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Socio-Economic Considerations in GMO Decision-Making

**Georgina Catacora-Vargas, GenØk-Centre for Biosafety,
Norway & Federal University of Santa Catarina, Brazil**

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Introduction

The inclusion of socio-economic considerations in biosafety decision-making is a widely debated issue at international, regional and national levels. Despite significant experience and acceptance on the inclusion of social and economic aspects in environmental decision-making (Freundenburg 1986; Bareano 2012), the recognition of the eco-social interrelationship and its practical implementation in regulation related to genetically modified organism (GMOs) have been more difficult and contentious (Secretariat of the CBD 2003; MacKenzie *et al.* 2003). The arguments both in favor and against the inclusion socio-economic considerations in biosafety decision-making are diverse. Points of view in favor acknowledge the relevance of socio-economic considerations in risk assessment and management of GMOs due to their potential impacts on biological diversity that may in turn jeopardize rural livelihoods, indigenous knowledge, market opportunities and even national economies, etc. These concerns have been more forcefully raised by governments and institutions in countries that are centers of origin and genetic diversity (MacKenzie *et al.* 2003; Khwaja 2002; Secretariat of the CBD 2011; Pavone 2011). In contrast, opinions against consider socio-economic considerations as of limited relevance in GMO regulation. Moreover, it is argued that their inclusion could delay the process of adoption of new technologies and increase the cost of compliance with biosafety policy (Falk-Zepeda and Zambrano 2011; Falk-Zepeda 2009, Secretariat of the CBD 2011; Secretariat of the CBD 2003).

Nevertheless, several countries have been - and are in the process of, including socio-economic provisions in their national biosafety frameworks, including countries that are not Parties to the Cartagena Protocol on Biosafety (Spök 2010; Bareano 2012). The Cartagena Protocol on Biosafety is the multilateral environmental agreement that sets international rules and procedures for the safe transfer, handling and use of GMOs in order to prevent “*adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health*” (Article 1) (Secretariat of the CBD 2000:3). Based on the current experience related to impacts of GMOs at socio-economic level, and the need for greater conceptual clarity on its utility, the following sections provide some elements on the basic questions of *what, why, when* and *how* to include socio-economic considerations in GMO decision-making.

What are socio-economic considerations related to GMOs?

There is not yet a clear and agreed definition on what socio-economic considerations entail in the context of biosafety regulation, despite more mature use of the concept in other fields of environmental decision-making (e.g. Sadler and McCabe 2002). In order to advance in some conceptual clarity and for the purpose of this paper, the definition of social impacts given by Sadler and McCabe (2002) in United Nations Environmental Programme training manuals could be adapted to preliminary describe socio-economic considerations related to GMOs as *the set of the intertwined social and economic consequences resulting from the changes arising from the introduction of GMOs into the environment, which need to be taken into account in the biosafety decision-making processes.*

Three aspects need to be pointed out from this proposed description:

1. The core of the analysis is the consequences or impacts rather than only the changes. This because some changes may not result in impacts (Vanclay 2002), or more importantly, may overshadow the real relevant effects (see Box 1 for further discussion on this point).

2. The socio-economic considerations embrace two general types of impacts: i) tangible and mostly quantitatively-measured impacts, such as changes and resulting outcomes in income generation, trading opportunities, forms of livelihoods, work generation, local organization, access to food, food quality, health status, gender equity, etc., and ii) intangible and mostly qualitatively-measured such as cultural and psychological changes and related impacts, like changes in values, attitudes, perceptions about themselves and their communities, visions for the future, etc. (Sadler and McCabe 2002).
3. Since social and environmental contexts vary from place to place, socio-economic impacts and therefore socio-economic considerations will vary from community to community and even from group to group (Vanclay 2002). This brings methodological challenges discussed below.

Box 1. Considerations on the impacts of changes, rather than only on the changes themselves

The glyphosate-tolerant soybean is promoted under the claim that its adoption will contribute to reduce the use of toxic herbicides. Since the provisional approval (in 2003) of genetically modified (GM) soybean tolerant to the herbicide glyphosate in Brazil, the use of glyphosate has increased considerably. From 62.5 thousand of kilograms of active ingredient applied in 2003 to approximately 300 thousand in 2009 (Meyer and Cederberg 2010). This change in volume equals an increase of 380% in the use of glyphosate as active ingredient. This increase results mainly from two processes: The increase in the area planted with soybean tolerant to glyphosate (Catacora *et al.* 2012), and the loss of efficacy of glyphosate in controlling weeds (Waltz 2010) due to the appearance of glyphosate-resistant weeds (Cerdeira *et al.* 2011). In order to control such a weeds, herbicides more toxic than glyphosate are used, such as paraquat. Although paraquat was banned in Europe in 2007 due to its implications in neurological and reproductive disorders (Wright 2007; Frazier 2007), the imports and use of paraquat is increasing in the largest (GM) soybean producing states of Brazil (Meyer and Cerderberg 2011). In 2009 alone, 3.32 million of liters of this herbicide was applied in the country (Catacora *et al.* 2012).

This case shows two changes in the production systems of soybean in Brazil: The first one related to the introduction of GM soybean and the second, on increase of glyphosate use. Since there is a wide controversy on the safety of GM crops and glyphosate, probably these changes may not say much. However, the consequences are the core of the socio-economic impact analysis, such as the development of glyphosate-resistant weeds that results in increased use of highly toxic herbicides, which at the same time are linked to other impacts: Increased production costs needed with the purchase of additional herbicides to glyphosate and increased health risks. If the socio-economic assessment focuses only on the changes (e.g. introduction of glyphosate-tolerant soybean as a mean to reduce the use of other more toxic herbicides) and not in the effects of those there is the risk of overlooking the related consequences and, as result, neglect to consider these aspects in the GMO decision-making process.

Why socio-economic considerations in decision-making related to GMOs?

A “Nature-Society co-evolution”, in development, i.e. the process of development from the mutual influence between the environmental and social systems (Norgaard and Sikor 1999) recognize that all interventions (e.g. projects and technology) have implications for both the environment and society (Pavone *et al.* 2011). This gives the rationale for *why* socio-economic considerations are relevant in environmental decision-making processes, such as the introduction of GMOs into the ecosystems. In addition to the evident mutual relationship between the environment and society, Borrow (2002) adds two other reasons for the consideration of socio-economic aspects in decision-making: One is the growing demand for social responsibility by markets and regulations (exemplified by the growing demand of fair trade and socially-responsible products); and two, the global necessity of advancing in sustainable development objectives.

When should socio-economic considerations be considered?

The debate on *when* to consider the socio-economic impacts of GMOs in the decision-making process is another unresolved issue in the biosafety discussions. Socio-economic assessment can be performed either before (*ex-ante*) or after (*ex-post*) the GMO introduction. Both are different in purpose and information provided. *Ex-ante* assessments are anticipatory, in other words, they aim to determine the potential impacts and undesired risks of GMO, information that is relevant during the decision-making process over applications of introduction of GMOs. These kinds of assessments are precautionary and have the potential to better contribute to sustainable development efforts (Borrow 2002). The Cartagena Protocol on Biosafety points out the *ex-ante* consideration of socio-economic impacts. Article 26.1 of the Protocol mentions that Parties who chose to include socio-economic considerations in their biosafety procedures, they are applicable in the process of reaching a decision of import of GMOs (Secretariat of the CBD 2000). Conversely, *ex-post* assessments focus on the monitoring of the risks identified in the *ex-ante* evaluation, and detecting any potential or real unforeseen adverse effects either from approved or illegally introduced GMOs. *Ex-post* assessments are relevant to identify and take preventive or corrective measures in the case of risk or damage, respectively, from GMOs. Based on the differentiated aims and sort of information provided, these two types of assessments are not inter-changeable. This means that one cannot replace the other since they fulfill different purposes and provide information for different decision-making processes.

How to include socio-economic considerations?

Generally speaking, socio-economic aspects and impacts related to GMOs are complex for diverse reasons: i) They vary along time and across space, and may occur over short time periods or within locations geographically close to each other, ii) multiple factors may influence social systems simultaneously, highlighting importance for their inclusion in the socio-economic analysis (e.g. social, economic, cultural, political, ethical, etc. factors), and iii) The societies are embedded in the natural environment (a more complex system in itself) giving place to a another set of socio-economic considerations arising from the Nature-Society relationship (Borrow 2002; Norgaard and Sikor 1999). These various features described above provide the rationale for the inclusion of the following methodological assessment and decision-making approaches related to socio-economic considerations:

- ***Integrated and complementary assessment to environmental risk assessment.*** As mentioned, ecological and socio-economic factors are intertwined and influenced mutually. This is clear in the example given in Box 1 where a socio-economic change i.e. the introduction of a GM herbicide-tolerant variety and the inherent intense use of the specific herbicide that this variety is tolerant to, is resulting in ecological changes (such as appearance of herbicide-tolerant weeds) that at the same time is giving place to a new set of eco-social implications: The need for other herbicides to combat weed resistance that further pollute agro-ecosystem, increase the production costs and raises the risk to public health.
- ***Holistic by including direct and indirect as well as cumulative and combinatorial effects.*** Changes and their consequences rarely occur in a linear or isolated manner in Nature or societies. Since both systems are complex, changes result in direct and indirect combinatorial and cumulative, and hence are often unforeseen impacts (Stabinsky 2001; Cardinale *et al.* 2012), out of which some may be undesirable. This justifies the need of monitoring the performance of GMOs if introduced into the environment. Following the example given above and from Box 1, the increases use of glyphosate is a direct impact from cultivating glyphosate-tolerant varieties. A reported indirect impact is the use of more toxic herbicides (e.g. paraquat) to control glyphosate-resistant weeds that appear in time. This, combined with the need of larger investments to purchase such herbicides and the higher risk to the health of ecosystems and human populations, the example of Box 1

points out to a potentially unsustainable production system in the long term at ecological, social and economic levels.

- **Multi- and transdisciplinary approaches.** The complexity of socio-economic issues, particularly the ones related to the environment, require an assessment and decision-making process that includes different disciplines that exchange knowledge and information among themselves. In the case summarized in the Box 1, ecological, health and social sciences are needed to adequately understand and estimate the corresponding risks taking place with alterations in weed populations, exposure to different herbicides, and changes to local livelihoods that may result from GMOs introductions. Also highly relevant yet often ignored areas, such as ethics, play an important role. For instance, the ethical considerations of increasing export and use of pesticides banned in some regions (such as paraquat) and its impacts on the welfare of local ecological and social systems).
- **Methodologically pluralistic.** Based on the above, an expected conclusion is the application of different research and decision-making approaches utilizing diverse fields of knowledge also necessitate the broader inclusion of questions to be answered and concerns from actors to be involved or impacted. The application of not only quantitative but qualitative (including participatory) methods is essential in socio-economic assessments. The participation of an informed public is crucial for achieving societal relevant outcomes in both GMO research and decision-making.
- **Context specific.** As stated earlier, the eco-social interrelationship varies in temporal and geographical scales. This requires a case-by-case and regularly updated assessment of the socio-economic impacts of GMOs according to the social and ecological context where they are introduced.
- **Long-term oriented.** Only long-term assessments will provide proper information on the socio-economic impacts of GMOs and their consequences on sustainability. The indirect, combinatorial and cumulative effects of GMO introductions in complex systems as Nature and society will not be appropriately captured or assessed in short-term scenarios.

Final comments

Socio-economic impacts (positive or negative, predicted or unforeseen) are inherent part of technology introduction and adoption. This points out the need of including socio-economic considerations in the biosafety decision-making related to GMOs.

The Nature-Society interface defines the complexity of the socio-economic dimension of any intervention (e.g. projects or technologies) and calls for a thoughtful and comprehensive methodological approach characterized by: A holistic view, integrative with environmental risk assessments, multi- and transdisciplinarity, methodological pluralism, context specific and long-term oriented. In other words, proper socio-economic assessments will require going beyond the common practice of mostly economic assessments, but aiming towards sustainable-development relevant appraisals. In order to carry out these socio-economic assessments relevant to sustainability, precautionary or anticipatory (also called *ex-ante*) assessments are needed, complemented with regular monitoring (or *ex-post*).

The challenges ahead for the appropriate assessment of socio-economic implications related to GMOs and their inclusion in environmental decision-making processes are significant. However, equally significant is their relevance, particularly in light of sustainable development. Hence, failing in the adequate consideration of the socio-economic dimension in biosafety processes may jeopardize our Nature's and societies welfare.

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