

## ACTIVITIES AND ACHIEVEMENTS QUESTIONNAIRE

### 1. Non-Technical Summary

A 1000 word (maximum) summary of the main research results, in non-technical language, should be provided below. The summary might be used by ESRC to publicise the research. It should cover the aims and objectives of the project, main research results and significant academic achievements, dissemination activities and potential or actual impacts on policy and practice.

**Background** Smallholders in KwaZulu Natal (KZN) are growing the latest genetically modified (GM) maize varieties, supplied by Monsanto, the US multinational. These are pest-resistant Bt varieties, herbicide tolerant (HT) varieties, where and weeding is replaced by chemical weed control and even the latest stacked gene variety which combines both traits. The basic objective of this study was to discover if these US developed technologies could make a useful contribution, or if they would prove to be unsuitable. This requires research to determine the impacts of GM varieties.

**Aims and Objectives** The first objective was to measure the impact of GM on output growth, employment, wages and livelihoods. The second was to assess the overall impacts on labour incomes and finally on poverty reduction. The third was to inform the policy process by providing national and provincial agriculture departments and national agricultural research services with an understanding of the likely outcomes of adopting the different GM options.

**Results** The main outcome of this project is not what we expected as we began with an idea that Bt varieties were suitable for a semi-subsistence environment, such as these farmers in KZN, since they provide built-in crop protection, which must improve yields, as farmers tended not to use enough pesticide, due to its cost and uncertain availability. The HT varieties are far less clearly useful, as they were developed in the USA with the express intention of eliminating weeding costs. With rural unemployment running at as much as 50%, saving labour could be just increasing unemployment and reducing social welfare. This does not allow for the flexibility with which HT has been applied in KZN. The HT varieties prove to be only moderately labour saving and instead are being used in conjunction with minimum tillage to reduce soil erosion. This is a serious problem locally and the provincial agriculture department has been pushing minimum tillage for some time. The HT variety has made this much more attractive to farmers as they no longer need to hire expensive tractor services to kill weeds before planting. Instead, they use herbicide (far less toxic than the pesticide Bt displaces) to kill the weeds and then shallow plough with oxen. The yields have increased considerably and thus the extra labour for harvesting the bigger crop practically makes up for the weeding labour that is saved.

Thus, the HT variety has not displaced labour and so has not damaged livelihoods of hired workers. It has improved the incomes of farmers and increased the sustainability of farming by reducing soil loss. This accounts for the increasing popularity of HT, which has proved far more popular with farmers than Bt. This is also well understood as drought in about four years in five is the norm and our results show that it is only in the occasional wetter year that Bt seed increases yields enough to cover its extra costs. If fact, it is Bt that displaces ore labour, not HT, because the saving in spraying labour is not counter balanced by more harvest labour in most years. However, the twenty-two



farmers who tried the stacked gene maize had the best results of all, even when the extra cost of this most expensive variety was taken into account. Provide that the price is not too much greater than the HT variety, it seems likely that stacked gene maize will become the dominant variety. The employment implications need to be assessed again next year, as the current sample is too small to give reliable results.

The limitation of these results is that they apply only to KZN, which is not typical of the maize growing countries of southern and eastern Africa. To be able to advise on the suitability of these technologies in more typical countries, where tractor ploughing is not available, our KZN results are used as data to calibrate a household model of Malawi. This model shows that HT technology would be adopted in Malawi and could substantially increase output, but that it needs to be released in conjunction with policies like rural infrastructure improvements, or the labour displacement effect could lower wages and have a negative overall impact.

**Academic Importance** The data we have assembled covers 249 farmers in the first year and 333 in the second, giving a total of 582 observations, over three different districts. Over 190 of the farmers are covered in both years, so we can see how they fared over time and some even grew two different varieties on different plots, which gives yet another very useful comparison. Thus, we are in a position to separate farmer and farm specific effects on measures like yields from the effects of the technology itself. It is vital to be able to isolate the technology effect in this way, as normally it is the best farmers who adopt an improved technology and this factor is not taken into account. Furthermore, whereas our early work on cotton only recorded those using Bt or conventional seed, we now have a whole range of technologies and farmers changing between them in all directions. We think these data will prove to be the most useful seen to date, but analysis will be harder as there is far more to explain. The household model shows the impact on the rural economy and gives robust, believable results.

**Dissemination** The study has so far produced four conference presentations and three journal articles, the best of which is in a special issue of the International Journal of Biotechnology. There are also two chapters in books and a specially commissioned report to the South African biosafety authorities. We can be confident of publishing more academic work in better journals, but the gestation period and lags involved are longer.

**Impacts** The most important impact is perhaps in the biosafety review process. The South African GMO regulatory authority takes into consideration socio-economic issues during the decision making process on whether certain GM products should be given commodity clearance (imported) or should receive a general release (commercial production) permit. *Ex ante* assessments that inform the decision-making process are, to a large extent, based on rather hazy assumptions. We have assessed *ex post* the actual impact of the release of both Bt and RR maize.