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The Impacts of Ethanol Blending and Indigenization Policies on Value Creation and Income Distribution along the Emerging Chisumbanje Sugarcane Bio-Ethanol Value Chain in Zimbabwe

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ABSTRACT In Zimbabwe, the Government went into a partnership with a private investor operating as Green Fuels in February 2009 to set up the Chisumbanje Ethanol Project. The Government legislates mandatory blending of petrol with ethanol from Chisumbanje and started from an initial five percent to a planned twenty-five percent. Using input-output (I-O) and counterfactual analysis approaches along the emerging bio-ethanol value chain, this paper analyses impacts of different policies on income generation and distribution along the value chain. The results show that as the blending level increases the private investor gets more and more net financial benefits compared to other economic agents and recommends that changes in shareholding and implementation of community share ownership mechanisms are potential approaches to address the skewed distribution of income along the chain.

INTRODUCTION

The Government of Zimbabwe has been making different policies to minimize the negative impacts of drastic changes in fuel prices on the economy. Often, policies can have both negative and positive impacts, although some of them are not intended. In addition, policies can be instituted to ensure equitable distribution of resources, income, opportunities and other similar issues. In Zimbabwe, the government through the Agriculture and Rural Development Authority went into a partnership with the Zimbabwe Bio-Energy Ltd operating as Green Fuels in February 2009 to set up the Chisumbanje ethanol[1] project. The project involves primary production of sugarcane and processing it into anhydrous bio-ethanol. According to the Government of Zimbabwe (2015), Chisumbanje project which at the time of its conception was based on a build, operate and transfer model established in a 20-year agreement. Primary production of sugarcane was projected to be established on over 40 000 hectares of land[2].

In support of the investment, the Zimbabwe Energy Regulatory Authority (ZERA) in August 2013 announced regulations for mandatory blending of unleaded petrol with anhydrous ethanol under the provisions of Statutory Instrument (SI) 17 of 2013 and Petroleum Act [Chapter 13: 22] (ZERA 2013). The regulations meant that all fuel service stations were to sell product popularly known as E5[3]. In October 2013, the Government of Zimbabwe announced a ten percent mandatory blending for all petrol coming into the country (ZERA 2013)[4]. The ratio was raised to E15 in November 2013 under terms of Statutory Instrument 147a of 2013 and the plan was to get to E20 by March 2014 (ZERA 2013).

This paper analyses impacts of different policies on incomes and their distribution along the Chisumbanje sugarcane bio-ethanol value chains. This study is set within the wider context of the global discource on the impact of large scale land investments. Many current stud-

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ies (for instance, CGIAR (2017), Hall (2011), Cotula et al. (2011) and Mutopo (2011)) have highlighted the potential losses of livelihoods and the potential negative impacts of large-scale land investments on the environment. Some have quantified the amount of land that has been acquired and the reasons driving these investments (Anseew 2013; Hall 2011; Boche and Anseew 2013). However a quantification of the impacts of the large-scale land investments, especially from an economic standpoint is still missing. The paper starts off with a global theoretical overview of blending policies, showing that blending of petrol with ethanol is a common practice in many countries. The rest of the paper presents the findings on impacts of different policies on the value chain.

Objectives

The primary objective of the paper was to analyse the potential impacts of different policies instituted or which will be instituted, for example, mandatory blending of E5, E10, E15, E20, E85, hundred percent and changes in indigenization policy, on incomes and their distribution along the sugarcane bio-ethanol value chains. The hypothesis tested was that as the level of ethanol petrol blending increases, the net benefits that are accruing to different actors increase disproportionately, with smallholder farmers getting less and corporates getting more and more.

METHODOLOGY

The approach and model used to determine the impact of ethanol blending policies and indigenization policies along the emerging sugarcane bio-ethanol value chain is based on input-output (I-O) modelling. The different stages of the value chain such as production, processing, and distribution are assumed to be the 'sectors' in standard I-O models, which have input-out relationships which can be clearly mapped out. To determine the policy impacts, the model factors in counterfactual analysis approaches. Although counterfactual analysis has its own challenges[5] as highlighted by Menzies (2014) and Horwich (1987), it can be used in cases where the input-output relationships are very clear. As noted by Menzies (2014) there are also a number of scholars and authors (Moore 2009; Paul 2004; Paul and Hall 2013) who actually argue for the use of counterfactual analysis in impact analysis especially in cases where data is a problem.

The empirical data used for this analysis was collected along the ethanol value chain starting from the primary sugarcane production process in Chisumbanje to the consumption level. Data collection involved multiple approaches including household level questionnaires, focus group discussions, key informant interviews and observation. A total of 200 questionnaires were administered at household level in Chisumbanje, while focus group discussions were held with various groups including war veterans, women's groups, youths and other community members. Key informant interviews were held with a number of actors along the chain including the company's management, political leaders, traditional leaders, local and national level government officials and regulatory officials. As the subject is a sensitive one it was not possible to get some of the information ideally required to perform analysis from the intended sources. To deal with this, the paper makes significant use of secondary data obtained from the public domain and the public media.

Geopolitical Context of Ethanol Blending in Zimbabwe

From 1999, Zimbabwe's political terrain went through some remarkable transformations which shaped the economic and social position of the country. The formation of the Movement for Democratic Change (MDC), in 1999, posed a potential threat to Zimbabwe African National Union –Patriotic Front (ZANU PF). The events that followed including inter alia, the Fast Track Land Reform Programme (FTLRP) largely supported by Zanu PF, and most importantly the increasing isolation of the country as its relations with western governments became sour. According to the World Bank (2011), the economy performed badly during the period from 2000 with GDP declining by over forty percent between 2000 and 2008. Industry capacity utilisation went down to below ten percent. This resulted in massive job losses and high unemployment rates of over ninety percent have been recorded. During this period, hyperinflation reached record astronomic levels of 231 million percent. The socio-economic status of the general populace worsened. In 2008 at the height

of this situation, ZANU PF and the two MDC formations[6] negotiated leading to formation of the Government of National Unity (GNU). The GNU which was a coalition of ZANU PF and the two (MDC) formations lasted just over 4 years.

Certain contestations help in defining the context of post GNU bio-ethanol production and use in Zimbabwe. Firstly there has been contestation on the nature and impact of targeted sanctions[7], with two opposing views. ZANU PF has maintained that The West has imposed sanctions which have crippled the economy and are hurting ordinary Zimbabweans. The argument is fortified by the fact that Zimbabwe has lost support (borrowing) from the Bretton Woods institutions[8] and cannot access concessionary funds to support its economy. Further, the targeted sanctions also include a number of key economically strategic institutions and companies such as the Zimbabwe Mining Development Corporation (ZMDC), Infrastructural Development Bank of Zimbabwe (IDBZ), Minerals Marketing Corporation of Zimbabwe (MMCZ), ZB Financial holdings, Agribank, Industrial Development Corporation (IDC), Zimbabwe Iron and Steel Company (ZISCO) steel, Marange Resources, Mbada Diamonds among others. Therefore, the voice against sanctions has been both to show that the sanctions are not just 'travel restrictions', but real economic sanctions which have negatively affected Zimbabweans.

In the opposing view there is the European Union, United States of America, and the MDC who have called them 'restrictive measures'. It is supported by the fact that before imposition of these restrictive measures, Zimbabwe had long stopped servicing its debt and thus naturally could not access funds from the Bretton Woods institutions. They also argue that these countries have not stopped supporting the country, even under the sanctions regime, for instance, the US embassy highlights that trade with the US has actually grown since 2003, and the US has provided over $1.4 billion in assistance to Zimbabwe since 2001[9]. They have attributed the poor performance of the economy more to broader issues of governance citing corruption, lack of transparency and lack of accountability as the country is not doing so well in these indicators[10]. The latest development is that of delisting of the targeted sanctions on selected entities and institutions, an approach largely adopted by the European Union. On the 23rd of September 2013[11], under the pressure of the diamond industry, the European Union lifted its sanctions on diamond imports from Zimbabwe. The EU agreed to lift the ban on imports from diamonds produced by the Zimbabwe Mining Development Cooperation (ZMDC) parastatal and its partners. This ban was part of the sanctions put in place by the EU Council in 2002 basing on the claims that ZMDC could have financed directly ZANU-PF party also cited as motivating factors for political violence, related abuse of human rights and non-holding of fair and free elections[12].

The second point of contestation is around the issue of elections and the winning of ZANU PF. In July 2013, Zimbabwe carried out the first harmonized poll after the expiry of the Government of National Unity (GNU). While African Regional Economic Communities RECS (SADC and AU, COMESA), governments and states have accepted the outcome of the election, western countries inclusive of USA and the EU block of countries initially did not accept the outcome and have to a large extent maintained the sanctions/restrictive measures regime although only the President and the first lady remain on the list as of 2015.

The issue of sanctions and the environment post-election have created an ambient environment for the fuelling of government support of ethanol production. From these developments, it can be argued that a key driving force behind government support to bio- ethanol production was the desire to bust the sanctions.

Global Context of Petrol-Ethanol Blending

The use of ethanol (pure or blended) as a fuel for vehicles is gaining momentum. For instance, there are over 4 million cars running on pure hydrated ethanol in Brazil (Coelho 2007)[13]. There are 700 000 flexi fuel vehicles (using both pure petrol and blend). The REN21 Report (2014) provides a list of some of the policies covering targets, quotas, mandates and so on that governments have put in place globally in support of biofuels production which demonstrates the prevalence of blending. In Zimbabwe there is contestation on impact of blended fuel on vehicles. Final users of petrol in particular motorists have regarded the Government mandatory blending policies as a violation of consumer prefer-

ences. With respect to this, a key point of contestation is that petrol blended with ethanol damages vehicles especially if the vehicle is not fitted with a flexi fuel gadget. The mandatory blending policy also has demands when it comes to the special infrastructure requirements to complete the blending process. Coelho (2007) quoting ANFAVEA (2005) shows that the Brazilian Automobile Association has summarised the minimum necessary vehicle modifications for using ethanol blends. The analysis shows compatibility of existing fleets with petrol-ethanol blends, demonstrating the minimal impact of blends especially at percentages lower than ten percent blending.

Overview of Analytical Model for Impact Analysis along the Sugarcane Bio-Ethanol Value Chain

The analytical model espoused to perform the analysis can be summarised as follows:

At any stage, let:

- *n* represent number of inputs
- *m* represent number of outputs

Case (1) Base Scenario

At production level,

$\Sigma^{n}_{i=1} Pa_i \times Qa_i = \Sigma^{n}_{i=1} Xa_i$

Where, Pa_i denotes price of i^{th} input and Qa_i quantity of i^{th} input,

Also, $\sum^{n}_{i=1} Pf_i \times Qf_i = \sum^{n}_{i=1} Xf_i$

Where, Pf_i denotes price of i^{th} output and Qf_i quantity of i^{th} output.

Therefore

$Mprod_0 = \lambda_0 [\Sigma^{m}_{i=1} Yf_i - \Sigma^{n}_{i=1} Xa_i]$

Where $\lambda_0 = Sprod_0$ (the scale factor),

At processing level,

In a similar fashion we have:

$Mproc_0 = \lambda_1 [\Sigma^{m}_{i=1} Yq_i - \Sigma^{n}_{i=1} Xr_i]$

Where, $\lambda_1 = Sproc_0$ (constant scale factor), Yq_i and Xq_i denote the i^{th} output and input values respectively.

The Value Chain Margin is then calculated as follows:

$WoP = Mvc_0$

$= Mprod_0 + Mproc_0$

$\lambda_0 [\Sigma^{m}_{i=1} Yf_i - \Sigma^{n}_{i=1} Xa_i] + \lambda_1 [\Sigma^{m}_{i=1} Yq_i - \Sigma^{n}_{i=1} Xr_i]$

Case (2) Policy Scenario (that is, With Policy)

Let the policy scenario be represented by z.

Then,

$Mprod_z = \lambda_0 [\Sigma^{m}_{i=1} Yf_i - \Sigma^{n}_{i=1} Xa_i]$

And,

$Mprod_z = \lambda_0 [\Sigma^{m}_{i=1} Yq_i - \Sigma^{n}_{i=1} Xr_i]$

Now, Cost of Policy has to be incorporated as follows:

Cost of Policy = $Cpol_z$

$= \Sigma^{n}_{i=1} Yg_i$.

Therefore,

Value Chain Margin = Mvc_z

$= Mprod_z + Mproc_z - Cpol_z$

$\lambda_0 [\Sigma^{m}_{i=1} Yf_i - \Sigma^{n}_{i=1} Xa_i] + \lambda_1 [\Sigma^{m}_{i=1} Yq_i - \Sigma^{n}_{i=1} Xr_i] - \Sigma^{n}_{i=1} Yg_i$

Defining the Reference Scenario and Its Parameters

To facilitate the analysis in this paper, a five percent mandatory blending level is assumed to be the baseline/reference scenario. This assumption is important because a zero percent reference assumption (meaning no blending is taking place) would render the analysis impotent. In this regard, the purpose of the analysis is to see how changes energy policies affect the creation and distribution of income and wealth along the sugarcane bio-ethanol value chain. The analysis in this paper varies the blending levels from five, to ten, fifteen, twenty-five and eighty-five percent to simulate the impact on the reference scenario. In addition, the analysis examines the implications of changes in indigenisation policy as well as various incentives that can be instituted in the energy sector.

At primary production level, the yield of sugarcane is assumed to be 135t/ha while the cost of production per hectare is $4541. The conversion rate of sugarcane to ethanol is assumed at 1 tone to 75 litres of ethanol. Consumption of petrol per annum is assumed based on daily consumption of 2 266 761 litres per day (Mapako and Mbewe 2004). The full baseline scenario which is the reference situation at five percent ethanol blending level is presented as column three in Table 1.

RESULTS

The Impact of Policies on the Sugarcane Bio-ethanol Value Chain

Definition of the Scope of Impact Analysis along the Sugarcane Bio-Ethanol Value Chain

The analysis of policy impacts done in this paper focuses on two broad areas namely impact of blending levels and impact of indigeni-

Table 1: Results of simulations of impact along sugarcane bio-ethanol value chain of different ethanol blending levels

Stage of value chain	*Parameter*	*Computed estimates at 5% ethanol (baseline/ reference scenario)*	*Computed estimates at 10% ethanol blend*	*Computed estimates at 15% ethanol blend*	*Computed estimates at 25% ethanol blend*	*Computed estimates at 85% ethanol blend*	*Computed estimates at 100% ethanol*
Primary Production of Sugarcane	Inputs costs (USD)/Unit($/ha)	4541	4541	4541	4541	4541	4541
	Total output/unit(t/ha)	135	135	135	135	135	135
	Price per/tonne($)	4	4	4	4	4	4
	Total gross margins/unit ($/ha)	-4001	-4001	-4001	-4001	-4001	-4001
	Gross Value of Feedstock cost per hectare (US$/Ha)	1447	1447	1447	1447	1447	1447
	Amount of land put under sugarcane (ha) based on amount of ethanol required	513799.16	1027598.32	1541397.48	2568995.8	8734585.72	10275983.2
	Total value of feedstock/ annum($)(standard)	743467384.5	1486934769	2230402154	3717336923	12638945537	14869347690
Processing of Sugarcane into Bio-ethanol into Ethanol	Amount of raw sugarcane required per year (tonnes)	513799.16	1027598.32	1541397.48	2568995.8	8734585.72	10275983.2
	Inputs costs ($/litre of ethanol)	0.4798	0.4798	0.4798	0.4798	0.4798	0.4798
	Total amount of pure ethanol required (per year) (litres)	38534937	77069874	115604811	192674685	655093929	770698740
	Price /Litre (US$)	0.95	0.95	0.95	0.95	0.95	0.95
	Gross margins/litre ($)	0.49371	0.49371	0.49371	0.49371	0.49371	0.49371
	Total Gross margin at processing ($)	19025083.75	38050167.49	57075251.24	95125418.73	323426423.7	380501674.9
	Gross value of Ethanol ($)	36608190.15	73216380.3	109824570.5	183040950.8	622339232.6	732163803
Wholesaling and Trans-portation of Ethanol	Inputs ($/litre)	0.0256	0.0256	0.0256	0.0256	0.0256	0.0256
	Outputs (litres of ethanol)	41368388.25	82736776.5	124105164.8	206841941.3	703262600.3	827367765
	Gross income($/annum)	1059030.739	2118061.478	3177092.218	5295153.696	18003522.57	21180614.78
	Gross value of ethanol ($)	37667220.89	75334441.78	113001662.7	188336104.4	640342755.1	753344417.8
Blending and Wholesaling Stage	Input costs ($/litre)	0.95	0.95	0.95	0.95	0.95	0.95
	Outputs (litres)	41368388.25	82736776.5	124105164.8	206841941.3	703262600.3	827367765
	Price per litre ($)	1.0165	1.0165	1.0165	1.0165	1.0165	1.0165
	Gross margins (ethanol only	0.0665	0.0665	0.0665	0.0665	0.0665	0.0665
	Total gross margins	2750997.819	5501995.637	8252993.456	13754989.09	46766962.92	55019956.37
	Gross value of ethanol at Blending stage	40418218.71	80836437.42	121254656.1	202091093.5	687109718	808364374.2
Retailing Stage	Input costs (7% maximum)	0.9975	0.9975	0.9975	0.9975	0.9975	0.9975
	Outputs	41368388.25	82736776.5	124105164.8	206841941.3	703262600.3	827367765
	Price per litre	1.0877	1.0877	1.0877	1.0877	1.0877	1.0877
	Gross margins /litre (ethanol only)	0.071155	0.071155	0.071155	0.071155	0.071155	0.071155
	Total gross margins (net income)	2943567.666	5887135.332	8830702.998	14717838.33	50040650.32	58871353.32
	Gross value of ethanol at blending stage	43361786.37	86723572.75	130085359.1	216808931.9	737150368.4	867235727.5

sation policy on the value chain. With respect to blending, naturally different levels of ethanol blending impose different levels of demands on certain variables along the sugarcane bio-ethanol value chain. The analysis focused on the impact on some selected variables namely, i) land put under sugarcane for purposes of ethanol production, ii) amount of raw sugarcane required per annum, iii) total amount of ethanol required per annum, and iv) gross value of ethanol at each stage of the chain. The impact on each of these variables is described in the proceeding section.

With respect to indigenisation policy, this is seen as a key determinant of the distribution of wealth along the sugarcane bio-ethanol chain as this spells out the shareholding and compensation mechanisms for local communities. The model applied traces how selected variables change in response to adjustments in policies in these aspects.

DISCUSSION

Impact of Blending Level on Land, Production and Incomes along the Value Chain

Evidence of the impact of the biofuel investment in Chisumbanje is emerging. The most recent of this evidence reflects that homes were displaced, communities have lost their capacity for food sovereignty and are suffering from worsened poverty (CGIAR 2017). The hypothesis tested was that as the level of ethanol petrol blending increases, the net benefits are accruing to different actors increase disproportionately, with smallholder farmers getting less and corporate getting more and more. A key question to facilitate in testing this hypothesis is what happens to incomes of key groups such as war veterans and settler farmers and the community as the blending level increases. The results also show that increases in mandatory blending levels increases income that accrue to all other the primary agents along the value except war veterans and settlers since their land holding is fixed. The hypothesis is accepted on the basis that smallholders' incomes are not increasing with blending levels. The results show that as the blending level increases the private investor gets more and more compared to other economic agents.

The results also show that for all the other economic agents, business increases because the value of ethanol proportionally increases since the prices are not going down because of increased supply. For instance, at five percent mandatory blending level, value of value of ethanol at processing is $36.6 million dollars, if the blending level is raised to ten percent, the value of ethanol produced at processing levels doubles to $73.2 million. There are no changes in distribution of income among economic agents.

It implies that institution of higher mandatory blending levels that are not coupled with distributional policies or measures to ensure equitable distribution of the additional income generated serve to perpetuate the existing income distribution patterns.

At the level of primary production of sugarcane, a key variable is the amount of land put under production. Naturally higher blending levels require more ethanol, which implies that more land will have to be under sugarcane to satisfy the higher demand. Because land particularly in Chisumbanje has been under contestation, it is important to understand the impacts and implications of increasing the blending levels on not just land but all other resources that are required in primary production of sugarcane for ethanol.

The results show that as the blending levels are increased, it is not just demand for ethanol that is going up, but also all the inputs that are used in production of ethanol, including land labour and capital. Using land as an example, and basing on the production systems assumed in the reference scenario, from five percent to ten percent, the required land doubles from 5100 hectares to 10200 hectares (assuming the yield of 135t/ha and a 1 tonne to 75 litres sugarcane to ethanol conversion ratio).

From the results, unless there are new technologies, that increase the yield levels for the same land area, demand for land will always increase proportionately with increases in blending levels as shown in Table 1. The implication is that it may not be ideal to increase the blending levels without paying attention to the issue of land especially in cases where the land is already contested. Although the analysis does not consider other inputs of production such as water, chemicals and so on, it makes sense to infer that increases in blending levels will lead to increases in uses of other inputs, and therefore decisions on blending level should take into account the potential impacts.

In addition, increased production induced by raising the blending levels can lead to increased negative externalities. In some cases, Governments promotes increases in ethanol production without carefully considering the full economic costs (Pimentel 2003). The costs on the local livelihoods, the environment and on the social systems especially in cases where there are contestations should therefore be fully considered when blending levels are raised.

At the processing level, increasing the blending ratio also has a similar effect. As the blending level is increased for instance from five percent to ten percent, its amounts to doubling the amount of ethanol required whilst raising it to twenty-five percent implies means multiplying the reference scenario amount 5 times. This has direct implications on the processing capacities. As of 2014, the installed capacity at Chisumbanje processing plant is approximately 105 million litres of ethanol per annum. Under Statutory Instrument 147a of 2013, Government of Zimbabwe raised the mandatory blending level from ten percent to fifteen percent with effect from the 30th of November 2013. In January 2014, the Government relaxed its rules for the mandatory blending of ethanol in petrol from the statutory fifteen percent to ten percent. The key reason cited was the failure by the company to harvest because of heavy rains that made some parts of the sugar estates unreachable. What is clear is that as the blending level increases, it imposes new demands on both production and processing capacity, and if these are not carefully considered, mandatory ratios may be raised, only to be reduced because of capacity challenges. Therefore, it could be that unless new plants are constructed, or new entrants enter the ethanol production industry, it may be technically impossible to sustain consistently the fifteen percent blending level.

Impact of Indigenisation Policies along the Sugarcane Ethanol Value Chain

An important analytical dimension is the impact of indigenisation policies on the sugarcane bio-ethanol value chain, especially on the distribution of income. This dimension is important in that changes in the ownership structure/shareholding have potential to change how the income is distributed along the sugarcane bio-ethanol value chain. According to the Government of Zimbabwe Parliament portfolio committee report Government concedes that the project does not comply with Indigenization and Economic Empowerment Act (Chapter 14: 33). This is in line with the General regulations of 2010 under Indigenization and Economic Empowerment act which make it a rule that investment should be forty-nine/fifty-one percent in favour of investors who are citizens, and while locals should benefit from these investment through ten percent share community ownership. The Parliamentary report also notes the Private investors have ninety percent stake while Government of Zimbabwe through ARDA owns ten percent. Additionally, Green Fuel got an ethanol blending license notwithstanding the fact that it did not satisfy the fifty-one/forty-nine percent Joint Venture with government as prescribed by the law.

This background is important because it shows that the issue of shareholding and eventually how it affects income distribution along the sugarcane bio-ethanol value chain is unfinished business and can therefore not be ignored in the analysis done in this paper. Changes in shareholding and implementation of community share ownership trust are potential mechanisms through which the distribution of income along the sugarcane bio-ethanol value chain can be changed. The income (profit) distribution pattern in the reference scenerio shows that seventy-three percent of profits going to Greenfuels, eight percent to government through ARDA, nine percent to retailers, eight percent to blenders, one percent to settle farmers and one percent to war veterans. The War Veterans just like the Settle Farmers were allocated 2 hectare plots of planted sugarcane. They, however, do not know where exactly these two hectares are, and therefore actually do not work on them. Each of those who have been allocated the 2 hectares is paid US$800 per year, which is broken down as US$4 per tonne assuming a yield of 100 tonnes per hectare. With a fifty-one percent shareholding acquired by the local entity in this case ARDA; the new income distribution structure along the chain would be as shown Table 2.

The Government of Zimbabwe (2015) Parliament portfolio committee report recommends and considers Community Share Ownership Trust (CSOT) as a lucrative ‘quick gain’ in line with the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIM ASSET). While

Table 2: Simulation of impacts of different policy scenarios on baseline income distribution along the ethanol value chain

Value chain actor	*Baseline scenario (current income distribution pattern, year 2015)*	*10% share ownership trust*	*51/49% in favour of ARDA*	*51/49 rule in favour of ARDA and Community*
Greenfuels (Macdom and Rating included)	73	55	35	34
Community	0	7	0	7
Retailers	9	15	15	15
Fuel blenders	8	14	14	14
ARDA	8	7	34	28
War veterans	1	1	1	1
Settler farmers	1	1	1	1

the analysis carried out in this paper does not look at the broader issues of effectiveness of CSOT in delivering the required sharing of equity with the community, it is important to analyse the broader potential impact of such a policy on the distribution of income along the value chain. Table 2 shows that the implementation of ten percent CSOT will result in the community getting at least seven percent of the income generated from the value chain that is at production, processing, distribution and blending levels.

The results show that as the blending levels are increased, it is not just demand for ethanol that is growing, but also all the inputs that are used in production of ethanol, including land labour and capital. From the results, unless there are new technologies that increase the yield levels for the same land area; demand for land will always increase proportionately with increases in blending levels. The implication is that it may not be ideal to increase the blending levels without paying attention to the issue of land, especially in cases where the land is already contested. This might lead to unintended impacts such as displacement, loss of livelihoods and so on as highlighted by other authors, for instance, CGIAR (2017), Hall (2011), Cotula et al. (2011) and Mutopo (2011). In addition, increased production induced by raising the blending levels can lead to increased negative externalities. Therefore, the costs on the local livelihoods, the environment and on the social systems especially in cases where there are contestations should therefore be fully considered when blending levels are raised.

What is clear is that as the blending level increases, it imposes new demands on both production and processing capacity, and if these are not carefully considered, mandatory ratios may be raised, only to be reduced because of capacity challenges. Therefore, it could be that unless new plants are constructed, or new entrants enter the ethanol production industry, it may be technically impossible to sustain consistently the fifteen percent blending level.

The hypothesis tested was that as the level of ethanol petrol blending increases, the net benefits accruing to different agents increase disproportionately, with smallholder farmers getting less and corporate getting more and more. The hypothesis is accepted on the basis that smallholders' incomes are not increasing in line with blending levels.

Although there are no specific studies that deal directly with the impact of policy, a few studies have been done which focus on what has to happen as government makes policies on ethanol production and use. For instance, other scholars such as Grumet and Poltak (2001) highlight that the economic, environmental and health aspects have to be carefully considered since there are some significant impacts across the board. These authors also note the new infrastructural demands that are associated with increased use of ethanol such as new pipelines and other parent infrastructure because of the differences in water absorption rates. These authors also note the importance of predicting new demands that are brought by new levels of ethanol use.

CONCLUSION

In conclusion, the paper has demonstrated the impact of blending level policy on various activities along the sugarcane bio-ethanol value chain. A reference scenario of I-O relationships along the sugarcane bio-ethanol value

chain was created based on the initial blending level, set at five percent. The evidence shows that unless there are new technologies, which increase the yield levels for the same land area, demand for land will always increase proportionately with increases in blending levels, and therefore increasing blending levels should carefully consider the impacts on the supply side. Higher and higher blending levels impose new demands on all systems, including production and processing as well the environment. Therefore, it could be that unless new plants are constructed, or new entrants enter the ethanol production industry, it may be technically impossible to sustain consistently higher blending levels.

RECOMMENDATIONS

The recommendation is that any policy related increase in blending levels should be preceded by systematic analysis of the potential impact along different actors and their activities along the value chain. The analysis also showed and recommends that changes in shareholding and implementation of community share ownership trust are potential mechanisms through which the distribution of income along the sugarcane bio-ethanol value chain can be changed.

NOTES

i. Ethanol fuel is ethanol (ethyl alcohol), the same type of alcohol found in alcoholic beverages. It is most often used as a motor fuel, mainly as a bio fuel additive for gasoline.

ii. Some of the land which is under contestation between the investor(Zimbabwe Bio Energy and Agriculture and Rural Development Authority, ARDA) on one side, and communal farmers on one side.

iii. Fuel containing ethanol normally has an "E" number which explains the mixture. E10 has ten percent ethanol and ninety percent petrol while E85 is a blend of eighty-five percent ethanol and fifteen percent petrol.

iv. Also see Zimbabwe independent newspaper (11/10/2013), http://www.theindependent.co.zw/2013/10/11/mugabe-gives-ethanol-blending/.

v. For instance, the theory assumes that causation is an absolute relation whose nature does not vary from one context to another.

vi. In 2005, the MDC split into two with one led by Morgan Tvsangirai (MDC-T) and the other led by Professor Welshman Ncube(MDC).

vii. Some especially aligned to the European Union Block have called them restrictive measures.

viii. The Bretton Woods Institutions include World Bank and International Monetary Fund (IMF) and were set up in Bretton Woods, New Hampshire, USA in 1944. Their purpose was to rejuvenate the economy after the war and to ensure economic cooperation on the international scene.

ix. US Sanctions Policy: Facts and myths: http://harare.usembassy.gov/sanctions_facts_ myths.html.

x. In the World Bank's Worldwide Governance Indicators (2010), Zimbabwe ranked well below the 10th percentile in each indicator, with the only exception of the Political Stability indicator, where it rates at about the 15th percentile.

xi. http://www.diamonds.net/News/News Item.aspx?ArticleID= 44667& ArticleTitle= EU+Lifts+Sanctions+on+ Zimbabwe+ Mining+ Development+Corp.

xii. South world: Zimbabwe: EU Lists sanctions on Zimbabwe. http://www.southworld.net/newtest/index.php/component/k2/item/531.

xiii. Coelho S (2007): CENBIO – The Brazilian Reference Center on Biomass University of São Paulo September 7th, 2007 Lima, Peru.

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