources and associated knowledge?
- how to enforce IPRs and the sustainable use and remuneration of TK and GR
- how to evaluate costly IP policy commitments affecting patented AKST when agricultural commodity prices are so low and when various factors inhibit export of value-added food and fiber products
- how to estimate the value of TK and GR in patented products and negotiate a royalty sufficient to sustain and regenerate agrobiodiversity and its trustees

Intellectual property rules protect patented agricultural products, e.g. inputs, but there is no mechanism to protect and remunerate the traditional knowledge and genetic resources from many of those products are derived. The conservation and sustainable use of agricultural biodiversity requires mechanisms to support traditional knowledge and the in situ conservation of genetic resources, particularly those used in agriculture. Current policy options for remunerating the trustees of agrobiodiversity include one-time payments for access to genetic resources, sometimes defined as an “investment” in bilateral investment treaties, or the annual licensing of traditional knowledge and genetic resources according to a Traditional Resources Rights Agreement negotiated biodiverse resources requires several layers of administration, including effective working under the aegis of the World Intellectual Property Organization. However, the enforcement of such an agreement and the sustainable use of agrobiodiverse resources requires several layers of administration, including effective working arrangements between indigenous and community groups who have been the primary trustees of agrobiodiversity and national governments or a regional governmental mechanism. A further policy option to support sustainable conservation of agrobiodiversity would be an amendment to the WTO TRIPs agreement that would require patent applicants to disclose traditional knowledge and the source

of genetic resources used in patented products. Such disclosure could help in the process of licensing the traditional knowledge and genetic resources used in a patented product.

8.5.3 Impact of rights on AKST at the national and institutional levels

The previous subchapter has indicated that the implementation of international policies on (intellectual property) rights to AKST at the national level may be costly compared to the benefits. This subchapter will concentrate on the potential impacts of the implementation of such rights on the acquisition, development and use of proprietary knowledge in developing countries notably on relevant institutions in agricultural research and extension.

Intellectual property rights (IPRs) on products and processes that are relevant to agricultural development in the widest sense create novel conditions for the use of AKST at different levels. IPRs are intended to stimulate innovation, both in terms of investment in research and of obtaining potentially useful technologies from abroad by providing for an exclusive right on the commercialization of the technology or products derived thereof. The exclusive right may be used to create a commercial benefit by banning competitors from the market and/or by obtaining benefits through the licensing to others. IPRs thus fit in a paradigm of market-led development which is essentially different from both the concept of sharing ideas that characterize most farming communities (and which is essentially different from medicinal knowledge in many communities) and from the public goods paradigm which dominated the agricultural research for development policies for over 50 years. The introduction of IPRs is thus likely to significantly affect the organization and focus of research for development and AKST in general, and public research institutions in particular. Currently, these developments are particularly felt in the sphere of plant breeding and biotechnology. In the remainder of this subchapter we will therefore concentrate on this field of AKST for development.

Stimulating private investments in research. IPRs are meant to stimulate private investment in research, which could involve new research in a developing country. However, IPRs may more likely support in LDCs with a limited research capacity the importation of proprietary technologies from abroad (e.g. Bt cotton). Factual proof of such impacts is very limited however. UPOV (2005) makes claims to that effect, but its research methodology is not very comprehensive. Several studies show however inconclusive results for the plant breeding sector (Pray, 1991; Alston and Venner, 2000; World Bank, 2006). The latter report based on a study in five developing countries concludes that IPRs may support the development of a private seed industry mainly when this sector has reached a certain level of development, but that it is in practice not a major stimulus for initial investments in the sector. It furthermore illustrates the potential of other protection

mechanisms for breeders and seedsmen, including technical (biological) protection, and seed and biosafety laws.

Public-private partnerships in research. Through their reliance on license agreements, IPRs form an interesting alley to help organize the relations between different players in the knowledge chains, providing incentives for upstream technology providers to share their inventions with users in applied research, agricultural input supply, and farming. In return, IPRs may provide, through exclusive licenses for particular markets, for incentives for downstream users (e.g. seed producers) that without such exclusivity might not be able to bear the cost of including a new technology (e.g. a variety) in their product mix. In general, IPRs provide a way to share benefits among the different chain partners through the transfer of technology fees (royalties). IPRs are the basis of negotiating partnerships in research between private and public partners, notably private IPR-holders and public research institutions in accessing technologies in a certain country. Such acquisitions are facilitated by NGOs such as ISAAA and AATF.

Financial support to the public research systems. Even though IPRs fit in a commercial approach to innovation, it is in many countries the public sector research institutions that promote the introduction of IPRs in agriculture. This is mainly based on a perception that these institutes may obtain significant revenue when their inventions (e.g. plant varieties) may be protected. This revenue is welcomed in a situation of under-investment in public research in many countries, which is common in many countries since the 1990s (Byerlee et al, 2002). This 'life line' may, however, have a major setback, i.e. that such benefits can only be obtained in commercial markets (e.g. seed markets) and reliance on IPR based revenues is likely to lead to a change in public research priorities from development to business opportunities, in some cases to commercial crops like maize and oil crops at the cost of research on small grains and pulses, and to benign cropping conditions and market oriented farmers at the cost of a smallholder farmer focus (Fischer and Byerlee, 2002). Such sifts may fit in market orientation priorities of national development strategies, but may at the same time challenge to some extent the public tasks of contributing to poverty alleviation and household nutrition security (Louwaars et al, 2006).

Challenges to technology transfer – thickets of rights. Even though license agreements may promote technology transfer by clarifying roles and responsibilities, IPRs may also pose serious risks to research and the use of technologies in development. Particularly in advanced research so called thickets of rights lead to the tragedy of the anti-commons (Heller and Eisenberg, 1998). Property rights on research tools, processes and products create very complex situations for researchers and their institutions, potentially leading to under-utilization of technologies. Research institutes have to learn how to establish and negotiate their freedom to operate on

these technologies. The quality and enforceability of the claims of a patent may significantly differ between jurisdictions; negotiating access to a technology can be very difficult when unequal partners are involved; so-called humanitarian use licenses may be granted when the use of a technology is unlikely to challenge the commercial interests of the right holder, but the small print can create significant obligations for the recipient.

These are new fields in most developing countries of which the actual impact cannot be readily assessed yet (World Bank, 2006). The rights on enabling technologies may determine the challenges downstream for producing public goods, which has been the main focus of public research, and more specifically for the centers of the Consultative Group on International Agricultural Research. When more and more technologies are protected by IPRs in their target countries the policies of producing international public goods may become more and more difficult (Fischer and Byerlee, 2002). Currently, these centers are venturing in technology licenses that provide a public good status for the purpose of poverty alleviation and food security in developing countries, while maintaining ownership in commercial markets both in developing and industrialized countries.

Costs of compliance. Compliance to the third party rights requires public and private research institutions alike to invest in capacities that they didn't use to require in the past, notably legal and commercial specialists. There are already commercial seed companies that spend far more on legal council than on research, and even though this may not be the case at this moment, this may be a 'warning' to public research institutions. Legal advice is not only needed to channeling the use of research results in development oriented and commercial markets through contracts that need to be negotiated and concluded and court and settling disputes, it is also more and more influencing the research itself. Scientists may be required to use old (free or cheap) technologies instead of the most effective ones that may be costly or not available for use. Scientists feel stifled by the role of the lawyers of the institute who have a task to make sure that third party rights are respected and that the IP produced in by the scientists can be protected, putting restrictions in scientific communication before a patent application is filed.
Another cost of compliance is the need to transfer obligations derived from contracts downstream, i.e. a research institute working in plant breeding with genetic materials that have been obtained through contracts may have to require farmers involved in local testing of potential new varieties to sign contracts restricting their use of the varieties that they obtained (e.g. farmers participating in rice research in the Philippines).

Humanitarian use licenses on individual bits of AKST only reduce these burdens to a limited extend. More generic approaches as initiated by an international consortium of research

institutions forming the "Generation Challenge Program" (www.generationcp.org – Barry and Louwaars, 2005), more generic strategies that make technologies more easily available for development purposes as proposed by PIPRA (www.pipra.org) and potentially also the application of open-source approaches to genetic technologies (www.bios.net) may provide more sustainable solutions to the emerging thicket, but their impact is yet limited.

Private, communal and national rights. It is not only the private rights (mainly IPRs) that affect the organization of agricultural research for development. Also communal rights, such as those based on traditional knowledge, and sovereign national rights (on genetic resources based on the CBD) affect research institutions in a similar way. Transaction costs are increased through the need to negotiate access and terms, the opportunities to use the best available inputs in research are reduced, and the use of the research results may be restricted. Safrin (2005) and Louwaars (2006) explicitly include this kind of rights in the analysis of institutional challenges. Research institutions need to trace all the knowledge, technologies and genetic materials in the various research programs and may have to check at the start of every program or experiment whether third party rights may interfere, and may have to consult these at every step of making heir new technologies available to farmers. The implementation of the International Treaty on Plant Genetic resources for Food and Agriculture is likely to reduce the burden at least for the use of genetic resources of the major field crops and pasture species.

Challenges for public research. Whether public research institution intend to obtain revenue through protecting their own intellectual property or not, the need to develop institutional policies how to deal with such rights. Such policies need to be backed by public policies on this matter. In practical terms, institutes need to be prepared to answer the following questions (Barton et al., 1999): Which inventions should be freely released to the public? Which inventions may be most efficiently brought to the user through the private sector and how can this be achieved in a transparent and equitable manner? Which inventions can be a potential source of income? Which inventions and assets can be used as bargaining chips for cross licensing? Which inventions need IP protection in order to keep them in the public domain?

Responses to such questions require capacity building (Erbisch and Fischer, 1998) that focus at three different levels: scientists, research managers and policy makers (Cohen et al., 1999), and the establishment of specialized technology transfer offices (Maredia and Erbisch, 1999).

Above all, national policy makers responsible for agricultural development and the national agricultural research systems need to be aware of the challenges that new rights regimes on intellectaual property, traditional knowledge and genetic resources pose in the public research

institutes and their relation with an emerging private sector. Policies that reduce public expenditure, that promote the use of IPRs by public research institutions or that restrict access to genetic resources and traditional agricultural knowledge should be based on a thorough understanding of the role of public research in the arena of access, development and use of AKST in development.

8.5.4 Right systems on natural resources: local/global

Scientific knowledge is accountable of the frames through which the real world is perceived by stakeholders, like scientist (fundamental and applied), local innovators, policy makers, businessmen, negotiators in international arenas, etc. The current knowledge on local management systems of natural resources and the theories to which it refers are the basis upon which decisions and agreements are made.

For example, in 1969 Hardin applied game theory to what he termed *The Tragedy of the Commons.* He called for the privatization of natural resources to ensure their proper management and for relinquishing common management of resources. His proposal ignored the fact that there are multiple forms of collective organization of access, management and use of resources and that the absence of private rights of ownership over natural resources does not automatically imply absence of an efficient management of these resources. Commons are open access resources the property of which is not allocated to individuals but supposedly owned in common. Commons are not excludable at sufficiently low cost and are *in se* not rivalrous. Additional consumers of this good may draw up from this excess supply with no extra cost. (Kaul et al., 1999; Wouters and de Meester, 2003). Indeed, there are many examples of successful management 'in common', based on a variety of rights which are used to regulate access to, usage, exploitation, ownership, alienation, exclusion, etc. of such resources. Even though land is a rival and excludable good, many traditional societies maintain open, non exclusive grazing and hunting grounds. And some communities still manage as commons such natural resources as land, forests, water and plant and animal species (Barzel, 1997; Bromley, 1990; Demsetz, 1967). These approaches reconfirm that excludable resources do not necessarily have to be made private or exclusive. Doing so is a policy choice, and often a societal choice to ensure the sustainable use of certain goods.

This matter is raised – without further details – in Article 10c of the CBD ("Sustainable Use of Components of Biological Diversity": "protect and encourage customary use of resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements"). This Article is now used by native populations experiencing difficulties with norms they feel are being imposed on them, e.g. those based on new governing transnational

environmental rules, conventions, institutional arrangements, etc. on behalf of the protection of 'global' resources (Goldman, 2004), which lead to confusion about ownership or accountability of 'resources' that have senses and values at the local as well as at the global levels. Worst, these misunderstanding could lead to increase poverty of those who are set aside (Allier, 1997, 2002).

Studies, observations, measurements, appraisal, modeling of local management systems is also part of AKST and have to be open to a diversity of standpoints and theoretical frameworks. Otherwise, the risk is to reduce the panel of practices and, by ignoring local right regimes, to lead to resources destruction funded on the good willing of those who think they know everything. Research in that field is not only founded on observation of actual processes but has to contribute to designing new management systems that fit better to evolving and dynamic conditions. Conceptual analyses of usage and management rights over both land and the natural resources it carries has greatly benefited from scientific research since the late 1980s (Ostrom, Schlager, Sandberg, Le Roy, Lavigne Delville, Chauveau, Karsenty…). These studies describe and analyze different modes and forms of 'common goods' management beyond individual appropriation founded on a simplistic application of neo-classical economic theory, because it relies on the different forms knowledge – and information – can take. Taking in account the different forms of knowledge involved, like 'explicit' and 'incorporated' ones, lead to a more complex view of what is at stake in a range of situations.

Between public and private types of management, the only ones traditionally considered in Western law, different categories of common management may be identified along these lines. Depending on the stakes the reference group has a variable geometry (from family level to nation through the village or the family territory) and involves specific decision processes that make a group to function like a body. In this interpretation state appropriation based on positive law may co-exist with the modalities of local appropriation, according to the principle of legal plurality which allows to no longer view as incompatible two legal worlds used to coexisting, in particular in Africa since the colonial era, as well as in numerous other situations. More recently, Le Roy (2004) defined these normative productions as "*droits de la pratique*", i.e. rights attaching to practice, as a "plural set based on different ages and particular stakes, actors and formalisms", specifying what is commonly designated as the 'law of the land'.

Although their logic are different, these forms of appropriation are superimposed in practice, and distinguish in addition the modalities relating to land and to the resources it carries: a piece of land may be viewed as a "good" while the resources may be seen as "things" free of access or as an "having" (as defined above) open to harvesting by people other than the owner with his/her authorization. Besides, all this may be subject to seasonal variation depending on the types of

resources to be taken (grass, crops, berries, mushrooms, game, fish, etc.). Chauveau (1998) introduces the “right to hand over”, between the right of exclusion and of alienation, as analytical tools of new hybrid forms of access to land, such as buying land for migrants, which gives them the right to pass it on to their heirs, but not the right to sell it. For this author, “the system of appropriation of natural resources consists of a set of “measures and practices” which govern the relationships between a community and the renewable natural resources of its space of activity.” A produce of history, changes of different types may cause this traditional, if not customary order to evolve. The author adds two interpretation avenues: on the one hand he considers that this system is seldom developed as an autonomous domain within customary systems but falls within the more general social norms. On the other hand, this system follows an intrinsic evolution as a result of overall change in the customary order, and of interactions with the positive law implemented by the modern state. Several authors fear thus that the trend towards commoditization of land and resources will challenge these different modes and systematically lead to individual property and ownership as understood by capitalist economy and modern law, as suggested by Hardin for example.

However the excess capacity of common goods is limited and congestion is reached when the consumption of the good start to be rival. Congestion arises when an additional unit of the good consumed by one member negatively affects other members’ satisfaction of the public good. An example of this situation is the fish-stock in oceans. Overfishing depletes the world’s fish-stock and threaten endangered species with extinction (Wouters and de Meester, 2003). Thus a huge and complex set of laws and agreements have completed the UN Convention on the Law of the Sea (1982), which turned on two fundamental principles: (1) the territorial sea, or the right of a coastal state to control a narrow band of sea as an extension of its sovereignty offshore; and (2) freedom of the high seas, meaning the freedoms of navigation and fishing in the high sea beyond that offshore coastal area (Joyner, 2000). We still focus here on NRM, putting aside what deals with flag rights, criminal law, pollution, etc. According to E. Borgese (1999), the first point relies on the co-management between states and coastal communities in planning, regulating, and conducting resource management, or, more broadly, ‘integrated coastal management’. One of the main issue is the obligation for states to maintain or restore populations of harvested fisheries at levels that produce a ‘maximum sustainable yield’ of indigenous living resources. So, a ‘bottom-up’ approach is complementing the traditional ‘top-down’ mindset. ‘Non-exploitive users’, i.e. the rest of society’s citizens also have a right of access to the Exclusive Economic Zone for other functions, which include permission to locate aquaculture installations, mineral mining, shipping access, etc. decisions on which must surely remain with government (Caddy, 1999). On the second, a UN Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks has been adopted in 1995, mandating states to establish

subregional and regional conventions and organizations to facilitate conservation and management of living resources, and an International Seabed Authority for the deep ocean floor and non living marine resources. Except for sedentary species of the sea floor, international fisheries agreements do not speak in terms of ownership of resources but of access rights. This raises the fine point as to whether a share of the resource can be exercised now at any time in the future and even whether this right could be extended to include the progeny of the resource share in future rights. So, the 1982 LOS Convention serves as the hub of the contemporary law of the sea regime, around which a corpus of international law for protecting and managing the world's oceans has evolved in a broad scope and is firmly in place after three decades (Joyner, 2000), providing a comprehensive basis for future 'customary law' that can assist authorities in constructing appropriate management frameworks (Caddy, 1999).

Challenges for Public Research. Thus scientific knowledge has to be produced as well to understand the complexity of such situations, in the oceans as well as on the continents to formalize these different sets of right regimes, but also in order to design new ways for collective action in innovation making explicit and feasible the fair implementation of those rights in situation in order to obtain the best and sustainable management of renewable natural resources. Then, laws, incentives, contracts, taxes, quotas, permits and licenses have to take in account this diversity of knowledge and not to design the world through a single one way.

Natural Resources Management policies should take into account how ownership and accountability are shared among communities through common rights and not only in the legal form of individual property.

State appropriation of NRM based on positive law (i.e. the set of rights in force in a country at the moment) may co-exist with the modalities of local rights systems, which distinguish access to, usage, exploitation, ownership, alienation, exclusion, of "common" goods at a collective level. This recognition of the ' law of the land' based on local customs and right regimes may involve land tenure systems that cannot be reduced to individual ownership. Collective ownership and management of natural resources is protected in Article 10c of the CBD (Sustainable Use of Components of Biological Diversity). Indigenous groups have referenced this Article to help defend their collective rights and NRM practices against governments that would ignore these rights in fulfilling commitments to protect 'global' resources. New instruments for collective action have to be sustained in innovation to make explicit and feasible the fair implementation of collective rights and NRM practices in order to obtain the best and sustainable management of renewable natural resources. Laws, incentives, contracts, taxes, quotas and permits have to take in account this diversity of NRM knowledge. The design of NRM policies should not be derived from or conform to a concept of individual ownership and rights that is not universal….

8.6 Policies to Stimulate Agricultural Innovation

8.6.1 Description of the domain

This subchapter assesses policies to influence the generation, dissemination, diffusion and utilization of AKST. These processes together will be referred to as agricultural innovation. Typically formal AKST is assumed to be the source of innovation. However, most agricultural innovation, especially when we are dealing with the resource-poor, risk-prone, diverse, low external input, rainfed agricultures that (fail to) provide, the livelihoods for most of the poor with whom IAASTD is concerned, emerges from farmers' own experience, discovery, experimentation and learning. The sub-chapter therefore includes in AKST the innovation brought about by countless farmers (M/F). Formal AKST so far has had limited impact on resource-poor farmers, especially in Africa. This is a major challenge for this sub-chapter.

The word 'innovation' itself is used in many different meanings (Röling, 2006). Many people think in terms of 'diffusion of innovations' (e.g., Rogers, 2003). In that tradition, the noun innovation refers to 'an idea, practice or object that is perceived as new by an individual or other unit of adoption' (ibid: 12). In practice, innovation usually refers to agricultural technologies (hardware), ignoring the fact that innovation can also refer to inter- and intra-organizational changes (orgware), or to ideas, ways of looking at the world, unseen rules of the game, or institutions (software) (Leeuwis with van den Ban, 2004). In commerce, innovation usually refers to a product newly introduced to the market. Innovation can more generally be defined as a process, the action or process of innovating, the introduction of something new, of an alteration or a transformation. System innovation refers to a radical process of societal transformation that involves re-configuration of networks or coalitions of stakeholders in some contingent pursuit. A newer approach to innovation that we shall assess is the innovation system (World Bank 2006a). It assumes that innovation can be seen as an emergent property of a configuration of interacting stakeholders (Bawden and Packam, 1993).

Not any change is innovation. The inundation of coastal areas as a result of rising sea levels brought about by climate change is not an innovation. But the way societies learn to deal with it definitely is innovation. The word innovation therefore has a positive slant. It is a healthy reaction to a threat, opportunity, changed aspiration, or other change in the relationship between goals and institutionalized means (Merton, 1957; Röling, 1970). In this chapter, we shall include rebellion as a healthy reaction, but not escapism, ritualism, or maintenance of entrenched ways in the face of new challenges. This does not preclude the possibility that innovation becomes dysfunctional, e.g., when market-driven innovation increases the gap between rich and poor, or threatens the thin troposphere on which life depends (Flannery, 2005). Then innovation itself

becomes a threat, which can motivate innovation in the way we innovate. Innovation of innovation is a major theme of this sub-chapter.

This sub-chapter will refer to agriculture as the production and maintenance of ecosystem services, including food, fiber, water, soil fertility, biodiversity (including pollination and genetic diversity), (micro-) climatic stability, carbon cycling, and human health. Humans leave the hunting and gathering stage when they start food farming. Now that humans have become a major force of nature (Lubchenco 1998), most other ecosystem services also have become a matter of farming. The sub-chapter assumes that pro-poor innovation cannot ignore the production of ecosystem services other than food. Their degradation has become a major cause of poverty (Millennium Ecosystem Assessment, 2005).

This way of looking at agriculture has implications for innovation. Innovation is not only about better control brought about by 'life sciences' of natural causes, it is specially also about social change, reasons, and the way people interact and engage in concerted action to deal with shared (negotiated) problems, opportunities or aspirations. In that sense, agricultural innovation is not different from health. Understanding cancer as a disease might require all the life science ingenuity we can muster, but changing carcinogenic behaviors such as smoking, lack of movement, eating unsafe and unhealthy foods, use of organophosphates, and the destruction of the ozone layer, requires interventions to bring about behavioral and social change.

In all, we shall describe and assess different concepts of innovation and the policies based on them:

1. *Technology supply push and agricultural treadmill;*
2. *Supervised credit schemes;*
3. *Endogenous development and participatory approaches;*
4. *Innovation Systems as pathways for AKST impact.*

For each of these, we provide a *description*, examine the relationship between its ex-post empirical basis and its *transformation into an ex-ante policy model*, elaborate the *conditions* that are crucial for the policy to be effective and appropriate, and a *pro-poor assessment* of the policy.

8.6.2 The dominant policy model: technology supply push and agricultural treadmill

'Let's get real and talk technologies' (Mark Rosegrant)

8.6.2.1 Description

The dominant policy model for promoting innovation is also called ‘the linear model’, ‘the transfer of technology model’, or ‘the agricultural treadmill’. In its simplest form it recommends developing productivity enhancing technologies through research for ‘delivery’; or ‘release’ to farmers, ‘the ultimate users’. Box 8.3 provides recent examples of the model in action.

Insert Box 8.3 Some examples of the dominant policy model in action

The policy model emerged in a specific historical context, the American Mid-West in the decennia after WWII. It is based on the following *empirical* findings in that and similar contexts, such as the Netherlands (Van den Ban 1963):

1. *Diffusion of Innovations.* Some technologies diffuse (autonomously spread) quite rapidly after their initial release into a farming community, typically following the S-curve pattern of a slow start, rapid expansion and tapering off when all farmers for whom the innovation was relevant or feasible have adopted. The classic case was hybrid maize in Iowa (Ryan and Gross 1943). Diffusion of innovations later became a major research tradition with literally thousands of published studies (Rogers, 2003). Diffusion multiplies the impact of agricultural research and extension effort for free. But diffusion is mainly observed ex-post: it is difficult to predict (or ensure) that it will take place.
2. *Agricultural Treadmill*. The treadmill refers to the same phenomenon, but it focuses on the economic aspects (Cochrane, 1958). Farmers who adopt early use a technology that is more productive or less costly than the still prevailing state-of-the-art, i.e. when price levels have not as yet decreased as a result of increased efficiency of the whole sector. These forerunners capture a windfall profit. Soon, however, others begin to use the innovation, total production increases and prices start to drop. Farmers who have not yet innovated typically experience price squeeze: their incomes decrease even if they work as hard as before. They must now innovate. The treadmill therefore refers to the fact that diffusion is propelled by the market: it provides incentives for early adoption and disincentives for being late.
3. *Terms of Trade*. A key underlying aspect of the treadmill is that farmers cannot hold on to the rewards of technical innovation. Because none of the thousands of small firms who produce a commodity can control the price, all try to produce as much as possible against the going price. Given the low elasticity of demand of agricultural products, this means that prices are under constant downward pressure. During the last decennia, the price of food has continuously declined both in real and relative terms. The farm subsidies in the US and Europe can be seen as a necessary cost to allow this societal benefit without rural impoverishment.
4. *Scale enlargement*. In the tail of the diffusion process, farmers who are too poor, too small, too old, too stupid, or too ill to adopt eventually drop out. Their resources are taken up by the stayers, usually those who capture the windfall profits. This shakeout leads to economies of scale in the sector as a whole.

5. *Internal rate of return*. Evenson et al. (1979) have demonstrated that investing in agricultural research and extension to feed the treadmill has a high internal rate of return. The macro effects of relatively minor expenditures on technology development and delivery are major in terms of (a) reallocating labor from agriculture to other pursuits as agriculture becomes more efficient, (b) improving the competitive position of a country's agricultural exports on the world market, and (c) reducing the cost of food. An advantage is that farmers do not complain. Their representatives in the farmers' unions are among those who capture windfall profits and benefit from the process, even though, in the end, it leads to loss of farmers' political power as their numbers dwindle to a few percents of the population. A disadvantage of the treadmill is that it more or less forces farmers to externalize social and environmental costs. These costs tend to be difficult to calculate and have not usually been taken into account by the likes of Evenson et al.

8.6.2.2 Transformation of the empirical model into a policy model

There is a difference between an ex-post empirical model of what has happened in the past, and an ex-ante policy model that guides decisions and investments in terms of what should happen in the future. The weight of evidence of diffusion research, treadmill research, scale enlargement and the high internal rate of return was in favor of the emergence of a technology supply push as the policy model par excellence when it comes to promoting agricultural innovation. It is alive and kicking in the World Bank, FAO, international research centers, national research organizations, ministries of agriculture, planning and finance, donor organizations, and farmer organizations. It is difficult to dislodge it.

This can be partly explained by what Latour (1987) calls 'interessement', i.e. research findings are not used on a large scale in society unless these findings are in the interest of major societal players. Technology supply push is in the direct interest of agricultural researchers because it is the raison d'être for their funding. It fits neo-liberal economics, WTO and the Washington consensus like a glove, in that it assumes farmers to be rational choice makers and beneficial macro effects to emerge from their individual behaviors, in accordance with methodological individualism. The WTO advocates a global treadmill as the best and fastest way to develop agriculture in developing countries. The Training and Visit system of extension sought to streamline the technology supply chain between research and 'contact farmers', in the hope of diffusion among 'follower farmers'. It was abandoned because it did not work (e.g., Anderson et al. 2006). Undaunted, the Outline for the WDR 2008 (World Bank, 2006b) says: 'Improving productivity in the heterogeneous rainfed regions of agriculture-based countries is perhaps the highest priority for addressing extreme poverty and food security'.

8.6.2.3 Conditions

The conditions in which the empirical observations that underpin the model were made are not the same as those in the developing countries in which it is pursued. Let us look at the typical conditions in the American Mid-West, or Western Europe for that matter, in the years after WWII.

1. A large number of similar farmers produce the same commodity for the same market in similar agroecological conditions (a 'recommendation domain');
2. They are all too small to be able to control the price and therefore try to produce as much as possible against the going price (price takers);
3. They are well organized and their needs and conditions are taken seriously by research, extension and policy makers. They have an out of proportion political influence on national politics;
4. They have access to credit and other services, inputs, and markets at relatively low transaction costs;
5. They are highly capitalized in terms of machinery, buildings, and land, even if incomes are under pressure;
6. They have undergone agricultural education and training;
7. They have access to newspapers, farm journals, radio, extension, commercial advisors (e.g., bankers, pesticide sellers, book keepers) and other professional farmers;
8. A set of supportive policies is in place, such as grants for land improvement and land re-adjudication, support of interest costs, tax breaks, price subsidies, market protection, etc. The few surviving farmers in industrial countries have enjoyed 50 years of high public support and investment in the treadmill.

In other words, these conditions are marked by the kind of *institutional development* in *sensu* North (2005) that allows a focus on *economic growth*, for example by feeding the treadmill through technology supply.

8.6.2.4 Pro-poor assessment

The technology push model has received a boost as a result of the success of the Green Revolution. In GR areas, millions of small farmers were producing the same commodity for the same market in fairly controlled circumstances. It was not too difficult for Governments to create the conditions in which these farmers could adopt the high-yielding varieties developed by research: a supply of subsidized fertilizers and pesticides (e.g., up to 80% of the price in Indonesia), guaranteed prices for farm output, or at least price stabilization policies, etc. But, says Gelia Castillo (1998), 'we have done the easy things'. It soon became evident that the GR conditions do not pertain to vast areas of the developing world, which Chambers and Ghildyal (1985) have called resource-poor, diverse, risk-prone, rainfed and dependent on low external

input technologies. In fact, the GR influenced these areas negatively by generating further pressure on prices.

The following conditions apply in the resource-poor rural areas of agriculture-based countries that hold most of the world's poor:

1. Farmers face very small windows of opportunity within which innovation is possible, especially in terms of markets. These opportunities are quite variable in terms of rainfall across and between seasons, price fluctuations, etc.
2. The diverse agroecological circumstances and survival strategies of farmers make it difficult to identify sizeable recommendation domains for which uniform component technologies can be developed.
3. Farms are (very) small and the larger part of what they produce is used for subsistence, leaving only small surpluses to support a monetary economy (e.g., to buy inputs).
4. Agriculture often is the only source of revenue for governments and rent seekers, let alone that there is a supportive climate for farm innovation;
5. Credit, input provision and other services have been all but abolished as a result of structural adjustment and other Washington consensus policies (Stiglitz 2006);
6. Farmers have very little political clout. For example in Ghana, the government is importing cheap subsidized rice from the US because it is in the interest of the powerful urban electorate. As a result, the promising development of Ghanaian commercial rice production has come to a halt. The cheap rice is also substituting other local staples (Oxfam International, 2005). Farmers in Ghana are not organized.
7. Research and extension have little interest in the conditions or needs of the farmers for whom they purportedly are working. Vissoh (2006) has carefully documented the very slow reaction of formal research to the emergence of pernicious herbaceous weeds such as Imperata cylindrica, as a result of more permanent land use in Benin.
8. Small farmers face competition from cheap imports. This is not just a question of the dumping of e.g., chicken wings from the Netherlands, which are a worthless by-product, or of subsidized exports. Resource-poor farmers are facing competition from farmers in industrial countries who have been on the treadmill for 40 or 50 years. The few survivors (typically 3% of the working population) are highly professional, embedded in networks of services, support and commercialization (typically 10% of the working population), are highly capitalized in terms of machinery and other resources, and professionalized. Their labor productivity far outstrips that of farmers in developing countries, so that, even if they earn twenty or more times as much, they can out-compete small farmers any time (Bairuch, 1997). Added Value per Worker in 2003 (const. 2000 US$) in developed market economies was 23081 with a growth in 1992-2003 of 4.4%. For Africa SS, the figures are respectively 327 and 1.4% (FAO, 2005). Maize can now be

imported into Kenya at a 20% lower cost than the cost price of the best Kenyan farmers (Cyrus Ndiritu, pers. com. 2002). This means that the emerging urban markets for agricultural produce (e.g., through supermarkets, shopping malls) can easily be captured by imports. Elites in coffee producing African countries drink Nescafé.

In these conditions, agricultural research has low impact. A typical example is the Cocoa Research Institute, Ghana (CRIG), a professional organization working on a crop that is one of the main income earners for the country and a commodity which at least brings farmers some income, especially since 2002 when Government started to improve the FOB price paid to farmers from about 40 to the current roughly 70% (Ayenor, 2006; Dormon, 2006). By its own courageous admittance, of the technologies CRIG has developed, farmers have adopted only about 3% (Ayenor, 2006).

In all, the conclusion must be that technology push seems not to work to reduce poverty in resource-poor, diverse, risk-prone and rain dependent farm areas that are typical for most of Africa, the Deccan Plateau in India, North-Eastern Brazil, etc. These areas act as holding grounds for rapidly increasing populations that are dynamic in developing their subsistence from an increasingly eroding resource base, e.g., by changing shifting cultivation into forms of permanent land use. But increasingly impossible situations emerge when young men and women cannot replicate their cultural repertoire, no longer see a future in their home areas, and turn to emigration (including desperate attempts to get into Europe and the US), feminization, radicalization, escapism in religious sects, warlords, etc.

Alternatives must be found. At the time of writing, the draft World Development Report (World Bank, 2006b) seems to have taken on board some of these conclusions. The Washington Consensus is increasingly contested. Yet, the focus on technology supply push seems to be alive and kicking. Part of the reason seems to be that governance of the global treadmill process is politically unacceptable even if is clear that it is destroying resource-poor agricultures and disqualifying them from making a contribution to global food security. This is one of the worst failures of the market, but an ‘inconvenient truth’ for agricultural exporters such as the US, France and the Netherlands, whose farmers wield strong political clout. The draft Outline of the World Development Report 2008 does not mention the international causes of rural poverty, except for the OECD tariffs and subsidies which detract attention from the more fundamental causes of inequity, i.e. pitting subsistence farmers against the most efficient farmers in the world and expecting them to catch up through productivity enhancing technology.

8.6.3 Supervised credit approaches

8.6.3.1 Description

Supervised credit is a package approach that has the following characteristics:

1. A commercial agency, parastatal or government agency puts together a package that allows small farmers to engage in the production of an export commodity, such as tea, cotton, coffee, cocoa or other product that farmers cannot eat or easily sell elsewhere. The package typically includes planting materials, marketing (quality control, grading, certification (in the case of organic produce), (pre-) processing, transport, export and payment of farmers), inputs, credit (which is deducted from the farmer's payment, hence 'supervised credit') and extension and training. Sometimes the package also includes some price stabilization.
2. The package has been tested as attractive for small farmers.
3. The relatively high costs of servicing the package are deducted from the revenues.
4. Small farmers act as out-growers in that they adopt the package and become clients of the central agency and subscribe to the conditions set by it.
5. Supervised credit schemes were developed by colonial agencies. After independence, these schemes were mostly nationalized for management by government agencies or parastatals, and subsequently privatized under pressure from international financial organizations.

8.6.3.2 Transformation of the empirical model into a policy model

Supervised credit, when properly managed, can be very effective. A typical example is the Kenya Tea Development Authority, which has, over the years, provided opportunities for thousands of small-scale farmers, who now produce a larger share of the tea exported from Kenya than the commercial planters. Such successes have made them the favored model of commercial agricultural export companies. In Thailand, an out-grower scheme exporting orchids has thousands of suppliers who each might not have more than three pots of orchids as a production base. In Senegal, companies exporting French beans to European supermarkets put money into the pockets of thousands of small farmers. Box 8.4 provides an example from Turkey.

Insert Box 8.4 Köytür supplies 40% of the broilers consumed in Turkey (Unver 2005)

One specific test of aspects of the model in practice is illustrative of the power and some of the assumptions of the model (Box 8.5).

Insert Box 8.5 The Kenya Government's SRDP project in Tetu

8.6.3.3 Conditions

The proven effectiveness of supervised credit in putting money into the pockets of resource-poor farmers stands in contrast to its current popularity. As we saw above in the Tetu experiment, this has to do especially with the conditions that need to be created.

1. The package approach is (very) sensitive to management quality. It requires high dedication and professionalism. For example, seeds and fertilizers have to be delivered in time (and not two weeks after the rains, the onset of which is variable). Farmers need to be paid in time lest they loose interest. The arrangements for transport of commodities, delivery of planting material, contracts, etc., are sensitive to management failure.
2. Nationalizing the schemes opened them up to misuse of various kinds. In Nigeria, after Independence, the funds that the Cocoa Marketing Board had set aside for price stabilization were grabbed by the ruling party at the time to buy vehicles for the political campaign. In most countries, the government used the schemes as a way of extracting revenue from agriculture either for formal or informal purposes and could easily get away with it, given the lack of transparency of the schemes, and the lack of education and power of the farmers. Supervised credit schemes became gravy trains, if not fiefdoms or patrimonial networks. In Benin, pesticide sellers (read politicians) refuse to sell a proven cheaper and less toxic pesticide package for cotton because it would reduce their profits. Thus they jeopardize the competitiveness of the country's cotton on the world market (Sinzogan 2006). In Ghana, the Government only paid farmers 40% of the FOB price for cocoa. As a result, farmers abandoned the major export crop of the country and the share of the country's cocoa on the world market decreased steadily. Then, under pressure from international donors, the Government over a few years since 2003 increased the FOB price to about 70%. Coupled to a favorable world market, this led to a doubling of production without any major technological change (Ayenor 2006). Other misuses include the doctoring of weighing scales, manipulating quality assessment, bribes for pay-outs, capturing differences between formal and informal exchange rates, and taking bribes from importers of pesticides and fertilizers. In some countries, stockpiles of obsolete pesticides have accumulated that were never distributed to farmers because of lack of knapsack sprayers but that were nevertheless imported every year because of the kick-backs involved.
3. As a result of such misuses of the schemes, most Governments have been under strong pressure from international agencies to liberalize them. This has had various effects, such as a reduction of the number of small farmers who benefit from the export industry, a collapse of the quality of the exports (e.g., cocoa in Nigeria), and so forth.
4. The supervised credit model is also vulnerable to externalization of costs by commercial companies to their out-growers (Box 8.6).

Insert Box 8.6 Small-scale dairy producers and Nestlé in Southern Chile (Berdegué 2001)

8.6.3.4 Pro-poor assessment

The supervised credit package approach is eminently capable of putting money in small farmers' pockets and has proved its ability to foster effective rural innovation. However, its effective utilization is very sensitive to management failure, corruption and patrimonialism, over-extraction

of wealth by government, and externalization of costs to farmers. In small farm households, the opportunities offered by package schemes can also cause internal problems, when men begin to produce export commodities on land that women used for subsistence production, or when the money earned is not ploughed back into the family. Supervised credit schemes benefit from transparency and from being run by farmers themselves. Even then sensitivity to quality of management and corruption remain, of course. It has proved exceedingly difficult for resource-poor farmers to organize to effectively cater for the demands of supermarkets. Yet supermarkets are capturing an increasing share of the market for food in developing countries (Reardon, et al. 2003). The supervised credit package approach seems to hold promise in this respect.

One could conclude that the large-scale proven successes of supervised credit warrant its candidacy as a serious policy option for pro-poor development, on condition that it is not in the hands of public agencies but run along strict business practice, and also on condition that the out-growers have access to decision making, insight into financial arrangements, etc. A key condition for the success of supervised credit is to develop effective marketing chains that link farmers to local urban and export markets. In this respect, the efforts to establish markets in industrial countries for organic products (Egelyng, 2000; Egelyng and Hogh-Jensen 2005) and to develop group certification schemes for farmers in developing countries (Pyburn, in prep.) are important.

8.*6.4 Endogenous development*

8.6.4.1 Description

Endogenous development (ED) implies ‘development from within that is both biophysical and socio-cultural in nature. Although not exclusively, it draws mainly on locally available resources, local knowledge, culture and leadership, and their implicit cosmovisions, with an openness, that allows for integration of outside knowledge and practices’ (Haverkort et al. 2002; Millar 2005). The recognition of ED as a development process emerged when people like Van der Ploeg (1994) recognized that there is no uni-dimensional calibrated development path towards modernity on which progress can be measured. Instead empirical research shows that in the same economic and technological context, farmers choose very different optimization paths, or ‘farming styles’. In the Netherlands for example, some dairy farmers opt to maximize business returns, others seek professionalism (e.g., a beautiful and productive herd), a few get their kicks from machinery and engines, while reducing costs and frugality is considered by some to be blessed by God. This rejection of a uni-dimensional path, which the under-developed allegedly follow to become developed has had a sobering effect on policy and called for framework conditions within which ED can blossom.

In developing countries the discovery of Indigenous Knowledge (IK) has had a similar impact. In 1974, Norman established that Nigerian farmers, who had persisted in mixed cropping, although they lived next to and worked on Samaru Research Station on which mono-cropping had been practiced for decades, did so for very good reasons. Mixed cropping reduces risks of failing rains, minimizes the spread of pests and diseases, optimizes the input of labor (the factor in the minimum) and delivers the largest monetary value. Since then, it has been recognized, that farmers are knowledgeable in their own right, and that their knowledge is repository of generations of intelligent experimentation and collective wisdom. But not everyone has got it. Said one Indian researcher: 'You don't have to talk to the farmers, we told them everything they know'.

Empirical research (Warren et al. 1991) shows that IK can be relied upon for (1) knowledge about the agroecosystem and seasonality in which the farmers operate, (2) information about what local people need, want and have capacity for in terms of resources, access to markets, etc. Furthermore, (3) they have a great deal of technical knowledge, even if they do not always know the scientific explanations. (4) Where formal research focuses on component technologies, farmers tend to have a system view based on having to live by the results. They also innovate at the system level. For example, farmers on the very densely inhabited Adja Plateau in Benin have developed an 'oil palm fallow' system of rotation that allows them to suppress Imperata cylindrica, restore soil fertility for annual crops, and make money from distilling palm wine once the palms are cut down (Brouwers 1993). This system is one of the few sustainable systems of permanent land use under low external input conditions that have so far emerged from the collapse of shifting cultivation under population pressure.

Finally, it is increasingly recognized that IK not only refers to technical knowledge but also to institutions, norms, including systems of accountability, and so forth. That is, working in a 'non-western' community, and that is a realization that is as important for expatriates as it is for local urbanites, means that one can never assume a *tabula rasa*, i.e. an blank sheet on which one can write one's own version of development. Existing institutions can be a boon, but also a hinder to democratic, pro-poor, bottom-up development. Examples are patriarchy, patronage and patrimonialism. The last, a system of using public human and other resources for personal rent seeking and aggrandizement, is an institution that often corrupts development efforts, especially in Africa (Brinkerhoff and Goldsmith 2002). In the absence of countervailing power, it must be assumed.

IK should not be considered as a thing of the past, i.e. comprising technologies and artifacts that belong in a museum or 'IK bank', as for example land races in a seed bank. IK is living. It absorbs

and borrows external ideas and practices. Local societies are always evolving, even if not always for the better from the point of democracy, pro-poor development, etc. Any development effort must deal with this local dynamic, and with sentient beings who are intelligently trying to improve their lives. Innovativeness can be assumed. Usually blaming failure of a development effort on 'resistance to change' or 'traditionalism' is mistaken in that the cause must be sought in absence of fit between the intervention and local dynamics. Only after very severe and widespread frustration and humiliation can one expect ritualism, withdrawal, fatalism, escapism and other adaptations to a hopeless situation.

8.6.4.2 Transformation of the empirical model into a policy model

Although the empiry is quite consistent across time and space, it is not easy to specify a policy model for ED. Such a policy model would imply an effective '*pas de deux*', an effective dance between the '*pouvoir paysan'* and the *'pouvoir publique'.* This is difficult things to achieve, especially when the '*pouvoir paysan'* is limited to refusal to dance. Though it is difficult to specify a coherent ED policy, the following concrete policy measures are consistent with ED: market liberalization, decentralization, use of rapid rural appraisals, participatory approaches, multi-stakeholder processes and empowerment. We briefly describe them.

Market liberalization is, in a way, an ED policy *avant la lettre* in that it assumes that individuals and businesses will make rational choices in seeking to optimize their outcomes. Here we do not discuss market liberalization further because one of the key reasons for organizing the IAASTD is the growing consensus that globalization of the market without globalization of governance has failed to solve the poverty and environmental issues that are threatening to blow the world apart (Stiglitz 2006).

Decentralization recognizes that local ownership and involvement are necessary if not sufficient conditions for successful development. There has been an impressive move towards decentralization in developing countries in recent years, although often it has not included a real delegation of power and funds. Furthermore, in the absence of countervailing power and transparency at the local level, not much is gained. In fact elites and governments at the local level can be just as exploitative as the ones at the national level. Then decentralization can mean yet another roadblock to extract rent from farm produce.

Rapid appraisal. The radical idea behind these appraisals is that local people's opinions and information are data. Instead of doing research oneself, e.g., instead of measuring rainfall across a number of years to get at the pattern, one can ask farmers who have lived in the area their whole life. The idea is radical because one has to trust local people's intelligence and good sense and accept their observations, opinions and ideas as true. For scientists that is not easy. One

mature PhD student, who had been tremendously successful in funding a tree planting movement through thousands of nurseries run by local African women, found that her data were not accepted in her prestigious US university because the fact that thousands of local women had embraced local tree planting was not adequate scientific proof that tree planting was a good solution to the poverty and ecological problems in the country. After all, the women could be wrong. And of course, local farmers can be wrong, for example, when loss of organic matter content in the soil leads to reduction of soil moisture content, which farmers blame on failing rains. But the idea behind rapid appraisals, especially when triangulation is included, is that local people are usually right and more accurate than the one-shot surveys or experiments of scientists, or the formal statistics of governments and international agencies.

Participatory approaches. Participatory approaches emerged from the recognition of IK. If local people are knowledgeable about their context and agroecological conditions, and if their own stated needs, wants and capacities and institutions are taken to be important (and not assumed), then it is a small step to include them in decision-making. This was clearly stated for the first time by Morss in 1976 in a study of 25 development projects that showed that the extent to which benefits of projects are sustained are directly related to the extent to which their beneficiaries contributed materials and labor and participated in decision making. Since then, participation has become a dominant pro-poor development approach. Usually, participation is calibrated on an ordinal ladder (e.g., Pretty 1994; Biggs 1995) from simple consultation to fully autonomous decision-making.

Participatory schemes involve a platform for interaction between some central agency and a local community. The actual modality varies a great deal. Elements can include (1) exploratory rapid appraisal of the opportunities and constraints, (2) diagnostic study to establish acceptable, feasible and promising joint activities, and (3) concrete local collaborative action. PTD (Participatory Technology Development) (e.g., Jiggins and De Zeeuw 1992) is a concrete example that is relevant for AKST. Box 8.7 presents a recent example of a fairly large PTD effort.

Box 8.7 Convergence of Sciences (CoS) Programme in Ghana and Benin (Hounkonnou, et al. 2006)

Empowerment. An implication of recognizing resource-poor farmers as intelligent agents who can be taken seriously is to accept that efforts to enlist them into the global project must empower them as partners in development. It is much more efficient to increase farmers' countervailing power over interventions than to increase intervention power through investing in more vehicles, agent training, etc. Farmer Field Schools (Box 8.7) have been shown to be able to empower resource-poor farmers and voiceless rural women (Pontius, et al. 2002; Van den Berg, 2003).

Multi-stakeholder processes. A special form of participation is the multi-stakeholder process. In many situations, especially resource dilemmas, where different categories of inter-dependent users make competing claims on common pool resources, solutions simply cannot come from regulation, technology or market. The only way forward is a managed process of negotiation, shared (social) learning, and agreement on concerted action, based on trust, fairness and reciprocity. This is no pie in the sky. There is increasing evidence that humans are perfectly capable of agreeing on sustainable solutions and to create institutional conditions for them (e.g., Ostrom et al. 1992; Blackmore et al. in press). Multi-stakeholder processes are increasingly important as degraded natural resources and ecosystems become a key ingredient in poverty.

8.6.4.3 Conditions

(1) In an institutionally starved society in which the main institutions are government, church, and army, using indigenous knowledge and participatory approaches is a hapless undertaking. Civil servants and public agencies have no incentives whatsoever to engage in such approaches. All it can lead to is interference in their lives. Box 8.8 provides a typical example.

Box 8.8 Asal Bapak Senang

A key condition for is institutional pluriformity, especially the existence of NGOs. Box 8.9 provides an example from India.

Box 8.9 Velugu (Dhamankar et al. In press)

(2) A condition for taking the resource-poor seriously is for them to have political clout, be it through party politics, tribal networks, boycotts or otherwise. However, most of the world's poor live in countries with governments that are not accountable to them and for which they are not an important electorate. This is a problem that market liberation nor budget support can redress, but it is a key challenge for pro-poor AKST.

(3) Participatory approaches assume facilitators, activists and other paid staff who interact with local people, listen to their opinions, organize them, etc. It is difficult for both government and NGOs to field these in the numbers required to make an impact. There is no dearth of successful pilots, but scaling up is seldom effective.

(4) Participatory approaches belong to a family of governance or coordination mechanisms that global society has not learned to handle to full advantage (Tables 8.3 and 8.4 based on Ison et al. in press).

Inset Table 8.3. Three dimensions of human coordination in various discourses

Inset Table 8.4. Coordination mechanisms

Most innovation is based on a mix of all three mechanisms. But participatory approaches require the logic of the third column, even if hierarchy and market mechanisms provide framework conditions through 'sticks behind the door', or incentive structures. Most government officials and politicians have a hard time recognizing other mechanisms than hierarchy, while economists have hard time thinking outside the rational choice model. It is only recently that economists have become sensitive to the third column (e.g., North 2005; Bowles and Gintis, 2002).

8.6.4.4 Pro-poor Assessment

Interventions that follow third column logic are popular and important for pro-poor development. Countless projects have shown how relatively easy it is to enlist the resource-poor in the global project and to mobilize them for development action. Such projects are consistently successful at the local level. But it is hard to translate them into policies at the macro level. They cost money but their impact at the macro level is hard to measure, as Anderson et al. (2006) have argued to explain the demise of extension. Participatory approaches do not generate visible changes in GDP in other macro measures of progress. Often they lead to challenges of vested interests, for example when success with tribals threatens the interests of landlords who then put pressure on politicians to stop the pro-poor activities.

In view of histories of small-scale projects without macro impact, donors increasingly opt for budget support of countries that have made some progress in terms of 'governance'. Basically this means that donor support goes to strengthen intervention power and to reinforcing the status quo, rather than fostering pro-poor development and countervailing power (Bigg and Satterthwaite 2006).

In light of the issues raised, the following policies seem to hold promise of a positive pro-poor effect.

(1) Supporting decentralization through direct budget support (from national or donor resources) to local governments on condition that they follow inclusive procedures, e.g., available funds for bidding by local collectives, e.g., women's groups, catchment improvement committees, drinking water schemes, etc.

(2) Opening (part of) the budget for agricultural research and extension to local farmer organizations, on the basis of proposals submitted by them.

(3) Fund local access to information and adult education through internet, local radio information programs, and farmer learning clubs which combine some central input (facilitator, radio, pamphlet, internet pages) with local discussion (e.g., on agriculture, health, food processing, energy, etc.).

(4) Strengthen local farmers' organizations across different levels. Enhance government accountability to rural people.

Building a rationale for participatory approaches that appeals to the national level remains elusive. However empowering and otherwise effective such approaches might be in uplifting the poor, there is nothing in them but grief for politicians and other power holders. What is more, they require investment in activities beyond paying salaries that are not directly profitable or that do not come back through taxes in a demonstrable manner. They are 'fiscally unsustainable'. The irony is that governments and their (international) advisers are convinced of the fiscal sustainability of the technology supply push model even though it does not apply in resource-poor conditions, while the rationality of participatory approaches, whose importance has been demonstrated time and again at the local level, has no economic logic to back it.

The Farmer Field School encapsulates the promise of the participatory approach but also illustrates its elusiveness at the macro level (Box 8.10).

Insert Box 8.10 Farmer field schools

8.6.5 Policy options for supporting innovation systems (IS)

8.6.5.1 Description

Building on the work of Hall et al. (World Bank0, 2006a; Röling and Engel 1991; Engel and Salomon 1997; Röling and Wagemakers 1998; Chema et al. 2003; Havelock 1986; Swanson and Peterson 1989 and others, we define innovation system (IS) as:

The actors (individuals, enterprises, organizations), the interaction among them, the rules that shape that interaction, and the framing conditions at higher levels, that together can be expected to, or actually do, generate the concerted action or synergy required to enhance the livelihoods, clout, and opportunities of the resource-poor actors in the system.

The IS approach stands in contrast to technology supply push, which sees innovation as the-end-of-pipe outcome of a unidirectional linear process (Chambers and Jiggins 1987). This does not mean that the IS cannot be configured as a linear sequence, but even then there usually is a great deal of interaction between the different actors in the configuration. In empirical IS research, 'the essential determinant of innovation appeared to be that the suppliers of new knowledge were intimately engaged with the users of that knowledge' (Barnett. 2006).

The IS approach is based on soft system thinking (Checkland, 1981; with Scholes, 1990; Bawden and Packam, 1993): innovation is the emergent property of interaction among stakeholders with

some common purpose. The system perspective draws attention not to individual actors, but to the linkages, relationships, interfaces, conflicts, convergence, reciprocity, etc., among them. The key issue is to enhance concerted action or synergy to realize the common purpose. One cannot, however, ever assume that common purpose. One of the key ingredients of an IS approach often is to facilitate its emergence.

Its focus on linkages orients the IS approach to innovation that can be realized through management of interaction: services delivery; credit provision; buying and selling; training; cooperation; conflict resolution; reducing stealing, rent seeking, corruption, and exploitation; agreement; information, and concerted action. In other words, the IS approach appears to be suited to dealing with institutional development*, which North (2005) sees as a precursor to growth.*

8.6.5.2 Transformation of the empirical model into a policy model

The IS approach definitely is an ex ante policy model that is beginning to gain popularity among donors and that has been written up as such (World Bank, 2006a). It is based on empirical research of the emergence of Asian economies, but earlier enthusiasm system approaches (e.g., Lionberger and Chang 1971; Rogers et al. 1976; Röling 1986; Havelock 1986; Swanson and Peterson 1989) were based on the observed effectiveness of configurations of actors in industrial countries, such as the Land Grant College System in the US and the 'Triptych' of RandD, education and extension in the Netherlands.

Other empirical support for the IS approach can be found in multi-stakeholder approaches to integrated natural resource management. For example, water conservation in the South of the Netherlands brings together a large number of different stakeholders in an effective coalition. The research that evaluated this effort (Jiggins, 2004) was part of a European research program that investigated the role of social learning among stakeholders in catchments as a policy tool for implementing the European Water Framework Directive (Blackmore et al. in press). In Australia, Land Care (Campbell, 1994) inspired the world by showing what local coalitions of property owners and other stakeholders could realize in terms of sustainable land use. Such experiences also showed up the weaknesses of the IS approach. For example, without creating enabling framework conditions at higher scales, successful local activism can easily peter out or become frustrated.

8.6.5.3 Conditions

The empirical base of the IS as a policy model is in highly developed institutional setting. This does not automatically augur well for applying it in situations where it is expected to create *viable institutions. Concretely, the IS approach would include the following steps:*

- Establish national themes that represent priorities of (local) government in national plans, or other long-term strategies for poverty reduction.
- For each theme, technographies, rapid appraisal of agricultural knowledge systems (RAAKS) (Engel and Salomon 1997) or other appraisal methods are used to identify configurations of stakeholders (including farmer organizations) that constitute promising 'theatres of innovation' (Engel 1995), or innovation systems.
- These configurations are facilitated to form a 'Community of Practice' (COPs, Wenger 1998) at the decentralized (e.g., District) and national levels, where the national level is represented by a multi-sectoral Steering Committee that has the power and ability to create conducive institutional framework conditions. An IS approach thus requires trained facilitators who operate within a national mandate that recognizes the importance of IS.
- For each COP, participatory diagnostic studies identify concrete opportunities that can be realized through concerted action by the stakeholders. These will comprise demand dynamics and market differentiation; institutional innovations to reduce risk, improve market efficiency and increase the participation of smallholders; the development of new approaches to supervised credit for cocoa, cotton, and other high value exports; smallholder access to urban (super-) markets; smallholder sharing in value added, etc.
- Each COP submits proposals to the Steering Committee, which has seed money to help COPs realize their plans. In addition, such proposals are expected to attract investment from other sources.
- Each COP is monitored to allow national learning about the IS approach as a basis for further staff training and management effectiveness.

In all, the IS approach assumes considerable political will based on understanding of processes that cannot be captured by hierarchy and market. But the concrete focus on 'theatres of innovation' within national priority themes, and the explicit investment in concrete activities through national Steering Committees build bridges between the rationality of the state and that of decentralized stakeholders, that most participatory approaches do not do.

8.6.5.4 Pro-poor assessment

- Projects such as CoS (see Box 8.7.5) have established that participatory development of low external input technologies, based on exploratory and diagnostic studies that allow sensitivity to context, and avoid pre-analytical choices and cul-de-sac path dependencies, have a contribution to make *within* the small windows of opportunity of small-holders (also Tripp, 2006; McCann et

al., 2006). However, CoS established above all that reducing poverty requires *stretching* those windows through institutional development[2]. This is in line with the insight of New Institutional Economics (North, 2005) that growth policies are not appropriate when conducive institutions have not been developed. The WDR discourse suggests that major emphasis needs to be given to the role of institutional innovation 'in moving forward the expanded agenda': improving (inter-) national and local governance, strengthening rural producers' organizations, promoting local development, and experimenting with and scaling up innovations, especially in finance, insurance, contracting, service provision, and collective management of the environment. Institutional innovation as a major dimension of pro-poor AKST. The IS approach with its emphasis on capturing synergy among stakeholders seems the best bet yet to achieve institutional development *sensu* North. The IS approach therefore represents a radically innovative pathway for pro-poor AKST impact and could help internalize the institutional dimension into AKST pro-poor professionalism (Rand D, consultancy, teaching, and advocacy).

- In all, the IS approach allows AKST to take on board concepts that allow innovation of innovation:

(a) Agriculture is re-defined as the production of ecosystem services, including food, health, biodiversity, the maintenance of hydrological systems, the closing of carbon and nitrogen cycles, carbon sequestration, bio-fuels and climate stability.

(b) The limiting factor in pro-poor development is opportunity, especially access to markets, not productivity enhancing technology in isolation.

(c) Climate change and the need to mobilize the world's resources for global food security draw attention to market failure to address vital *material* flows.

(d) As we have seen, coordination mechanisms are usually taken to comprise hierarchy (government) and market ('invisible hand'). Increasingly, the third mechanism, interaction, is recognized to play a vital role. The IS approach captures this thinking for institutional development across multiple scales.

8.6.5.5 Inter-disciplinarity

- International AKST has not resolved the fundamental difference between: (1) the focus on technology development to enhance productivity at the farm level and drive the global treadmill, and (2) a focus on institutional development. The challenge for agricultural scientists seems to be to 'internalize' the social and institutional dimensions of agrarian development (Van Huis 2006) and to be able to play the mix shown in Figure 8.6 (after Dorward et al. 1998).

Insert Figure 8.6. Innovation as a function of institutional and technical change

[2] A special issue of the International Journal of Agricultural Sustainability (IJAS) on institutional issues emerging from CoS1 will appear mid 2007.

- This issue can be expanded: what does it mean for an agricultural scientist, be (s)he a natural, economic, or social scientist, to take on board the triple logics governing life science causality, market rationality and human interactive emergence? Rational choice economics and 'market fundamentalism' fail when it comes to:

1. Mechanisms for pricing multi-functionality and ecosystem service production of the 'new' agriculture. At present, it is hard to imagine any other economic driver for agricultural development than Cochrane's treadmill;
2. Optimizing utilization of material flows. Globalization has so far disqualified West Africa's a-biotic endowment and millions of intelligent, able and eager workers from contributing to global food security threatened by climate change;
3. Environmental sustainability, climate change and other 'tragedies of the commons'. The quote from Bindraban and Rabbinge (2005) in subchapter 8.6.2 shows that the integration of agricultural science and economics tends to be realized by the former assuming the global treadmill. New inter-disciplinarity requires pathways to innovation that combine technological, economic and institutional development (Fig. 8.7).

Insert Figure 8.7 Innovation as a function of technology, market and institutions

8.6.5.6 Pro-poor people innovation policies

Important reasons for the failure of pro-poor AKST are

(1) Policies dominated by belief in technology supply push and the market driven global agricultural treadmill;

(2) The political impasse caused by the refusal by national governments of agricultural export countries to accept global governance to redress marginalization of resource-poor agricultures, and disqualification of their a-biotic and human resource endowments from contributing to global food security;

(3) Lack of fit between the logic of endogenous development and the short-term rationality of the state.

(4) Over-reliance of the free market as the design for a desirable society and neglect of material flows and governance mechanisms other than hierarchy and market.

- Pro-poor AKST focuses on pathways that increase opportunity through institutional change, especially access to urban and export markets. The Innovation System approach holds promise of being an effective tool for this.
- Structural Adjustment has thrown away the child with the bathwater by liberalizing supervised credit schemes. These schemes have so far demonstrably been the most successful approach to putting money in smallholders' pockets. It was not the approach that was wrong but the way parastatals applied it.

- Supervised schemes need to be linked to local processing and value adding, market and supply chain development, and urban retailing.
- A pre-condition for pro-poor AKST is investment in gender-sensitive empowerment, education, information and organization of resource-poor farmers.

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