Food and Agriculture Organization of the United Nations

POLICY BRIEF No.6

EPIC | Economics and Policy Innovations for Climate-Smart Agriculture

Agriculture-charcoal interactions as determinants of deforestation rates:

Implications for REDD+ design in Zambia

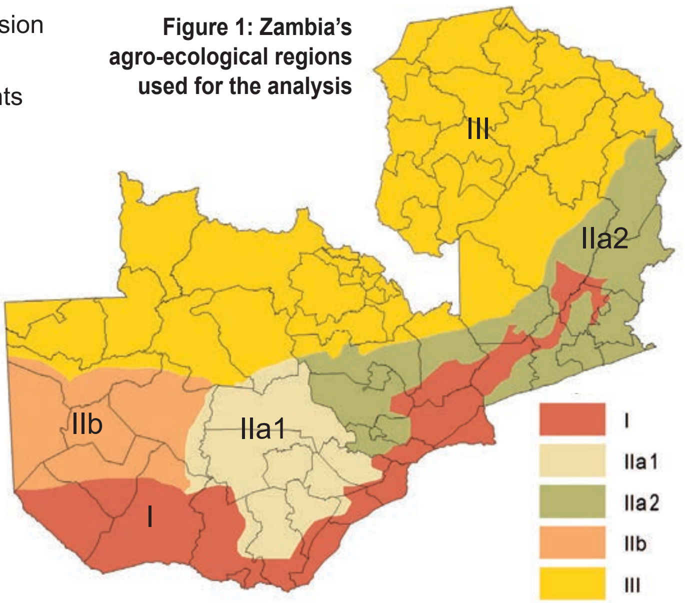
November 2015

Executive summary

This policy brief addresses the question of the economic drivers of both deforestation and forest degradation (DD) in Zambia[1]. It develops a business-as-usual (BAU) scenario to support reference levels for greenhouse gas (GHC) emissions. The relative contributions to DD of the two largest proximate drivers of deforestation in Zambia, charcoal production and agriculture, are predicted under different scenarios over the 2015-2022 period. Possible ways of reducing land use change (LUC) are examined using an economy-wide model capturing Zambia's different agro-ecological regions (AERs) (Figure 1). The model assumes that forests used for unsustainable charcoal production are degraded, or can be in part converted to land for agriculture use. However, land can also be deforested directly for agricultural use without going through charcoal production. The brief concludes that concerted action on both the supply and demand sides is crucial to the success of the national strategy for reducing emissions from deforestation and forest degradation in developing countries (REDD+).

As part of a broader discussion on the setting of reference levels, the brief also presents potential BAU projections for DD based on existing policies and the projected Comprehensive Africa Agriculture Development Programme (CAADP) investments, and the economic drivers they entail.

Figure 1: Zambia's agro-ecological regions used for the analysis



Source: Adapted from Soil Survey, Mt. Makulu Chilanga, Zambia. December, 2002.

1. A separate Policy Brief developed under the EPIC Programme assesses the role of GHG emissions from agriculture and mitigation potentials from reducing emissions from crops & livestock, and sequestration potential in agroforestry.

HIGHLIGHTS – KEY RESULTS

- With LUC representing 74 percent of Zambia's emissions, REDD+ is a key element for implementing a national CSA strategy that balances objectives of food security, adaptation, and GHG mitigation.
- REDD+ implementation needs to be closely coordinated with agricultural policies and investments for it to succeed.
- More evidence is needed on the extent of land use change in Zambia and the relative extent of deforestation vs. forest degradation. The current uncertainty is reflected in the estimates for annual deforestation rates, which range from 100 000 hectares to 400 000 hectares.
- A serious reduction in deforestation and forest degradation in Zambia requires that the supply and demand sides for both charcoal and agricultural land be addressed simultaneously.

Introduction

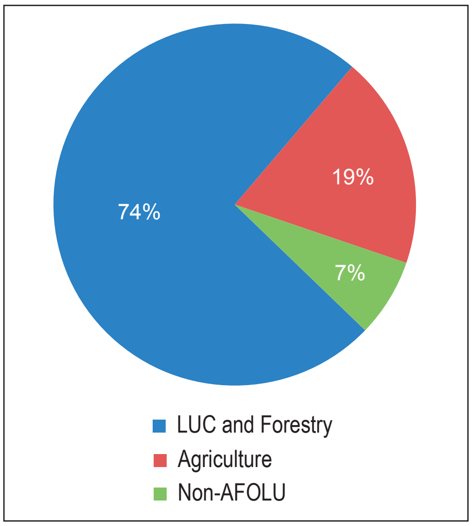
The Second National Communication of the government of Zambia to the United Nations Framework Convention on Climate Change (UNFCCC) identifies the Agriculture Forestry and Other Land Use (AFOLU) sector as the major contributor to national GHG emissions. LUC and forestry account for 74 percent of national emissions, the agriculture sector is responsible for 19 percent, while the rest of the economy only contributes 7 percent (see Figure 2). Thus, addressing LUC while improving rural welfare should be a major objective of any climate-smart agriculture (CSA) strategy for Zambia.

When addressing LU and LUC it is important to distinguish between interventions aimed at affecting the balance between different types of landscapes and interventions targeted within existing landscapes[2]. The former will be of a more systemic nature, affecting the comparative advantage of different landscapes in producing goods and services, whereas the latter will tend to target the adoption of specific practices within a landscape.

Given that the underlying drivers of DD in Zambia also exist outside forest landscapes, it is important that a national CSA strategy take into consideration the agricultural system as a whole, weighing the role of different landscapes in providing food security and GHG mitigation, the interaction across landscapes, and the improvements that can be made within a landscape. It is important to assess the relative contribution (or potential contribution) of different landscapes to food security, climate change adaptation and GHG mitigation goals. This could guide investment and policy interventions in terms of addressing imbalances across landscapes based on the assessment and, at the same time, work within existing landscapes by improving management practices in ways that increase food security and have potential GHG mitigation co-benefits.

The recently released REDD+ strategy for Zambia is in line with the above approach as it focuses on tackling different DD drivers in the forestry, agriculture, energy and mining sectors. It will be implemented through the focal areas identified by the Zambezi, Kafue and Luangwa watersheds. These three focal landscapes contain a total of approximately 29 million hectares of forest with both subsistence and commercial agricultural activities, such as sugarcane plantations and tobacco schemes. Key elements of a REDD+ strategy are the institutional arrangements and safeguards that are already laid out in the Zambian strategy, and reference emission levels, which are still being established. However, the implementation of the national REDD+ strategy will require an economic analysis of the drivers of deforestation to understand what policy interventions are needed.

Figure 2: National GHG Emissions from Zambia



Source: Government of Zambia, 2014.

2. An example of an “across” landscape consideration is productivity improvements outside forested areas that increase the comparative advantage of the forest in providing forest products, as opposed to being deforested for agricultural purposes. On the other hand, one can envision many “within landscape” management practices that can improve food security through increased incomes or resilience, or that can mitigate GHG emissions.

GHG Emissions from LUC: Developing a BAU scenario

Several challenges arise when attempting to set reference levels for reducing GHG emissions from DD. Knowing historical emission rates is an important first step in trying to predict what future rates might be, i.e. determining a business-as-usual (BAU) scenario without any REDD+ intervention. However, estimated rates of deforestation vary substantially in Zambia, depending on the measurement methods used. For example, FAO in 2010[3] estimated average annual rates of deforestation to be 167 000 hectares per annum between 2000 and 2010. However, the most commonly quoted figure is 250 000-300 000 hectares per annum based on 1965-2005 data (Vinya et al.[4]). An additional challenge arises from the variation in carbon density of forests, which can be substantial, especially across different forest types, but also depending on whether or not a forest is already degraded.

Figure 3 shows a BAU scenario based on CAADP growth objectives for agriculture and on our model simulations, indicating that overall LUC was potentially in the range of 400 000 hectares in 2014 and likely to grow. What emerges is that although overall LUC does not vary substantially once CAADP growth rates have been decided (7 percent growth annually), the extent of forest degradation vis-à-vis deforestation, as projected by the model, is highly dependent on the percentage of land affected by unsustainable charcoal production converted to agricultural use. This has implications for the design of REDD+ policies, because emissions from forest degradation and deforestation are distinct, as are their drivers, although they are interlinked.

3. FAO (2010). Global Forest Resource Assessment 2010; Main Report, Food and Agriculture Organisation of the United Nations, FAO Forestry Paper 163.
4. Vinya, R., Syampungani, S., Kasumu, E.C., Monde, C. & Kasubika, R. (2011). Preliminary Study on the Drivers of Deforestation and Potential for REDD+ in Zambia.

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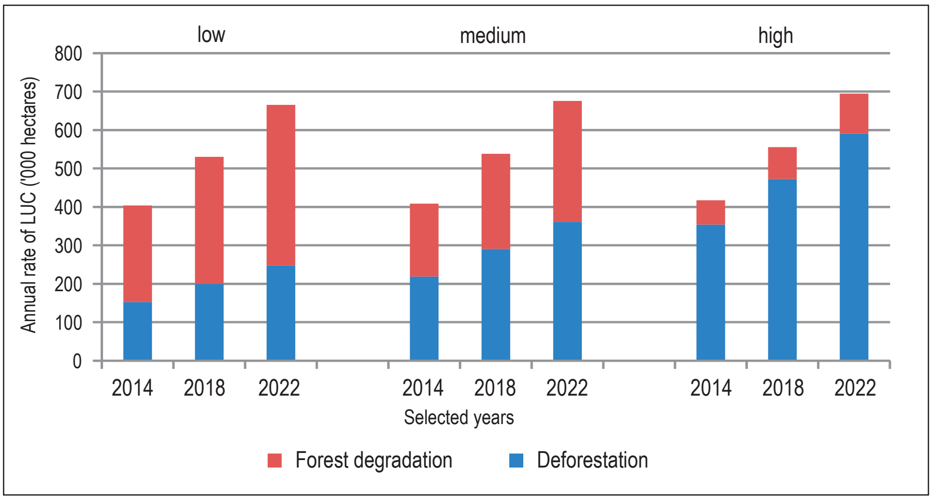
Implementing the national REDD+ strategy: an economic perspective

Clearly, the implementation of a REDD+ strategy must pay particular attention to the interplay between the processes leading to deforestation and those leading to forest degradation. The two are interconnected since degradation can be a first step towards deforestation, but by their very nature they respond to different demands – energy vs. agricultural land.

Figure 4 highlights how the interplay between charcoal and agriculture is important in determining deforestation rates in Zambia. For example, measures exclusively addressing charcoal drivers – such as decreasing demand through improved stove efficiency or improving sustainability of production – reduce forest degradation, but are ineffective in reducing deforestation rates because land continues to be cleared due to demand for agricultural land. Conversely, measures addressing agricultural drivers – such as reducing fertilizer subsidies in a targeted manner, or reducing land degradation through increased adoption of sustainable land management (SLM) measures – considerably reduce deforestation rates but have little impact on forest degradation.

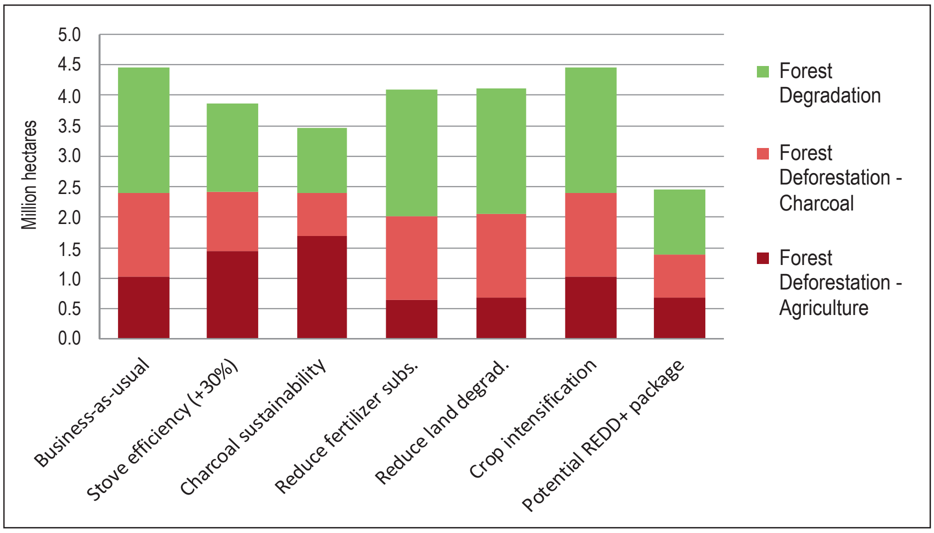
Simulations indicate that a potential REDD+ package proposing a reduction of fertilizer subsidies in AERs I and IIa, reducing land degradation through SLM practices, combined with making charcoal production more sustainable and improving stove efficiency could prevent approximately 1 million hectares of deforestation in the period 2015-2022, and reduce forest degradation in an area of 1.06 million hectares. Summing the separate effect of the four policies included in the hypothetical implementation of the REDD+ programme, assuming the effect were additive, would imply approximately 725 000 hectares in deforestation reduction over the same period (i.e. 28 percent less effective than the joint REDD+ approach), indicating that there are considerable synergies in implementing a REDD+ policy that jointly tackles the charcoal and agricultural drivers of deforestation, as the REDD+ National Strategy intends. We also report on the welfare effects on small and large farm rural households in different agro-ecological zones, indicating that special attention may have to be paid to REDD+ incentives in AER IIa2, where the largest reduction in deforestation would occur, leading also to the largest loss of income among rural households. See Table 1 for the assumptions behind each simulation.

Figure 3: Projected land use change - range of BAU as a function of link between charcoal and deforestation for agriculture



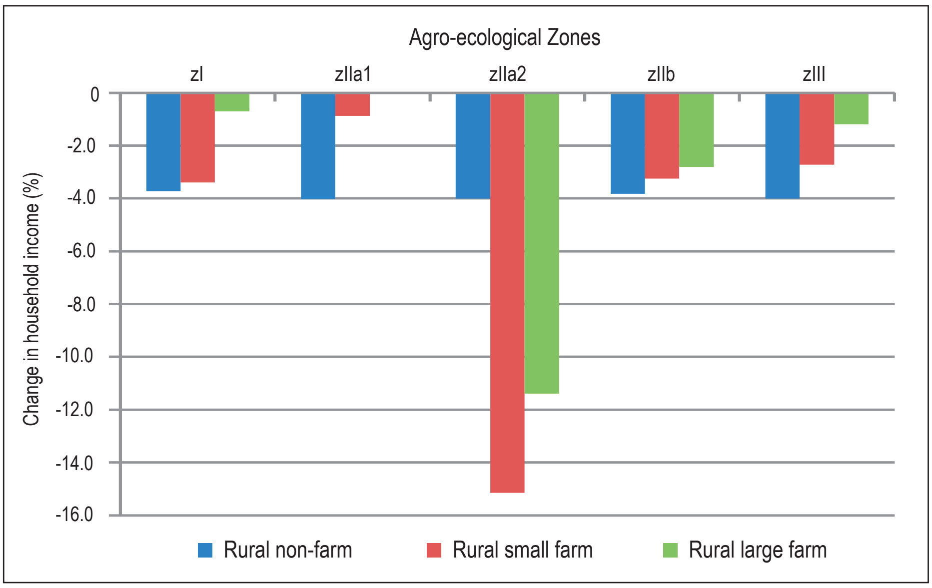
Source: FAO, results obtained from CGE simulations in "worst case" with a range of shrag values (low=0.2, medium= 0.4, high=0.8).

Figure 4: Projected cumulative forest degradation and deforestation under different scenarios for the period 2015-2022



Source: FAO, CGE simulations.

Figure 5: Projected percentage change in income for households in different AERs under a potential REDD+ programme



Source: FAO, CGE simulations.

Table 1: Summary of changes in parameters associated with each simulation presented in the model

	Growth rates (supply & demand)	Fertilizer subsidies	Land needed to produce one "unit" of charcoal	Share of land under unsustainable charcoal that is converted to agriculture
Business-as-usual (BAU)	Agriculture grows at 7% through annual total factor productivity (TFP) growth of 2.4%. Population grows at 2% annually. Capital and land accumulation endogenous. Land degradation rate 5–10% depending on AER.	Implicitly incorporated in demand for fertilizers.	Varies by AER: calculation based on charcoal-related deforestation divided by value of charcoal production by AER.	40%
Stove efficiency (+30%)	BAU + 30% reduction in demand for charcoal (through budget neutral excise tax on charcoal)	BAU	BAU	BAU
Charcoal land to agriculture	BAU	BAU	BAU	Share increases by 4% p.a. (44% in 2015, 48% in 2016).
Charcoal sustainability	BAU	BAU	Decreases by 10% p.a. in each AER, up to 80% by 2022.	BAU
Reducing fertilizer subsidies	BAU	Gradually introduce a "tax" on fertilizers for all AERs (in 2% increments).	BAU	BAU
Reducing land degradation	BAU + reduction in annual and degradation rate of 10% relative to base year values.	BAU	BAU	BAU
Crop intensification	BAU + additional annual 1% increase in labour- and capital-specific productivity for crops.	BAU	BAU	BAU
Potential REDD+ package	BAU + 30% reduction in demand for charcoal (through budget neutral excise tax on charcoal).	"Tax" on fertilizers in AERs I, IIa1 and IIa2 (in 2% increments).	Decreases by 10% p.a. in each AER, up to 80% by 2022.	Share increases by 4% p.a. (44% in 2015, 48% in 2016).

Impact of potential REDD+ packages on incomes

The BAU scenario, as assumed in our simulations, is one where incomes grow over a period of 8 years by 120-150 percent among rural households (albeit from a low starting point), with peaks of 230 percent in some AERs due to productivity growth, labour force expansion, capital accumulation and an expanded agricultural area. A relatively small part of this increase in income is eroded for households in AERs I, IIa1, IIb and III by the implementation of the REDD+ package envisaged in these simulations (Figure 5). Conversely, both small and large farm households in AER IIa2 are considerably negatively affected by the REDD+ package because of the considerable impact on returns to agriculture of reducing input subsidies, which then leads to a reduction in the incentive to deforest to open new agricultural areas – households that in the BAU scenario would have particularly high growth (230 and 206 percent respectively over the 8 years). These results would indicate that financial resources available under REDD+ may need to be allocated asymmetrically so that households in AER IIa2 are provided with appropriate incentives for losses incurred due to constraints associated with a REDD+ package such as reduced input subsidies and the upfront costs of adopting sustainable land management practices or adopting improved cooking stoves. This is particularly important because of the 990 000 hectares of projected reduction in deforestation, 400 000 would be in AER IIa2.

Conclusions and recommendations

1. With LUC representing 74 percent of Zambia's emissions, REDD+ is a key element for implementing a national CSA strategy that balances objectives of food security, adaptation and GHG mitigation.
2. REDD+ implementation needs to be closely coordinated with agricultural policies and investments for it to succeed.
3. To attain serious reduction in DD in Zambia, supply and demand sides for both charcoal and agricultural land have to be addressed simultaneously. Initiatives aimed at decreasing deforestation from charcoal are not effective unless the demand for agricultural land is also kept in check. Conversely, measures addressing agricultural drivers considerably reduce deforestation rates, but have little impact on forest degradation.
4. More evidence is needed on the extent of LUC in Zambia, and the relative magnitude of deforestation vs. forest degradation. The current uncertainty is reflected in the estimates for annual deforestation rates, which range from 100 000 hectares to 400 000 hectares. Resources need to be allocated to obtaining more accurate estimates of historical deforestation and land degradation rates. Improved estimates would provide a better basis for discussions on reference levels, and for calibrating models for projecting future DD rates.

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ABOUT EPIC

EPIC is a programme of the Food and Agriculture Organization of the United Nations (FAO). It supports countries in their transition to Climate-Smart Agriculture through sound socio-economic research and policy analysis on the interactions between agriculture, climate change and food security.

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