CHAPTER 9

USING BEFS TO INFORM POLICY

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9. INTRODUCTION

Energy security has become a critical issue for the twenty-first century. Increased demand for energy from emerging economies such as China and India, the dependence on oil from countries in unstable political regions, the expected shortages of fossil fuels and the need to limit greenhouse gas (GHG) emissions have generated enormous interest in biofuels. For countries like Tanzania, biofuels offer an opportunity to create national sources of energy and the potential to develop new rural employment that could help regenerate the agricultural sector. However, there are valid concerns about the development of fuels from agriculture because of its potential impact on food security and the competition it may create for natural resources. There are a number of issues related to biofuels developments which require careful analysis of the impacts. The Bioenergy and Food Security (BEFS) Project offers a range of tools that can assess whether bioenergy developments can be managed in a way that does not compromise food security and in a way that contributes to wider development and economic growth.

This chapter considers how the BEFS analysis of potential biofuel developments in Tanzania can contribute to the formulation of new policies and regulations for the sector so that the benefits are more equitably distributed. The chapter is structured as follows. Section 9.2 presents an overview of the results from each module. Section 9.3 presents one avenue for biofuel development through the consideration of a pilot scheme. In Section 9.4 some issues emerging from the BEFS analysis are discussed before concluding in Section 9.5.

9.1 HOW BEFS INFORMS POLICY IN TANZANIA

Before deciding on how to realize a bioenergy sector it is important to understand the full range of net impacts of bioenergy pathways on food security issues. The BEFS tools can analyze whether bioenergy is feasible in the first place and if so, how different bioenergy pathways can affect poverty and food security. The BEFS analysis can help inform and shape the direction of policy so that it promotes a sector that contributes to inclusive growth and development.

The BEFS approach

There are a number of conditions that influence bioenergy development at national level. These are:

- the agro-ecological and agro-edaphic conditions and availability of land resources;
- the suitability, productivity and production potential of various biofuel feedstock;
- the technical capabilities needed for the biofuels industry.

These factors determine the *where* and the *how* of setting up an industry. However, any consideration of these factors needs to be accompanied by an analysis of how bioenergy impacts on the agricultural sector, the wider economy and the household. Bioenergy developments have impacts on national food systems which could be positive or negative but require rigorous analysis to determine the precise nature of these effects. Suppose Tanzania chooses a particular pathway for bioenergy development based only on the biophysical and technical feasibility factors because this is the most cost-effective choice. However, that pathway may have wider impacts on food security through adverse changes in prices, income and employment. Thus, knowing what the likely impacts *a priori* are of certain choices may alter the where and the how of bioenergy development. Policy instruments and institutional developments can be constructed in order to adapt to changes or shocks to the food system so that Tanzania's goals on food security and poverty reduction are not compromised.

The diagram below (Figure 9.1) presents the Analytical Framework by BEFS in Tanzania.

Figure 9.1

The BEFS Analytical Framework

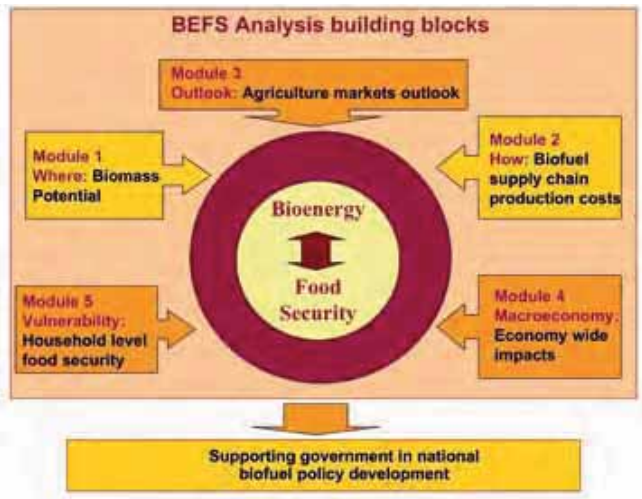


Table 9.1 presents the key information generated by each module in the Tanzanian assessment. It is precisely this information that should regularly feed into the policy process for more informed decision-making as the bioenergy sector evolves. Importantly, the information yielded by any single module needs to be considered against the information yielded by the other modules in order to arrive at a more comprehensive understanding of how decisions at one stage of the decision-making process can have impacts later on. Moreover, it should be noted that while the results presented in this analysis build on recent Tanzanian data, these results are by no means *definitive* or *comprehensive*. Rather, they demonstrate how the BEFS tools can answer a variety of questions by policy-makers concerned with economic development, food security and poverty reduction and the way bioenergy can affect these.

TABLE 9.1

The Tanzania Assessment- Summary analysis and output by Module

Module	Analysis	Information generated
ONE BIOMASS POTENTIAL	Identifies a range of areas where bioenergy crops may be grown by carrying out a land suitability assessment of bioenergy crops under rainfed conditions Based on the AEZ methodology developed by FAO.	#At subregional level identifies the areas that are most suited to production of particular crops #Identifies exclusion areas and potential food production competition areas. #Identifies how this suitability may be enhanced through the application of inputs and/or through improved agricultural management practices. #Calculates potential yield for specific crops and total production based on above #Identifies bioenergy zones that can meet industrial requirements
TWO BIOFUEL SUPPLY CHAIN PRODUCTION COSTS	Assesses the techno-economic feasibility of biofuel production by calculating production cost profiles to determine how the bioenergy industry may be set-up Based on process simulation analysis using Aspen Plus. The program was originally developed by the Massachusetts Institute of Technology for the U.S. Department of Energy to evaluate synthetic fuel technologies. Within Module 2, it was applied to biofuels by the University of Manizales in Colombia.	#Review of feedstock production prices # Assessment of biofuel technology access and human capacity for Tanzania #Identifies current technology status for Tanzania for ethanol and biodiesel based on an in country review # Sets up relevant reality based scenarios building on feedstock origin and industrial configuration #Generates biofuel production costs based on the selected scenarios #Identifies how development of co- and by-products can offset productions costs
THREE AGRICULTURE MARKETS OUTLOOK	Illustrates how the domestic agriculture market will evolve given domestic and international bioenergy policies. Based on the FAO-OECD Cosimo-Aglink Agriculture Outlook.	#Illustrates potential demand for commodities given projected income and population growth and potential supply given yield productivity and relative crop returns #Sets up a number of relevant scenarios including biofuel production #Identifies possible consequences of biofuel production on the agriculture outlook #Illustrates sensitivity of agriculture markets to external shocks including oil prices and international biofuel policies
FOUR ECONOMY WIDE IMPACTS	Examines the economy-wide impacts of bioenergy developments in terms of poverty reduction and economic growth potential under different bioenergy industrial set-ups Based on the dynamic Computable General Equilibrium model developed by IFPRI.	#Building on production costs defined in Module 2, sets up scenarios for the whole economy. #Identifies which biofuel production chains are most effective at stimulating economic growth and targeting poverty. #Identifies implications for other sectors of the economy, including other agriculture sectors #Identifies implications for capital, labour and land..
FIVE HOUSEHOLD LEVEL FOOD SECURITY	Since international and domestic biofuel developments result in crop price increases, determines household level impacts of resulting food price increases to define most vulnerable segments of the populations. Based on household level analysis developed by FAO and IFPRI.	#Identifies most important food crops in Tanzania #Assess vulnerability of country to prices fluctuations of key food crops #Identifies linkages between domestic and international key food prices #Assess which population segments are most vulnerable to major crop price changes

The BEFS tools can be used to analyse further variables. For example, the feasibility of using other crops not considered here or the consideration of alternative industrial configurations that yield different production cost profiles. The real strength of the tools lies in their ability to provide continued analyses to explore the bioenergy-agriculture-food security interface. The starting point for the BEFS analysis is agriculture. In Tanzania as in many other countries agriculture remains an important sector for the livelihoods of the most vulnerable in the population. For governments in the developing world an important question revolves around how best to boost the agricultural sector. An array of options needs to be considered. Bioenergy presents an important potential for agriculture because of the large sums of financial resources it brings from the private sector. Can these resources be managed in a way that harmonises the private interests with the public good? The BEFS analysis considers how a country's natural resources can be managed to promote agricultural growth and boost rural incomes consequently. Tanzania has just begun the process of biofuel developments. By contrast, Peru and Thailand (the other countries analyzed under BEFS) are at a different stage of bioenergy development and the BEFS tools consider different ways of managing the natural resource base by considering issues relating to GHG emissions, water availability, and wood fuels by way of examples.

The information produced by the Tanzanian analysis needs to be considered against the backdrop of prevailing policy on energy, food security poverty, employment and the environment (see Table 9.2). It is important that the BEFS tools are used in alignment with current policy objectives rather than suggest the creation of new initiatives that would strain the public purse. The results of the Tanzanian analysis suggests that there are potentially many gains to be had from bioenergy development but that these gains are likely to be only realized with careful management of the processes that guide bioenergy development.

TABLE 9.2

Summary of the key issues for Tanzania

Area of Policy Focus	Goals
Food Security	Ensure availability, reliability, improved access to markets by farmer
Energy Security	Ensure availability access, reliability, affordability
Poverty reduction	Promote Vision 2025, PRSP targets and MDGs through *income* generation
Environmental conservation	Improved biodiversity, reduced GHG, soil protection, water conservation, reduced deforestation
Social empowerment	Improved livelihoods, participation of Tanzanians in bioenergy industry
Land	Ensure equitable land ownership and tenure arrangements
Agricultural practices	Improve yields, sustainable agriculture
Identify *best* bioenergy crops	To develop bioenergy for energy security, improve agricultural yields of all crops, augment rural incomes for improved food access.

Note: Table summarizes key elements drawn from the country's policies on poverty, food security, agriculture and energy. For a more comprehensive discussion on these please see chapter 3.

9.2 POLICY IMPLICATIONS FROM THE BEFS TANZANIA ANALYSIS: UNDERSTANDING THE RESULTS AGAINST THE POLICY INFRASTRUCTURE IN TANZANIA.

MODULE 1 - *WHAT DO THE RESULTS TELL US? IMPLICATIONS FOR POLICY*

Module 1 derives the land suitability status at the subnational level for a number of crops. For the Government of Tanzania two questions arise in considering the development of the bioenergy sector. First what crop to produce and second where to produce it? The results from Module 1 provide a general picture of which crops do best where, under *rainfed* conditions. However, the analysis also shows that land suitability can increase substantively with a change in agricultural management practices in the medium term and the increased application of inputs over the long term.

Tanzania is rightly anxious that bioenergy developments should not compete with food crops for land use. However, the trade-off between feed and food is often overstated. The real food security issue for Tanzania and indeed for Africa in general, stems from poor yields. Understandably, the Government of Tanzania places a high priority on food self-sufficiency. This is seen as an important buffer against rising global food prices which can feed into Tanzanian food markets even when the crop is not traded internationally. Improving yields of food crops could do much to enhance the food basket of Tanzania using existing land areas. Bioenergy developments would not then compete with lands used for food. Even if a food crop such as cassava is chosen for biofuel production, improved yields would allow both food and bioenergy crop requirements to be met. This of course presupposes supportive investments into new crop varieties, access to and the promotion of conservation agriculture etc. to ensure that potential yields are reached.

The results of Module 1 are able to provide information on total production of a particular crop in the identified suitable areas. Some of these areas will already be under existing agricultural production while other areas may involve development into new lands. An important consideration would be whether it is best to develop bioenergy crop through intensification - using existing areas under crop production and ensuring that yields achieve close to their maximum potential - or developing the sector by expanding into new lands previously unused for any cultivation. The choice depends on whether the bioenergy crop is an existing food crop with the potential to improve yields or whether the bioenergy crop selected would involve displacing already established agricultural cultivation.

A further important aspect in the consideration of where the sector should be located among the available suitable lands relates to infrastructure such as roads, irrigation infrastructures, etc. that are essential to support the associated market be it for food or biofuels. Additionally, for the biofuel industry to be viable requires large contiguous pieces of land in order to ensure that the production requirements of industry can be met

in a cost-effective way. Thus, crop choice rests not just with the results of Module 1 but must be considered against the production cost profiles offered in Module 2 which, in this analysis, show that crops producing ethanol have a distinct cost advantage.

An interesting result that arises from the analysis of Module 1 is the comparative advantage of Tanzania in the development of sunflower. Even at the lowest level of inputs where the land is tilled, land suitability is still high. The use of inputs and a move to conservation agriculture dramatically improves the land suitability of sunflower - much more so than for any of the other crops analysed here. This could present an important point of discussion for policy-makers. Many argue that bioenergy developments should promote the use of a food crop because if the energy market fails, the output can serve the food market. Sunflower developments require, in terms of land suitability, the lowest inputs to yield investments.

The results of Module 1 consider land suitability only under rainfed conditions. Sunflower, sweet sorghum and cassava have a clear comparative advantage over some other crops, such as sugar cane and palm oil, where current land suitability is water constrained. Under a programme of irrigation, the land suitability for these crops would be vastly improved under all agricultural practices and for all level of inputs.

Can decisions on changing land use for bioenergy impact positively on food security, energy security, environmental sustainability, poverty reduction, etc.? Module 1 suggests an affirmative answer but this very much depends on the land decisions that are made and how poor farmers are included in the process. Land selection for biofuel production based on the very narrow biophysical criteria offered by Module 1 alongside the cost criteria offered in Module 2 could easily bypass the interests of smallholders. If one aim of bioenergy provision is to enhance food security and reduce poverty, the inclusion of smallholders in the sector will be vital. Module 4 demonstrates that particular bioenergy developments yield particular gains for poverty reduction. Decisions on where to locate must be considered in the light of the results generated by the other modules.

Module 1 provides clear evidence on where and how food crop yields can be potentially improved through the application of new inputs and changes in agricultural practice. This will require public investment whether there is a bioenergy sector or not. Module 1 can be used to ensure that regions important for national food security are not compromised by bioenergy developments. Indeed bioenergy presents an important opportunity to stimulate agricultural growth which will have spillover effects throughout the rural economy.

MODULE 2 - *WHAT DO THE RESULTS TELL US? IMPLICATIONS FOR POLICY*

Module 2 derives the production cost profiles of producing ethanol and biodiesel under diverse industrial configurations based on crop choice, the feedstock provider, the industrial set-up and different technology levels. In essence this is a feasibility study but with one

critical difference. The feasibility analysis deliberately includes smallholders within the industrial configurations to analyse whether their involvement can be cost competitive. This contrasts with the kind of feasibility study carried by the private sector where the industrial set-up is large so that economies of scale may be enjoyed and profits enhanced. The analysis conducted under Module 2 is conditional upon the production requirements being met by the bioenergy crops under consideration. This information is generated by Module 1.

Using real data the results suggest that Tanzania has a technology capability of level 2 for ethanol production and level 1 for biodiesel. The technology levels are derived based on the degree to which conventional or more advanced cutting edge technologies are used. For example, level 1 is consistent with the use of proven conventional technologies only. Production cost profiles are also conducted for technology levels 1, 2 and 3 in order to illustrate how technological advancements can impact significantly on production costs. The results suggest that long-term technology will dictate profitability levels and the ability to adapt better to changes in the sector, notably towards second generation bioenergy. Bioenergy development could provide an impetus to invest in scientific programmes at the graduate and vocational levels. The relationship between education, high incomes and the ensuing investment for growth has been well documented.

Results from Module 2 also show, perhaps not surprisingly, that large-scale sugar cane is more profitable than small-scale sugar cane where production costs match world ethanol production costs. Based on profitability criteria only, such a development would exclude poor smallholder farmers. However, profitability levels of small-scale cassava production compete well with those of large-scale sugar cane suggesting that cassava may be an optimal crop choice both on cost and food security criteria. Results derived in Module 4 also suggest that cassava generates higher levels of pro-poor growth than sugar cane-based systems. However, if smallholder yields can be improved, then sugar cane and cassava outgrower schemes produce similar pro-poor outcomes. Once again, the ability of the biofuel sector to include the poor does hinge on the extent to which smallholders can improve yields. Module 2 shows that neither molasses nor jatropha are profitable under the conditions assumed.

Profitability of the bioenergy sector matters to the investor which in Tanzania is likely to be private and external. For the Government of Tanzania the issue is whether the sector can be profitable enough for the private investor and also address the food security and poverty concerns of the country. Results in Module 2 show that cassava production is best for promoting the smallholder. Profitability is maintained under small-scale production but particularly under a mixed smallholder-estate production system. Moreover, this result is based on rainfed cassava yields. Under irrigation cassava yields are likely to increase resulting in lower feedstock costs making the small-scale cassava option even more profitable. Smallholders tend to have restricted access to the kind of credit that would enable them to make the necessary irrigation infrastructure investments. These constraints could be overcome in two ways: through government-backed loans or directly through government

investment into irrigation. Block farming appears to overcome some of the investment constraints faced by individual smallholders. Such a system would allow large-scale public investments to be more forthcoming while still benefiting individual smallholders.

Module 2 provides a range of productions cost profiles. The analysis does suggest that while large-scale production costs are low, smallholders can compete under certain conditions. This has important policy implications. Yields and technology are critical variables influencing production costs. Large-scale public investment here can do much to enhance agricultural performance.

The results presented here consider a limited range of cost profiles. Block farming has emerged as a possible way to enhance smallholder competitiveness. The tools in Module 2 could be further used to analyse how production costs under block farming compare with those of estates or mixed systems. In addition, it is also possible to consider production cost profiles using alternative crops and also to assess costs for other forms of bioenergy. The BEFS work in Peru and Thailand consider these other aspects.

MODULE 3 - *WHAT DO THE RESULTS TELL US? IMPLICATIONS FOR POLICY*

Module 3 considers how Tanzania's agricultural markets are expected to evolve over the next several years in the absence of biofuels. The Module considers the potential demand for commodities given projected income and population growth, and potential supply given yield productivity and relative crop returns. Policy-makers and investors can use this information to analyse whether Tanzanian agricultural markets have the capability to develop biofuels without adversely affecting food security.

Even though stakeholders have identified lands within Tanzania to develop biofuel feedstock to produce biofuels and there is potential to export to lucrative markets such as the European Union, biofuel markets are just emerging and there remains a significant risk within these markets. Biofuel viability is very much linked to oil prices and government policies, both of which are subject to volatility. For example, the results of a scenario analysis with lower oil prices would lead to an increase in world crop production, particularly in developed countries, and consequently would lead to lower crop prices. For most commodities Tanzania would need to increase imports to meet domestic consumption. The results illustrate the vulnerability of Tanzanian agricultural markets to movements in oil prices.

It is important to note that the analysis of Module 3 considers the current situation of agriculture and considers what would happen to agricultural markets over time assuming that *nothing* in the sector changes. These results are projections of the current status of agriculture and are thus not definitive forecasts. In reality, we would expect changes such as the adoption of new technology, climate change, trade agreements or economic shocks. These would change the outlook or picture for Tanzania. What this Module demonstrates is the very real

need for agriculture to modernize. If the status quo were to be maintained into the future, then the outlook is gloomy as the results demonstrate. Even in the absence of bioenergy, Tanzania must revive its agricultural sector in order to meet its own food needs in the long term.

MODULE 4 - *WHAT DO THE RESULTS TELL US? IMPLICATIONS FOR POLICY*

Module 4 builds on the results of production costs derived in Module 2 and links them into the national economy of Tanzania. In order to strategically target poverty reduction, linking the production costs results to the economy-wide effects can help policy-makers consider the necessary interventions needed to include small-scale outgrowers in the development of the sector and the preferred combination of large-scale estate and the small-scale outgrower scheme.

The bioenergy sector competes for resources (land, labour, inputs and capital). The sector is small at the start but grows with increased investments in the sector. Biofuel scenarios are developed and their impact on poverty reduction analysed. These scenarios differ according to their production technologies and strategies, that is, with feedstock, scale of feedstock production and intensive versus extensive production strategies.

The results show that all biofuel scenarios increase growth and reduce poverty. However, small-scale production options are the most pro-poor with small-scale cassava emerging as a clear winner for promoting growth and reducing poverty. The results also suggest that the best option to meet biofuel feedstock demand is through increasing yields because it does not require new lands or additional labour. While Module 2 showed that cassava feedstock production under mixed systems can be profitable, the results in Module 5 suggest that this is not a desirable option because it would require huge amounts of additional land. Moreover, the gains that derive from increased employment and wages in the biofuel sector would be, in part, offset by falling incomes of poor farmers because of their land loss.

An important result to emerge from the analysis is that displaced land for biofuel is likely to come from export crops rather than food crops. This suggests that the trade-off between food and fuel in Tanzania is unlikely to emerge. The real issue, however, is whether a new biofuel sector can be better than the existing export crop sector at reducing poverty. This is difficult to predict with any certainty. Much depends on the additional investments needed to support biofuels and whether these investments are in line with existing agricultural growth strategies. If not, the costs of investments into biofuels may override the gains in which case maintaining traditional export crop markets may be more feasible.

The results of Module 4 show that economy-wide impacts of biofuel development are positive for growth and poverty reduction. This could provide a strong impetus in developing the Sector. However, the results also suggest that biofuel developments need to be consistent with existing growth/agricultural strategies in order to harness the gains

suggested. This requires careful planning on where to locate the industry, what crops to develop as feedstock and a consideration of the opportunity cost of new investments that are not part of existing investment programmes.

MODULE 5 - *WHAT DO THE RESULTS TELL US? IMPLICATIONS FOR POLICY*

The analysis in Module 5 illustrates crop price changes and which households are most vulnerable to these changes. It also considers recent price movements. Maize and cassava price data suggest that the maize and cassava markets are interconnected in the medium term, although less so in the short term. Were Tanzania to divert cassava into ethanol production without an accompanying supply response, maize imports will increase with impacts for food security because world prices will have gone up and cassava prices too would rise.

The analysis in Module 5 has used a partial dataset collected from the rural areas of the Ruvuma and Kilimanjaro regions because a complete country dataset was not available. Whilst conclusions at the country level cannot be inferred by this analysis, the results do illustrate how price rises of different food crops affect regions and households differently. It would be important for Tanzania to derive a national picture to see what the net effects are from crop price increases to be aware of the scale of the problem and in order to instigate appropriate responses in terms of safety nets, etc.

The results show that the poorest households in Ruvuma will benefit from price increases in maize and rice. These households will be negatively hit by price increases in beans and cassava. By contrast, poorer households in Kilimanjaro will lose if the prices of maize, rice or sugar were to increase.

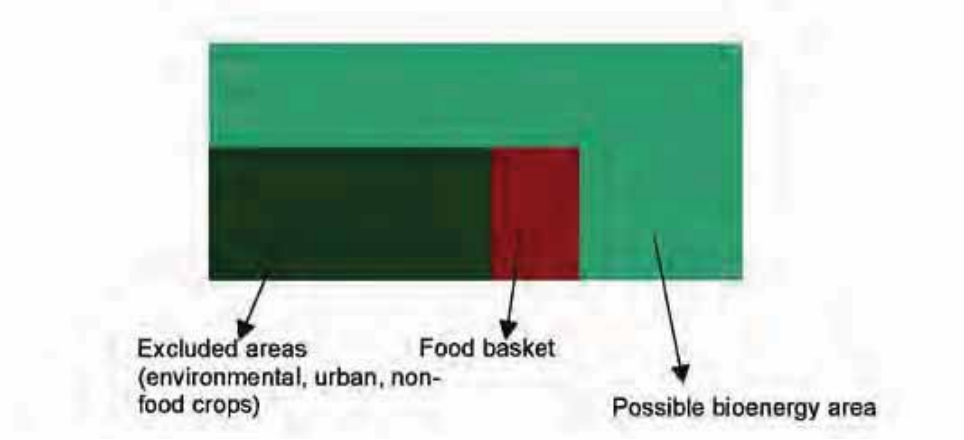
9.3 GETTING THE BIOFUEL PATHWAY RIGHT? WAYS FORWARD

The BEFS Tanzanian analysis demonstrates how smallholders could play a role in producing feedstock for biofuels. To date most of the potential producers of biofuels in Tanzania are large commercial scale farmers. Unless the value chain is strategically controlled and monitored, leaving the biofuel sector to market forces would prove disadvantageous to poor rural farmers and households. Although biofuel offers the potential for income diversification if the sector is poorly managed it may compromise food security for many. Balancing the benefits of bioenergy against the potential costs can be difficult on a national scale. Module 4 suggests that to achieve positive impacts on poverty and growth requires a large-scale biofuel industry. However, the risks of a widespread and large national biofuel programme may be too high at the outset for a poor country such as Tanzania. Developing a pilot scheme in a specific location can limit the risks associated with developing too fast and too large. It allows governments to identify the constructs for an efficient sector in terms of improved yields, training, technology development and other public investments without too much additional strain on the public purse. Moreover, it offers an opportunity to learning-by-doing and apply the knowledge gained from bioenergy into a wider agricultural setting.

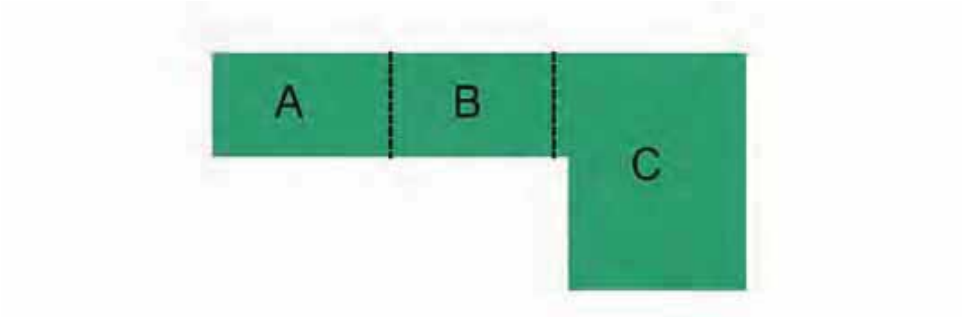
9.4 GETTING THE BIOENERGY SECTOR TO WORK FOR ENERGY SECURITY AND FOOD SECURITY – USING BEFS TO SET UP A PILOT

The Tanzanian analysis provides a basis to identify where and how to implement a pilot scheme while the analytical tools can be used to monitor and evaluate performance. The exercise below illustrates, at a very simple level, an approach to developing a pilot scheme based on the BEFS Analytical Framework.

The coloured box below represents the land mass of any particular country. In this case, the box represents Tanzania and total land mass. Not all land can be used for biofuel production. Some land will be excluded for other uses. In this simple exercise land for food (red) and other excluded areas (green) are *not* considered for biofuel developments. The food baskets are areas identified as being critical for national food production. The excluded areas include areas such as conservation parks, forest protected, mountainous or sloped regions. This leaves the blue areas as potential areas for development.



Of the remaining areas A, B and C available for bioenergy development the BEFS tools can be applied for selection of the pilot scheme.



Stage 1: Assessing biophysical criteria.

- Which crops grow best in each of the available areas, A, B and C (Module 1)
- Can production of bioenergy crops in the suitable areas fulfil the requirements of the industry
- Determine the need for extra investment in each area A, B and C for infrastructure-irrigation, water, roads, etc. (Module 1).

Stage 2: Assessing techno-economic feasibility

- Determine the production cost profile for a range of preferred crops under different technology and production systems (Modules1 and 2).
- Identify public investments and institutional supports for education, technology extension services, etc. (Module 2).

Stage 3: Evaluate biofuel pathways against the BEFS assessment

- Identify viable bioenergy pathways for pilot (Modules 1 and 2).
- Identify the benefits of each pathway using criteria on food security, poverty and growth.
- Identify *one* bioenergy pathway for pilot scheme and implement for a fixed period.

Stage 4: Monitoring household and economy wide impacts

- Implement monitoring and evaluation of pilot to consider effects at national and household levels.
- Monitor effects of national and international blending mandates on agricultural prices.
- Assess profitability of sector given prevailing global oil and agricultural markets (Modules 2 and 3).

Stage 5: Assessing the viability of a national biofuel sector

- Identify possibility and viability of extending the pilot to a national level using BEFS tools.

The pilot presented here is highly simplified and the stages of decision-making described are not intended as a blueprint for setting up a biofuel pilot scheme in Tanzania. The process described here is intended to show how the BEFS tools can inform the decisions involved in creating a new sector. Indeed, individual governments should certainly consider more steps or criteria in the decision-making process to reflect specific concerns. A pilot scheme offers policy-makers the advantage of assessing what policy and social constructs are needed to support progress and to adapt to difficulties created by biofuel developments. This can aid the formation of a bigger national bioenergy sector that is governed by comprehensive policies and regulations. In addition, a pilot offers the opportunity for local, regional and national authorities as well as the public to gain an understanding into how bioenergy developments may be used to enhance agricultural growth.

9.5 KEY ISSUES

There are a number of other issues that emerge from the Tanzanian analysis, not answered by the analytical tools of BEFS, that require policy attention.

• Land Rights

The necessity for a clear property rights system is central to the successful integration of biofuel production in the agricultural sector. The Government of Tanzania needs to consider how best to establish a system that is accessible to investors but also to subsistence farmers.

• The opportunity cost of public investment

It is important that investments associated with bioenergy are in-line with existing development plans on infrastructure, irrigation, education, etc. If investments are diverted away from valuable programmes on for example, healthcare, the true cost or opportunity cost of bioenergy would be much higher than the financial costs associated with construction. The re-direction of government investment away from important public goods is not be advocated.

• Labour displacement

Biofuel production (either domestic or international) may have an effect on labour demand if new land is brought into cultivation or if cropping patterns on currently cultivated land change substantially. Changes in labour demand could affect rural wages. Movements out of export crop production into bioenergy production could increase wages but this may be offset by falling land incomes for farmers as more land is brought under cultivation.

• Negotiations between the government and private investor and governments

The BEFS assessment for Tanzania has illustrated that the enormous potential for bioenergy to contribute to growth and poverty reduction. However, this requires careful management of the industry. Much of the interest in biofuel developments has come from private foreign investors. Thus, it is important for the government to continue to ensure that a balance is maintained between the interests of the private sector and the rural populations most likely to be affected by bioenergy developments. There is scope for the Government of Tanzania to consider how best to promote public-private partnerships in order to optimize the gains from the bioenergy sector. Note that the information generated by Module 2 allows governments to negotiate with the private sector for the inclusion of smallholders in the production of biofuels where their costs match those of large scale estates only.

• Second generation bioenergy

An important concern for many countries, such as Tanzania, considering developments into first generation bioenergy is whether investments today may obviate future second-

generation bioenergy developments. Clearly, the more advanced the technology used for the preparation of first generation fuels the easier the transition to some second generation fuels. However, the strongest argument for promoting advanced technology lies in the strong contribution this makes to enhancing domestic human capital which is essential for long-term growth and development.

A further concern stems from the increasing interest of developed countries to move towards second generation fuels which would render first generation biofuel producers uncompetitive. In spite of the excitement surrounding second generation fuels, their use in developed countries is still some way off. Indeed, for developing countries the threat of competition by second generation fuels is unlikely to be realized in the near future. By the time second generation fuels become operational Tanzania should be in a very different position on the development spectrum and should consider how to respond if necessary.

• Regional Southern African Development Community biofuel programme

For sub-Saharan Africa food insecurity is as much a regional as a national concern. Poor food crop yields characterize the performance of the agricultural sector in most countries in the Southern African Development Community (SADC) region. Promoting domestic energy security in the face of future oil price rises have prompted many countries in the region to move towards bioenergy. Since the SADC countries are all involved in trying to ensure food security and also to develop alternative national sources of energy, this suggests an opportunity for more cooperation towards regional food security and regional energy security strategies.

• Climate Change

One of the most important links between bioenergy, environment and food security occurs through climate change. In sub-Saharan Africa, how future climate change will affect food insecure households is of growing concern. Although this has not yet been directly covered by BEFS, there is a need to consider how climate change will affect agricultural performance with implications for both food and bioenergy security. Module 1 in the BEFS Analytical Framework implicitly deals with climate change because land suitability is determined as much by agroclimatic conditions as by agro-edaphic conditions.

9.6 CONCLUDING REMARKS

Tanzania has the potential to develop a bioenergy sector. Biofuel developments can be an important catalyst that regenerates the agricultural sector by bringing in new private as well as public investment. There is naturally profound concern that biofuels may compete with food production. High food prices in recent years have strengthened the resolve of the government to promote greater food self-sufficiency. In general, food insecurity in Tanzania has been driven by low food crop yields for some time. Cheap global food prices for many decades until about 2006 meant that agricultural investment was overlooked and diminished as a proportion of GDP with consequences for food production, food security

and poverty. Most of Tanzania's poor live in rural areas so investment in agriculture is key to lifting these people out of poverty. Improving crop yields through better inputs, improved land management, increased infrastructures to support production, more research and development and greater investment into human capital are the necessary ingredients of a comprehensive agricultural development package that would raise agricultural productivity levels so it feeds into increased income and growth. These measures would be essential even in the absence of a bioenergy sector. Maintaining the status quo in agriculture is not an option if long-term food needs are to be met. The critical question is whether bioenergy can help bring about the kinds of investments needed for agricultural growth. The BEFS assessment shows that bioenergy could do much for agriculture provided the sector is carefully managed.

The dividends from investing in biofuels can have positive impacts on poverty reduction and growth. This result rests on the assumption that the necessary public investments needed to support biofuel development will be forthcoming so that profits from the sector are more equitably distributed for the benefit of poor rural populations. It is important that the government of Tanzania selects a bioenergy pathway that is consistent with existing plans for energy, poverty reduction and food security to avoid misallocation of public funds. The results show that small-scale cassava production can be an optimal bioenergy pathway in Tanzania. It is recommended that the BEFS Analytical Framework is used further to explore this option.

The BEFS analysis in Tanzania represents the start of a discussion on the viability of biofuels in the country. The analysis should not be seen as comprehensive or definitive. Rather it serves as a starting point for the kind of analysis needed to underpin the realization and implementation of a bioenergy sector. The tools developed under BEFS should be seen as dynamic, whereby data can be updated, crops and analysis components added and recent policy changes or outlooks included. In this way, the BEFS tools can support government decision-making and policy formulation as bioenergy developments evolve over time.

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ENVIRONMENT – CLIMATE CHANGE – BIOENERGY – MONITORING AND ASSESSMENT
FAO - ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT WORKING PAPER

Bioenergy developments are high on many countries' agendas today in an effort to improve energy access, energy security and in the context of concerted efforts towards lowering global green house gas emissions.

Over time, however, serious concerns on the food security impacts, social feasibility and sustainability of bioenergy have arisen, especially with first generation bioenergy. In this context FAO, with generous funding from the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), set up the Bioenergy and Food Security (BEFS) project to analyze how bioenergy developments could be implemented without hindering food security. Over its term, the BEFS project has been supporting Peru, Tanzania and Thailand in analyzing the competitiveness of the bioenergy sector, potential impacts on food security, growth and poverty. In this effort, BEFS has constructed an Analytical Framework that can assist countries with the development of bioenergy policy and/or clarification of the potential impacts of the bioenergy developments.

The analysis presented in this document is the implementation of the BEFS Analytical Framework in Tanzania. The analysis includes five building blocks on biomass potential, biofuel supply chain production costs, the agriculture markets outlook in Tanzania, economy wide impacts and household level food security. The final aim of this analysis is to support policy in the country and start a continuous process that can inform policy over time. The crucial element in developing a sustainable bioenergy sector in Tanzania lies in the management of the sector. This is discussed though out the analysis and more in depth in




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