Chapter 20

Potential Socio-Economic, Cultural and Ethical Impacts of GMOs: Prospects for Socio-Economic Impact Assessment

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1. Introduction

Socio-economic and cultural considerations related to the use and release of genetically modified organisms (GMOs) have received less attention than the natural scientific and technological aspects. This trend sends a signal that the debate about the adequacy of GMO use and release is essentially technical-scientific and is only open for scientists and experts to engage in. The small body of literature on socio-economic considerations related to GMOs could be explained by a number of reasons. Socio-economic impacts of any technology take years to become evident, as the world has experienced with other new technologies as for instance the Green Revolution. By the time the impact is evident, it has already become widespread and in most cases, become deeply institutionalized. For instance, the introduction of the Green Revolution created a new class of agricultural laborers, and changed gender relations by increasing the burden of women in farming (Paris 1998). By the time social scientists began looking at these phenomena, they had already been well entrenched in social institutions and dramatically changed social relations. GMOs may cause both ecological and socially irreversible changes. While this may be the case for most technological innovations introduced in any society, GMOs have unique characteristics that make their ecological and social impacts even more serious and far-reaching. The fundamental ethical and social debates emanating from the fact that GMOs involve manipulation of life forms and processes, as well as the socio-economic and ecological impacts of GMO contamination, are among the many aspects that are unique to this particular technology. Even when the technology is withdrawn or people totally discontinue adopting the technology, its socio-economic impacts may persist and leave a permanent imprint in society, its history and its people. This is even more serious in GMOs which may introgress with wild populations or contaminate conventional crops long after farmers decide to stop planting GM crops. This stark reality underlines the critical importance of assessing the potential socio-economic impacts of GMOs before and during their introduction in any societal context.

2. Technology and Society

Technology cannot be separated from the social context where it is introduced. No technology in the world's history – from the discovery of fire to the domestication of plants and animals, traditional biotechnology, the Industrial Revolution and the Green Revolution – has ever happened in a social vacuum. Accordingly, the different spheres of society – be they economic, political, social, cultural, or ethical – are all affected by the introduction and adoption of a technology, though different in manner and pace. Throughout humankind's history, technological and scientific innovations have greatly impacted socio-economic relations and political life, some in subtle ways while others are highly visible. In a subtle way, the introduction of mechanized farming during the Green Revolution increased the inequity between small-scale and large-scale farm communities (Conway 2003) and reduced the availability for agricultural jobs performed by women (Paris 1998). As a result of the intensive rice production promoted under the Green Revolution, rural societies have been restructured by the birth of a new economic class of merchants that specializes in rice trading, as well as a new breed of agricultural laborers who do seasonal work in rice farms.

In the same way, the different components of society also have some influence on the way a technology is adopted and disseminated in society. Culture, ethics and religion have perhaps the most powerful influence in defining the way technologies are introduced and disseminated in any given society (Figure 20.1). In the case of GMOs, ethical and religious dimensions are the most dominant aspects of the controversies in many countries where religion remains a strong societal force. For instance, whether GMOs can be considered *halal* or *haram* sets the tone of the debate on their acceptability in Muslim societies (Safian & Hanani 2005).

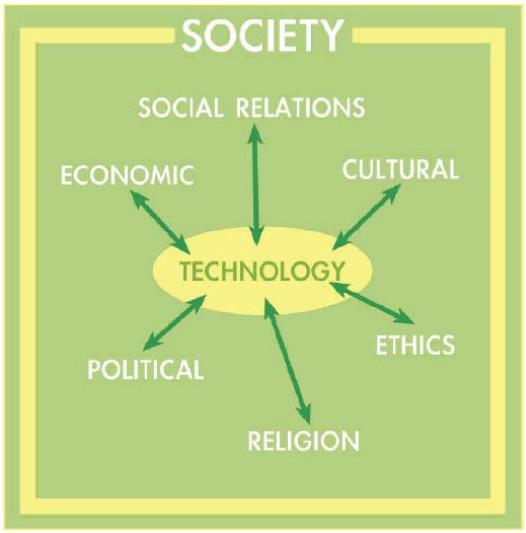

Figure 20.1. GMOs and Society (Garforth 2004; La Vina & Fransen 2004).

3. Socio-Economic Considerations 'Defined'

There have been several attempts to define what socio-economic considerations in the context of GMOs actually mean. The attempt has so far not been successful, and some have argued that socio-economic considerations must be dismissed since they are 'too vague' and 'totally outside the domain of biosafety'. To some, socio-economic considerations are simply 'uncontrollable', even 'unwieldy' and the best way to deal with these is to defer the discussions, or worse, ignore them.

Like other evolving concepts that defy concrete or precise definition, 'socio-economic considerations' have been loosely described as:

> taking into account a broad spectrum of concerns about the actual and potential consequences of biotechnology, such as impacts on farmers' incomes and welfare, cultural practices, community well-being, traditional crops and varieties, domestic science and technology, rural employment, trade and competition, the role of transnational corporations, indigenous peoples, food security, ethics and religion, consumer benefits, and ideas about agriculture, technology and society. (Garforth 2004; La Vina & Fransen 2004)

The elements in this definition are not exhaustive or static. Some of the socio-economic considerations, which are not covered in this definition, will be further expounded in this chapter. The intention is to provide a better understanding of the width and breadth of the issues involved, to promote more concrete definitions of terms, and to evolve assessment tools that could be used by regulators and civil society to minimize or avoid the potential adverse social consequences of GMOs.

4. Importance of Assessing Socio-Economic Impacts of GMOs

The need for assessing the potential socio-economic consequences of GMOs is hinged on several important reasons/values:

1) Social Responsibility. Scientists who develop and introduce technology into any society need to bear the moral and ethical responsibility for the impacts that their innovation may have on society. This involves also potential socio-economic impacts of technologies beyond the controlled confines of laboratories and greenhouses. Recent history in technology introduction stresses that the role of scientists and technologists should not end once a technology leaves the laboratory, but becomes even more important as it is introduced into society.

2) Inter-Generational Responsibility. A technology's aim should be to contribute to sustainable development and is therefore hinged on the inter-generational responsibility of developers of the technology and government regulators. Assessing the socio-economic impacts of GMOs would not only ensure that adverse effects are avoided, or at least minimized, but may also protect the interests and needs of the present as well as those of future generations since socio-economic impacts of technologies are felt throughout generations.

3) Social Acceptance. By giving serious consideration to the potential socio-economic impacts of GMOs, developers and regulators would have a better sense of society's acceptance of the technology and/or its product. As will be explained in later parts of this chapter, effective assessment of the potential socio-economic consequences of GMOs would require the active and broad involvement of various social actors.

4) Reducing Long-Term Costs. A primary concern in socio-economic assessment of GMOs is the costs related to the processes of broad participation of various stakeholders and actors and the period of time it takes to go through these processes. While this may be a valid concern in the short-term, it ignores the possible long-term costs of the technology on society arising from its potential adverse impacts. Hence, by taking socio-economic considerations into account in decision making on GMOs, irreversible social, economic and cultural costs may be avoided or minimized.

Developers and regulators cannot escape the ethical dimension of introducing GMOs without carefully assessing their potential socio-economic impacts. Unlike laboratories and greenhouses where the factors and conditions are all within the control of the scientists conducting the experiment, social and economic forces are beyond anyone's control. Thus, a strong sense of ethical responsibility underpins the need for thorough assessment of socio-economic considerations before GMOs are introduced in any given societal context.

4.1 Socio-Economic Considerations in Relation to GMOs: Legal Recognition

Owing largely to the strong lobby by civil society organizations and several developing countries, particularly the Africa Group, socio-economic considerations have officially been taken on board in the Cartagena Protocol on Biosafety (see Chapter 25).

Article 26 of the Protocol on Socio-Economic Considerations states:

> 1. The Parties, in reaching a decision on import under this Protocol or under its domestic measures implementing the Protocol, may take into account, consistent with their international obligations, socio-economic considerations arising from the impact of living modified organisms on the conservation and sustainable use of biological diversity, especially with regard to the value of biological diversity to indigenous and local communities; 2. The Parties are encouraged to cooperate on research and information exchange on any socio-economic impacts of living modified organisms, especially on indigenous and local communities.

While the Protocol has recognized that there are socio-economic considerations arising from GMOs, and that these may be taken into account in the decision-making process, research on socio-economic considerations is not a requirement for decision making. Nonetheless, the international community has thus acknowledged that socio-economic considerations are important components of the biosafety decision making process.

4.2 Socio-Economic Impact Assessment (SEIA)

In order to give meaning to the provision of the Biosafety Protocol on socio-economic considerations, tools have to be developed and applied to guide decisions on research, development, movement and introduction of GMOs. One such potentially powerful tool is the socio-economic impact assessment (SEIA), which is adapted from the existing mature tools adopted in environmental impact assessment.

SEIA can help in assessing the potential consequences on the various aspects of the society in which a particular technology is being introduced. It is basically a participatory assessment tool which maps local knowledge in a particular societal context where new technology will be introduced. By being participatory and interdisciplinary, e.g. focusing on economic, social, cultural, political, and ethical aspects, a SEIA entails involvement of different actors/stakeholders and a plurality of aspects in the assessment.

Overall, SEIA can help regulators and civil society groups to weigh the potential benefits of GMOs side by side with their potential risks and adverse impacts on the different socio-economic spheres. There are evolving frameworks on socio-economic impact assessment that are being developed in different contexts. The Philippines, for example, had initially set forth the importance of SEIA in the drafting of its national biosafety framework, although the final regulatory framework did not make it a mandatory requirement in applications for GMO releases. As the Philippine experience has shown, despite the presence of a mature environmental impact assessment framework from which lessons can be learned, the development of tools for socio-economic impact assessment remains a challenge to policy makers, regulators and civil society organizations.

5. Socio-Economic Considerations: What to Assess?

The breadth and depth of what is involved in socio-economic considerations are quite overwhelming, especially to those who want to make the commercialization of such a complex technology as GMOs as least complicated as possible. However, society is a complex organism that has evolved in specific contexts where economic, political, social, cultural, and ethical spheres constantly interrelate with each other in an intricate manner.

This section will attempt to identify some of the components of socio-economic considerations by using general headings representing the key spheres of society and the specific areas in each sphere that GMOs may have potential impacts on. Examples, mostly from experiences in and observations from developing countries, will be used to illustrate key points and critical concerns.

5.1 Economic Considerations

Control over Tools of and Relations to Production. Assessment of the potential socio-economic consequences of GMOs should take into account the issue of control over agricultural production and relations to production in the particular context where the technology is introduced. The potential impacts of introducing GMOs in a rural context have to be studied carefully, bearing in mind the lessons from technologies such as the Green Revolution which reinforced income inequality and wealth distribution in the rural areas, despite the increase in rice and corn production (Conway, 2003). The high costs of agricultural inputs introduced by the Green Revolution made them inaccessible for the rural poor who became heavily indebted to the rural elite who already had better control over the tools of production even before the new technology was introduced.

In the context of GM crops, the control over seeds and the accompanying inputs that complete the technology needs to be the core consideration in socio-economic assessment. The question of control over seeds is relevant at different levels, from the corporate interest in the development and distribution of GM seeds, to the local channels for technology dissemination. Key issues that need to be assessed are: will the dissemination of GM seeds provide opportunities for poor farmers to have some control over the tools of production, or will it further entrench control of particular segments of the community over farm inputs, processing and marketing? These questions may be difficult to answer, but lessons from recent experiences with the introduction of agricultural technologies as well as simulation exercises with the participation of representatives from key sectors can provide meaningful inputs.

Income and Wealth Distribution. Companies that develop GMO products intend to recoup their investments on research and development, through the intellectual property rights (IPR) system and marketing schemes, as well as by profits from the sale of these products. Since price segmentation is an unsound business practice, GMO seeds, for example, are generally sold at a standard price in a country where they are commercialized, which means that the same price applies to all farmers, whether rich or poor.

> For instance in the Philippines, Monsanto's MON 810 (Bt corn with cry1ab transformation event from the soil bacterium Bacillus thuringiensis) is sold at more than twice the price of the counterpart non-GM hybrid corn seed varieties. In a country where at least 60 per cent of corn farmers do not own the land that they till, this price is too high. Given this market reality, Monsanto adopts a targeted marketing scheme that primarily offers its Bt corn products to rich and middle-income farmers who can afford the higher cost of seeds as insurance against corn borer damage. Granting that the company's claims are true with regard to the benefits of Bt corn, those who will benefit from this promise are obviously those farmers who can afford the cost of seeds and who already have relatively high income to start with. This situation will expectedly aggravate the problem of income inequality and wealth distribution in the rural areas. While some may argue that the increase in the income of rich farmers will contribute to higher investment and employment creation in rural areas, this scenario highly depends on whether the promises of better yield and higher income from planting GM crops become a reality. The assertion is also hinged on the expected 'trickle down' of the benefits from those who are supposed to gain from planting GM crops to those who cannot afford the technology.

Income Security. The impact of GMOs on farmers' net income is another important economic consideration that needs to be seriously looked into. Economic cost-benefit analyses would be useful in this regard, taking into account the specific farming practices and conditions of farmers who have adopted the technology. Basic questions about the costs of GM seeds and other required inputs and their share in the total cost of production should be posed, along with the potential net income (or losses) that farmers can expect from using the seeds. Hidden costs, such as environmental and health effects, should ideally be considered too.

Rural Labor. Rural labor is one economic concern that is especially relevant to many developing countries where widespread rural unemployment is a perennial problem. Most GM seeds available in the market today are developed by biotechnology companies based on the needs and conditions of farmers in developed countries where agriculture is predominantly industrial in scale. The situation in industrial agriculture, where the cost and availability of labor is a major production cost, is vastly different from the situation in household-based farming that characterizes agriculture in many developing countries where labor is readily available, abundant and often cheap.

For instance, the introduction of herbicide-resistant GM crops that eliminates the need for weeding or tilling of the soil during land preparation will potentially have grave long-term impacts on rural labor. Less labor requirement on farms using herbicide-resistant GM crops would mean less employment opportunity for poor agricultural workers, especially in areas where there is high rate of rural unemployment. Some may argue that the use of GM seeds that cost more than conventional seeds but that require less labor would make more economic sense than hiring farm labor, which does not only involve paying legal wages but also complying with core agricultural labor standards as well. Such an argument reinforces the potential adverse impacts of GM crops on socio-economic relations in rural areas as well as in overall income distribution. It is argued further that the use of labor-saving GM seeds could theoretically create higher economic surplus that could contribute to increased investments and job generation. The global trends in decreasing investments in the rural areas and the declining contribution of agriculture to overall national income, however, point to the reality that whatever economic surplus is generated in agriculture is not substantially reinvested in the sector to benefit the rural poor.

Markets. Since the price of agricultural commodities is highly sensitive to and dictated by supply and demand, GMOs that promise yield improvements may affect market behavior. Particularly vulnerable are developing countries whose economies are highly dependent on the production and export of specific agricultural products. Spikes in the production of or expansion of areas devoted for the production of Bt cotton in the US or India, for example, could affect the potential market for cotton produced in poor western African nations where millions of farmers depend on cotton cultivation for their livelihood. Since GM commodities such as Bt cotton are produced largely for processing into textile materials and animal feed, they are not segregated from conventional cotton, and hence they will compete with each other in the market.

Even in cases where GMOs are segregated from their conventional counterparts, as in Europe and Japan, which do not accept GM commodities unless they are properly labeled, this could have potential impacts on the market. Segregation, while beneficial for consumer awareness, meaningful labeling and precaution, may ultimately result in price segmentation where the non-GM products could bear a higher price and would be primarily intended for markets that can afford them. On the other hand, GMOs could be channeled to markets with less capacity to pay or where such segregation is not legally required. While this may make sense from a purely market perspective, it would pass on to consumers the price of segregation, which should have been part of their inherent right to information in the first place.

Trade. One of the issues in trade that needs to be considered is the ability of developing countries to compete in the international market if they decide to venture into commercial production of GM crops. In order to compete with the commodities of bigger and wealthier countries in the export market, developing countries bear the burden of meeting high international standards, such as sanitary and phytosanitary standards. While GM crops promise to address specific problems related to particular pests and diseases, the quality of the product largely depends on the conditions in which they are produced and the management practices under which they are

grown. In the case of corn from the Philippines, for example, the most serious problems that affect the crop are fungal diseases, which affect the quality of the harvest and could diminish the chance of meeting international export standards. While promising to increase corn yield as a result of less corn borer attacks, none of the varieties of Bt corn commercially available in the local market address fungus infestation which negatively affects the quality and overall production of corn locally and hence the prospects of exporting surplus corn production to other countries. With stringent sanitary and phytosanitary measures imposed internationally on imported corn and the strict risk assessment processes required in key industrialized markets resulting from strong consumer rejection of GMOs, the prospects of Philippine GM corn competing in the export market do not look very promising.

Coexistence and GMO contamination. The risk of transfer of pollen is particularly high for cross-pollinating crops, such as corn and canola (see Chapter 12). Producers of organic crops risk having their crops contaminated by nearby GM crops whose pollen can travel long distances by wind or with the aid of insects. Coexistence as a policy is extremely challenging, with evidence pointing to the reality of GMO contamination of conventional crops, and even involving GMO crops grown experimentally on a limited scale and those that have not been approved for commercial planting. This situation is expected to be much more complicated in most developing countries where landholdings are much smaller and distances between farms are much shorter. GMO contamination of conventional crops, and of wild and weedy relatives, poses serious threats to biodiversity and the genetic base for long-term food security. Also at risk are the economic prospects that countries and farmers hope to gain from organic cultivation of agricultural products.

Organic Agriculture. In countries where GMOs are already legally commercialized, the prospects for farmers to venture into organic agriculture may be limited by the widespread cultivation of GM crops. There is a consensus in the available literature that the most obvious and potentially devastating impact of GMOs is their direct effect on organic agriculture through contamination. Already, this has become a controversial issue in the US and Canada, where organic farms have been contaminated by GMOs and some farmers have filed ongoing legal suits demanding damages (Nature Biotechnology 2002; SOS Food 2002).

Considered as the fastest growing sector in agriculture worldwide, organic agricultural products have increasingly become important to the economy of many developing countries in recent years (Patton 2006). Organic certification standards generally do not allow GMO contents, and agricultural products containing even small traces of GMOs do not merit the organic label. Should contamination of organic crops occur, farmers would lose the organic certification status for those crops and the premium prices they command.

Food Security. For developing countries where agriculture is a primary activity to ensure family subsistence and provide food supply to the domestic market, a key economic concern that needs to be considered is the potential impact of GMOs on long-term food security. The majority of the GMOs commercialized worldwide are not considered as food crops in developing countries where food security is at the core of agricultural development. Most of the GM corn, soybeans and cotton cultivated and traded worldwide are intended as animal feed. With cultivation of GM crops in the developing world, household food security faces the threat of conversion of land areas traditionally planted with food crops for the production of commodity crops for industrial use and export. Already, many poor and even medium-income countries have high incidences of malnutrition despite increased agricultural production, mainly due to crop uniformity and the erosion of traditional food bases that used to supply balanced and readily available nutrients to family members. A sound socio-economic impact assessment should seriously look into the

impacts of widespread promotion of GM crops for industrial use on the overall food security of communities in view of land limitation and the declining productivity of agricultural land due to intensive production.

Food Aid. While ensuring long-term food security remains a great challenge for the developing world, many poor countries are confronted by emergency situations that inhibit farmers from producing their own food, particularly in areas affected by war, widespread conflicts, natural calamities, drought, and famine. In such emergency situations when countries have to depend on international assistance for the survival of their people, economic sovereignty is often compromised. For instance, the issues involving GMOs in food aid were dramatized some years ago when some countries in Africa affected by drought and famine, namely Zambia, Mozambique and Zimbabwe, formally rejected the food aid brought in by the United Nation's World Food Program (WFP) on the grounds that the corn shipped from the US contained GMOs. Zambia, especially, held its ground by declaring that its decision was based on its responsibility to protect the health of its people and the integrity of its environment (Manda 2003). The WFP had to respect the stand of Zambia, and the controversy led it to formulate its position in procuring food aid from sources that could assure GMO-free food supply, whenever possible and available.

Intellectual Property Rights (IPRs). The issue of IPRs has received extensive attention and is the subject of intense debates at the international level. GMOs and GM products that are commercially available, even those that are still being developed, are protected by IPRs owned by the companies and institutions that developed them. The proprietary stake of companies over these products is at the heart of the discussion on who controls the technology and the resulting concentration in corporate hands that directly mould the relations to production and control over production in a given society.

Concerns about the implications of IPRs for GMOs extend beyond the economic sphere. The impacts of IPRs on public access to knowledge and technological innovations are far-reaching. IPRs have arguably hampered the free flow of information, knowledge and genetic materials that have served as the foundation of research and development efforts in public institutions. Proprietary control over useful technologies severely limit the potential of public institutions to pursue research that serves the interests of the poor, which is not considered a lucrative market for corporate products.

5.2 Social Considerations

Impacts on Farmers' Rights to Save Seeds. The potential consequences of GMOs on the traditional practice of farmers in saving, reusing, sharing, exchanging, and selling farm-saved seeds is a very important consideration in the assessment of socio-economic impacts of the technology. This is especially relevant in developing countries where farmers widely practice traditional seed saving and free exchange of planting materials, which may not be the case in developed countries where industrial agriculture is the dominant farming system. The traditional seed saving practices of farmers are widely regarded as the foundation of the immense genetic diversity in agriculture today. Thus, developments that may limit this practice, such as the stringent application of the IPR system on seeds, are seen as potential threats to the long-term food security of rural communities in particular and countries in general.

The inherent right of farmers to seed saving and exchange is legally protected by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) under the Food and Agriculture Organization (FAO). Governments are entrusted to protect farmers' rights through national legislation, a task which has not been easy for many countries that have also committed to protect IPRs of seed companies under international trade agreements, such as the Agreement

on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the WTO. Despite the flexibilities in the TRIPS Agreement, only a few countries have exercised the political will to protect farmers' rights to seeds while giving recognition to the proprietary rights of companies over innovations.

Part of farmers' rights to save and exchange seeds is their right to make decisions on their farms. The potential of GMOs to further entrench rural inequalities and marginalize poor farmers could also have long-term impacts on their capacity to decide on what, when and how to plant on their own farms. Experiences under the Green Revolution have shown how capital-intensive technologies could foster dependence on input providers among poor farmers who do not have the necessary capital required for adopting a new technology.

Impacts on Women. The impact of new technologies on women and gender roles in general is an area that should be looked into. The recent history of introduction of modern agricultural technologies has shown how rural women have been further marginalized and their roles made even more invisible by innovations which are generally designed for men (Paris 1998). In the case of herbicide-resistant corn that aims to eliminate the laborious task of weeding, women would be significantly marginalized since weeding is one of their primary tasks in corn cultivation, as for example in the Philippines. While this could decrease the burden of women in corn farming, their role will become further invisible, with men taking the primary decision making role on what varieties to plant.

Consumer Concerns. While GM seeds mean higher input costs on the part of producers, the technology promises to provide cheaper products to consumers resulting from higher and more efficient production. While price matters for most consumers, especially in developing countries, it is not the only factor that determines consumer responses to new products introduced in the market. Consumer acceptance is highly influenced by cultural and ethical values, and perceptions on health and environmental safety of the product – which are most relevant in the case of GMOs, as shown by a number of examples from developed and developing countries in recent years. Japan, Thailand and South Korea, following the trend set in Europe, now require labels on GMOs. While consumers in industrialized countries are generally less accepting of GMOs, their counterparts in developing countries can assert their right to choose.

6. Institutionalizing the SEIA

SEIA as a tool for decision making on approval and releases of GMOs needs to be institutionalized in the biosafety processes of countries. The specific government institutions responsible for implementing the SEIA processes need to be identified and their mandates have to be clearly formulated. Governments may decide to tap existing biosafety bodies or specialized agencies, independent institutions such as the academe, or create a special body for this purpose. In the case of the Philippines, for example, where socio-economic impact assessment is not obligatory, existing institutions responsible for biosafety decision making are tapped.
In order to be an effective tool for decision making, SEIA needs to be integrated in the biosafety decision-making policy and processes, such as the national biosafety framework, biosafety regulation or biosafety law of a country. SEIA should not be a stand-alone process, but should be an integral component of biosafety decision making. SEIA should neither be limited to an assessment after decisions on GMOs have already been taken, but should be integrated in different stages of the biosafety process – from the contained experiment, to the limited field trials up to the time prior to the commercial release of GMOs. Regulators should bear in mind that most of the socio-economic consequences of GMOs are likely to be irreversible and beyond anyone's control once the products have been disseminated to and adopted by society.

7. Socio-Economic Impact Assessment: Guiding Principles

To be effective in guiding decision making concerning GMOs, SEIA needs to involve the following key principles:

'Bottom-up' Approach. SEIA is essentially a bottom-up approach, involving the actors who may be affected by the potential impacts of GMOs. As a bottom-up approach, SEIA involves broad participation of the different actors of society who would most likely be affected by GMOs, which could differ according to the nature of the product involved. For instance, in the case of GM seeds, farmers are most likely to bear the costs or reap the benefits, and thus should play the biggest role in SEIA.

Based on public awareness. Active participation can only be expected from an informed public, which underlines the role of governments and civil society in providing balanced information and explaining the issues to the public.

Transparency and public access to information. Participation in decision making is largely determined by the trust and confidence of people in the government that initiates such processes. Public trust and confidence, in turn, are gained by governments that conduct their business in transparent and accountable manners, hence appropriate mechanisms need to be established so that the public has access to information on the status of approvals and on the basis of decisions made by regulators.

Provide alternative technologies and options. Awareness-raising efforts should also extend to broadening the public's perspective on other technologies and practices available to attain the same objectives aimed by a specific GMO. Information provided to the public should not be merely limited to a yes-or-no scenario but should provide inputs on technological alternatives to GMOs.

Multi-disciplinary assessment. SEIA clearly involves a multidisciplinary assessment and the role of social scientists in SEIA is largely limited to facilitating the process and providing necessary inputs that provide the appropriate context to the discussions with the various actors involved. Integrate in biosafety decision making and technology assessment framework. SEIA has to be considered as an integral part of the entire biosafety decision-making package in any given context, not as a stand-alone process. It should be explicitly recognized as such in national biosafety frameworks, regulations and laws.

Develop context-specific assessment tools. Regulators need to develop context specific socio-economic impact assessment tools with inputs from the different actors. In general, the processes involved in the SEIA and how they are actually implemented in reality would determine the credibility of the exercise as a basis for decision making on GMOs.

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