

## **RES-167-25-0187 - Factor Endowments, Biased Technological Change, Wages and Poverty Reduction: Can Genetically Modified Crops Bring a Green Revolution to Sub-Saharan Africa?**

Smallholders in KwaZulu Natal (KZN) are growing the latest genetically modified (GM) maize varieties, supplied by Monsanto, the US multinational. But can a labour-saving GM technology, such as herbicide-tolerant (HT) white maize, provide agricultural growth in Sub Saharan Africa (SSA), or is the more probable outcome simply increased under-employment in rural areas? But despite substantial work on the lack of a green revolution in SSA, there has been little work on factor endowments and biases since 1985.

Researchers from Imperial College, King's College London and University of Pretoria, set out to predict the impact of GM on output growth, employment, wages, food prices and livelihoods, according to factor endowments. They also sought to assess the overall impacts on labour incomes and on poverty reduction. The objective was to discover if these US-developed technologies could make a useful contribution, or if they would prove to be economically unsuitable. This required research to determine the impacts of GM varieties.

### **Key Findings**

- The main outcome was unexpected. It had been assumed that *Bacillus thuringiensis* (Bt) maize varieties were suitable for a semi-subsistence environment, since they provided built-in crop protection in the absence of sufficient pesticide, whereas HT varieties were likely to displace labour. This proved to be more variable, due to the flexibility with which HT has been applied in KZN. The HT varieties are only marginally labour saving when used in conjunction with minimum tillage to reduce soil erosion.
- The HT varieties have made minimum tillage much more attractive to farmers as they no longer need to hire expensive tractor services to kill weeds before planting. Instead, they use herbicide (less toxic than the pesticide Bt displaces) to kill weeds 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.
- Because HT has improved farmers' incomes and increased sustainability of farming by reducing soil loss, it has proved far more popular than Bt.
- Results showed that only in the occasional wetter years (typically one in five) did Bt seed increase yields enough to cover its extra costs.
- Sustainability is repeatedly stressed as an objective: it was found that HT was saving soil erosion while Bt reduced the level of toxic chemicals, so both could contribute to the green agenda. If Bt, HT and stacked gene (ie both traits) maize reduce environmental degradation, increase yields and do not

displace labour, then it is hard to argue they cause damage.

- Farmers who tried the stacked gene (ie both traits) maize had the best results, even when the cost of this most expensive variety was taken into account. Provided that the cost is not too much higher than the HT variety, it seems likely that stacked gene maize will become the dominant variety. However, the employment implications will need to be assessed again, as the current sample is too small to give reliable results.
- KZN is not typical of the maize growing countries of southern and eastern Africa, but the results have been used as data to calibrate a household model of Malawi, where tractor ploughing is not available.
- The Malawi model shows that HT technology could substantially increase output, but that it needs to be released in conjunction with policies such as rural infrastructure improvements, or the labour displacement effect could lower wages and have a negative overall impact.

### **About the Study**

The data assembled covers 249 farmers in the first year and 333 in the second, giving a total of 582 observations across three different districts. More than 190 of the farmers are covered in both years.

### **Key Words**

Maize, factor, endowments, poverty, genetically modified, employment, wages