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If Mozambique reduces net emissions from farming, will the poor suffer?

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Key points

- Economic growth in Mozambique is based too narrowly on minerals and energy to create enough jobs to reduce poverty
- Most greenhouse gas emissions in rural Mozambique, with its many smallholdings, stem from the conversion of forest to fields and from burning savannah
- Modelling suggests that measures in Mozambique to intensify production, reduce land conversion and capture carbon would increase crop returns, improve economic growth, and enhance food security

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If global warming is to be held to no more than 2°C this century, then greenhouse gas (GHG) emissions have to be reduced. Agriculture is responsible for between 11% and 35% of total emissions of GHG, the higher figure applying when the effects of converting forest, peat and wet lands to farming are included. Technically, there are ways to reduce emissions from agriculture and forestry at relatively low cost. Indeed, through carbon capture in soils and plants, agriculture could — for at least some time — drastically reduce its net emissions, perhaps getting close to zero.

Yet, by 2050 the world population is expected to rise to nine billion. Feeding everyone will mean expanding agricultural output by 70% or more. Given the limited land that can be used, much of this increase must come from intensified production, with the danger of increased GHG emissions.

Most poor people in the world live in rural areas and many work on farms. If agricultural systems are changed to reduce emissions and capture carbon, will this reduce their production and earnings?

This study addresses these issues, examining a low-income country where agriculture is the mainstay of most livelihoods: Mozambique. Three questions are posed:

- What might be done to reduce emissions from Mozambican farming?
- What would happen to the economy in terms of output, employment and, above all, the incomes and food security of poor people in Mozambique?
- What are the implications for policy-makers trying to mitigate emissions in agriculture, while promoting agricultural development to relieve poverty and hunger?

Mozambique and its farming systems

Since peace was restored in 1992, the economy of Mozambique has grown rapidly, in most years at rates of more than 6%. Most growth, however, comes from large-scale enterprises in minerals, hydropower and coal. These have not created many jobs and linkages to the rest of the economy have been quite weak.

Most Mozambicans live in rural areas where they farm smallholdings: three-quarters or more of the workforce are engaged in agriculture for at least part of the time. Land and labour productivity remains low: agriculture contributes just 25-30% to the gross domestic product.

Low productivity combined with the small areas worked by each farm household results in high levels of poverty and hunger. A 2008/09 national survey showed that 55% of the population live in poverty – a share that may have even risen since the previous assessment in 2002/03. Some 46% of children under-five are stunted, a percentage that has hardly fallen at all since the mid-1990s. Economic inequality is high, with the Gini coefficient calculated at 0.46.

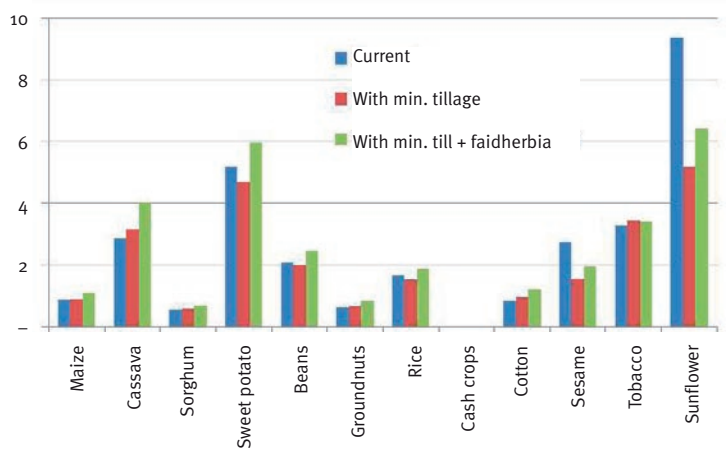
Small farms dominate agriculture: three million occupy 95% of the land, with the other 5% divided between medium and large-scale farms. Small farms produce food crops — maize, sorghum, rice, millet, potatoes, sweet potatoes, cassava and beans, while some also grow copra, cashew nut, cotton, sesame, sugar beans, sunflower and sugar cane for sale.

Most of the growth in agricultural production since the early 1990s has come from expanding the cultivated area, rather than increased yields per hectare.

Emissions and climate change

Estimates of emissions from Mozambican agriculture are imprecise, but show a definite pattern: 69% of GHGs in the equivalent warming potential of carbon dioxide come from burning savannah, and almost all the rest (26%) comes from the conversion of forest and grassland to fields.

Figure 1: Implicit returns to family labour (US$ per day)



Future climate change is expected to produce higher temperatures, increased rains in several parts of the country and higher sea levels with threats of salt incursions in coastal lands and estuaries. Models of future crop yields show, on average, only minor yield reductions for some crops — 11% for maize — and little significant impact for others. But averages matter less than variance. Climate change will bring more variable weather with higher risks of cyclones, storms and droughts, making harvests more variable.

Options to reduce agricultural emissions

Given the importance of savannah burning and clearance of forests and grasslands in emissions, farming systems need to avoid land clearance by intensifying production on existing land. Three approaches are indicated. One, intensify production on existing land, using more intercropping, and reduce ploughing by zero tillage. Two, plant more trees on fields to capture carbon and help recycle nutrients, with trees becoming carbon stores. *Faidherbia albida*, a tree that can be grown across much of Mozambique, has been shown to fix nitrogen and raise yields without the need for external fertilisation when planted at around 100 trees per hectare Three, manage grasslands with more intensive grazing for short periods, encourage a wide range of species and reduce the incidence of burning.

The economics of more intensive cultivation with trees planted has been examined through gross margins, looking at costs and returns to cultivation of a typical hectare of the main smallholder crops. While they may save labour in land preparation, especially where the soil was once ploughed, this may not apply in manual cultivation. Here there can be heavy costs in preparing the land when making planting pits and in additional weeding, especially in the early years. There may also be extra labour in managing Faidherbia trees, such as pruning low branches. However, returns for each day worked increase for most crops, showing that the extra effort will repay farmers (Figure 1).

It should, therefore, be possible to encourage farmers to make the conversion on purely financial grounds, without having to appeal to environmental concerns.

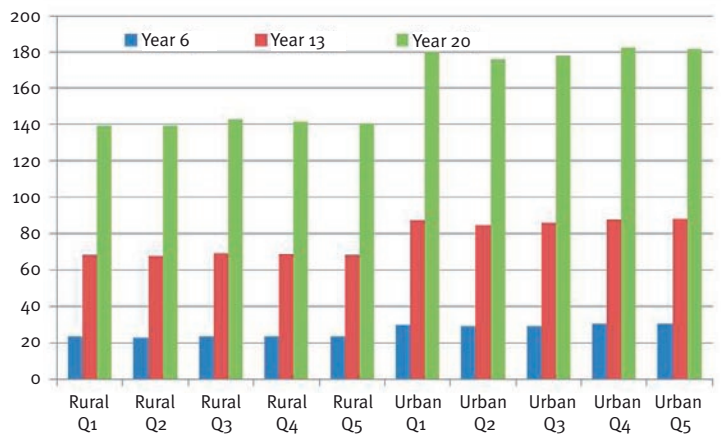
There are, however, public costs as well: mainly a large-scale extension effort to explain the systems, demonstrate them and adapt them to local circumstances. As an incentive to convert their fields, farmers might be given free Faidherbia seedlings, plus perhaps a small grant of seed and tools to compensate them for their extra efforts while converting their systems. If one fifth of farmers could be reached every year, with each group then converting their land over five years, much could be achieved in a dozen years. Public costs might reach a maximum of around $74 million a year at the mid-point.

The greatest challenge in making a transition, however, would not be in intensification backed by incentives, but in deterring farmers from further clearance of grass, scrub and forest, and burning of savannah. At present, land is cleared partly to accommodate the demand for land from a growing rural population, partly because it is usually easier to expand production by expanding the area rather than intensifying production on existing fields, and partly because of the need to recuperate fertility through fallowing. In addition to clearing land for new farms, savannah grass is burned to drive game from their cover to hunt, and to encourage the growth of fresh grass when the rains arrive, so herders have better pasture for their stock.

National impacts of lower emissions farming

A computable general equilibrium (CGE) model was used to examine possible results of measures to mitigate agricultural emissions. CGE models can show the full range of impacts and interactions in an economy, as changes work their way through the system. The model used here, STAGE (Static Applied General Equilibrium), draws on a social accounting matrix of the Mozambique economy for 2002 — the

Figure 2: Changes in disposable household incomes when changes are made



most recent available. The model includes 51 commodities, 48 production activities, nine factors of production, seven forms of taxes, and ten types of household — rural and urban, each divided into five quintiles by income.

The model generated a baseline of what would happen over 20 years if recent trends were unchanged; as well as a projection of what would happen if policies to mitigate emissions from agriculture were adopted.

Key assumptions in the ***baseline run*** include:

- that on international markets, prices in real terms of agricultural commodities fall by 3% per year and those of manufactures fall by 2% per year. For Mozambique to remain internationally competitive it must therefore improve productivity by those amounts every year
- that the productivity of land declines at a rate of 1% per year as a consequence of climate change
- that productivity of capital and labour rises by 2% per year.

Over 20 years, the economy grows by 4% a year against the baseline. Growth, however, would further widen the rural-urban divide, continuing the problems of the pattern of growth seen in the last two decades in Mozambique. It would also benefit owners of land at the expense of labour and capital employed in agriculture, although, thanks to widespread ownership of rural land, this does not widen rural differences by much. Typically food prices will rise appreciably and poor households are likely to suffer as a result, given that they spend much of their income on food.

In ***modelling the projected changes proposed for agriculture***, it was not possible to include the detail discussed above. Instead, it was assumed the changes would reverse declines in land productivity; with land productivity rising at 1.5% a year through to year six, then by 2% to year 13, and finally by 2.5% a year. Labour and capital productivity is assumed to increase by 1% per year. There may be a temporary increase in agro-chemical use to offset any loss of yields as farmers change their systems. Costs would be funded by donors through aid transfers.

The resulting projections show that the economy grows more strongly, 13% more than the baseline run after 20 years, and that exports increase.

Under the baseline run of likely trends, by far the largest increases in welfare and incomes accrued to urban households. Under the modelling of the new pattern of growth, urban households still get larger increases in their incomes, but the gap has been much reduced, as the changes confer additional gains disproportionately to rural households (Figure 2).

Moreover, while agricultural prices still rise with the changes, they do so by less than they would if current trends continue unchecked, being limited to 13% or less. Since the incomes of those in the lowest quintiles rise by 140% in rural areas, and 180% in urban areas, low-income households would have more ability to buy food after the changes.

All told, the changes deliver more growth, as well as growth that is more equitable, and should improve food security.

Policy implications

Modeling confirms the expectation that in a country where almost two-thirds of the population live in rural areas, most of them reliant on farming, measures to improve the productivity of agriculture have broad benefits — and benefits that feed across from rural to urban areas. More public investment in smallholder agriculture should, therefore, pay off.

In recent years Mozambique has been spending about 5% of its budget to support farming, only half the target adopted by the African Union in 2003 at its meeting in Maputo. Spending on agricultural research is particularly low. This is a critical bottleneck as lower emissions agriculture needs more action to develop and test farming systems that cut emissions, raise productivity, and that are, if possible, more resilient to a variable climate. Such research is more complex than, for example, producing higher yielding seeds.

Another challenge is to find ways to discourage conversion of forest and bush. Bans and regulations alone are unlikely to be respected. Compensating land users for not converting land would be prohibitively costly. Progress here may well depend on entrusting local communities to control conversion, but with some flexibility to accommodate expansion by new farmers and those with little land. Similarly, bush burning might be allowed on a limited scale and early enough to be controlled and make it less likely to cause wildfires. There may be other options: debate on how to address these challenges should begin.

Relevance for other countries

Mozambique is typical of countries that have relatively abundant land of medium potential or higher, with extensive farming marked by low inputs and low yields per hectare. This would apply to several other countries in sub-Saharan Africa, parts of Latin America and Southeast Asia. This study suggests that there are few trade-offs between reducing agricultural emissions and raising production and productivity. Where farming is carried out at low intensity, when emissions are reduced, there will not necessarily be a threat either to the livelihoods of farming households, many of them poor, or to goals of raising agricultural output. This does not mean it will be easy to achieve a double win. On the contrary, more detailed agricultural research will be required, backed by appropriate policies to encourage changes that are implemented with determination, and based on a long-term vision shared by governments, citizens and farmers.

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Resources and project information

Based on report:

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