



ABNE Policy Brief No. 1



Environmental Safety Aspects of Biotechnology

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B iotechnological tools have allowed the development of crops with novel traits such as insect and disease resistance, herbicide tolerance, tolerance to abiotic stresses, and nutritional enhancements through the transfer of DNA across species. While these crops have helped increase crop production, it is important to consider possible risks to human health and the environment. Many countries around the world are addressing such concerns through the establishment of regulatory policies and decision-making bodies. Like elsewhere in the world, regulators and policy makers in Africa are concerned with the safety of the environment and human health while making regulatory decisions on genetically modified (GM) crops. This policy brief provides an account of the potential environmental concerns that have been raised for GM crops and how these concerns could be addressed.

Impact of agriculture on the environment

Agriculture and the natural environment maintain complex and intimate relationships. While the natural environment provides the core resources for agriculture and influences its overall productivity, current agricultural systems in turn, impart a significant footprint on the environment through deforestation, soil degradation, water consumption, pesticide use and emission of greenhouse gases. Having in mind a clear idea of how the current agricultural practices impact the surrounding environment is the necessary starting point to appreciate the potential impact from the new agricultural systems generated with modern biotechnology tools.

Environmental issues raised for GM crops

The environmental concerns being most commonly expressed about biotech crops are (1) whether the GM plants will transfer the introduced material (gene) to other plants (either wild species or crops or both), and the potential consequences, (2) whether new substances eventually produced by GM plants can have negative effects on non-target organisms such as honeybees, (3) whether pests, insects or weeds, will evolve resistance to pesticides produced by certain GM plants and thereby become uncontrollable, (4) impacts on agricultural practices and agro-ecosystems. Other non-environmental concerns related to GM products include those concerning food safety, socio-economic, ethical and legal aspects. These will be described in separate policy briefs.

1 - **Gene flow.** – Gene flow is a natural exchange of genes between plants that occurs when plants that are sexually compatible are grown close together. The main consequence of such a phenomenon is the possibility that the genetic composition of a given population of plants will be affected. At the stage of field testing, proven strategies have been developed that can essentially prevent gene flow. The GM crop can be isolated by distance from other relatives or by removing reproductive structures. These strategies are the same ones utilized in certified seed production systems; they are based on the biological characteristics of the crop species, and are developed from guidelines proposed by national institutions and international organizations such as OECD and FAO. They have been successfully utilized for over 20 years to conduct field trials of GM crops in many countries.

2 – **Effect on non-target organisms** - Some GM plants like *Bt* cotton or *Bt* maize produce particular substances (insecticides) to protect themselves from being consumed by specific predators. *Bt* cotton

for instance, produce *Bt* proteins that work against specific insects, and do not negatively affect other living organisms such as honeybees, birds or rootworms. This has been demonstrated by many studies and the results are considered in consensus documents. *Bt* substances have been safely used in organic farming since 1924 as a biopesticide.

3 – Development of resistance - Insects or weeds exposed to insect tolerant or herbicide tolerant GM crops could evolve resistance, similar to how they develop resistance to synthetic insecticides or herbicides. This could result in increased reliance on other toxic insecticides or herbicides, or a return to prior pesticides or pest control strategies to manage target pests. The same strategies in place for pest resistance management in conventional agriculture, must apply to biotech crops in order to delay the occurrence of resistance. It is of the responsibility of the national regulatory bodies to make sure that pest resistance management strategies are implemented by the farmers.

4 – Agro-ecological impacts – As is the case with the introduction of any new variety, deployment of GM crops may impact agricultural practices such as intercropping and mixed cropping. In addition, it may reduce cultivation of landraces (local crop varieties). However, in reality, farmers have long been accumulating knowledge and experiences that allow them to successfully keep landrace purity even while cultivating modern and improved varieties. The same strategies will apply to cultivation of GM crops. It is also worthy to note that land races themselves, are evolving entities and not static stand-alone materials; farmers often share their best types and even interbreed them. Additionally, since GM crops are developed for controlling specific major pests, secondary and minor pests can become a problem if the primary pests are removed from the cropping system. Use of integrated pest management and crop management approaches should be emphasized to address some of these agroecological impacts.

Addressing environmental safety issues for GM crops

Environmental safety issues are not unique to GM crops. Any new technology has both risks and benefits. In order to address safety issues, functional regulatory systems must be in place, with the competencies required to properly assess and manage environmental risks along with other kind of risks. Any potential risk of GM crops to the environment depends on the crop itself, the trait of interest and the receiving environment under which the crop is grown. Environmental risk assessment and management, to be relevant, should be done on a case-by-case basis and must center on existing or new information related to the crop biology, the characteristics of the introduced gene and the trait expressed, and the ecological characteristics of the location where the crop will be planted.

Enabling conditions for environmental risk assessment and management have allowed many countries to safely conduct research field trials and/or commercially produce GM crops, helping to achieve both higher productivity and reduction in the negative impacts on the environment.

This is the first of a series of policy briefs to be developed by the African Union/NEPAD - African Biosafety Network of Expertise (ABNE) addressing environmental safety aspects of modern biotechnology. *This policy brief is targeted for regulators and decision makers.*

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