Socio-Economic, Ecological, and Policy Impact Assessment in the Introduction of a Transgenic Staple Crop Variety to the Developing World: The Insect Resistant Maize for Africa Project, Kenya

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In Kenya, as in most of East and Southern Africa, maize is the primary staple. However, the country has yet to become self-sufficient for maize, and current increases in productivity fall short of population growth. Throughout the region, pre-harvest losses due to stem borers are estimated by farmers to range around 15%. The identification of maize varieties with seed-based insect tolerance has been an ongoing focus of the Kenyan Agricultural Research Institute (KARI) since its inception in 1979. The Insect Resistant Maize for Africa (IRMA) Project, a partnership between CIMMYT and KARI funded by the Novartis Foundation for Sustainable Development, was initiated in 1999. Its aim was to increase maize production and food security through the development and deployment of insect resistant maize, both through conventional breeding and through the use of lines transformed with toxin genes from the entomopathogenic bacteria *Bacillus thuringiensis* (Bt). Whereas genetically modified insect resistant maize has been grown widely in the US since 1996, controversy, public opposition, and regulatory confusion have characterized the history of Bt maize in Europe. Although Kenya is ahead of most African nations in the adoption of the technology (with the third GM crop currently undergoing assessment prior to the import of germplasm), policies on biosafety and biotechnology in general are still in the early stages of development, and public awareness is minimal. Through the provision of practical experience, workshops, and continuous dialogue with stakeholders, the IRMA project aims to raise public awareness of the issues surrounding the technology and to build capacity among local institutions in biosafety and biotechnology policy as encapsulated in Article 22 of the Cartagena Protocol on Biosafety.

IRMA represents the first case in Kenya where nontarget effects, genetic erosion, and insect resistance management are all to be assessed prior to the release of the crop. The project is also unique in its incorporation of socio-economic studies in the assessment of the technology, addressing equity, market demand, and intellectual property-rights issues to equip Kenyan scientists, administrators, and policy makers with the full range of tools required for technology assessment. This paper analyses the approaches used to assess the impacts of Bt maize in the ecological and socio-economic realms, and IRMA's subsequent impacts on Kenyan biotechnology policy and public awareness, especially relating to GMOs.

Whereas previous attempts at project impact assessment may have been retrospective, coinciding with or following interventions, IRMA's prognostic impact assessment work will determine whether a release policy is to be pursued and, if so, will continue after commercialization. This predictive and monitoring approach is especially vital with the introduction of a new technology that is under intense scrutiny from national and international observers. This case study provides a model for projects dealing with the introduction of biotechnology products in the developing world.

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