

The Character of Emerging Biofuel Value Chains: Focus on the Chisumbanje Sugarcane Bio-ethanol Chain in Zimbabwe

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KEYWORDS Land Investments. Value Chain Governance. Political Economy. Supply Utilisation Accounts. Monopoly

ABSTRACT The investments in large scale sugarcane production for processing into ethanol fuel that have occurred in Zimbabwe have generated debate in the media and the public in general. This paper characterises the typology and key elements of the emerging Chisumbanje sugarcane bio-ethanol value chain using empirical data on supply utilisation accounts (SUA) and value chain governance. It is concluded that the value chain is characterised by the pervasiveness of monopolistic tendencies and dominance of powerful private corporates being supported by government. Legislative changes and involvement of powerful Government and political institutions has created strong opportunities for rent seeking as the investor lobbies powerful players in pursuance of high private economic benefits. The value chain systematically excludes the smallholder farming community from directly participating in the productive aspects of the chain. Production systems have changed for the local communities that have been displaced and there are indications of losses of traditional livelihood sources.

INTRODUCTION

The investments in large-scale sugarcane production for processing into bio-ethanol fuel that have occurred in Zimbabwe have generated active and elevated multidimensional debate in the public in general. Among many of dimensions of this debate are issues to do with the potential impact of the investment on welfare of different economic agents, fairness and competitiveness of the value chain itself, and the role of various agents shaping the governance of the value chain, which include political, administrative and business dimensions. The potential impact of government energy policy particularly ethanol petroleum blending levels on incomes of different economic agents has also been an issue among stakeholders. The paper is an addition to the growing body of knowledge on large scale land investments. A number of research-

ers including CGIAR (2017), Cotula et al. (2011) and Mutopo (2011) have to some extent described the outcomes of the investments. Others such as Boche and Anseew (2013) focused on the amount of land being acquired. In this paper, a characterisation of this emerging sugarcane bio-ethanol value chain is performed. The paper begins by outlining the empirical approaches applied to obtain the primary data used in the analysis before the context of bio-ethanol production from the global to the local is presented. The rest of the paper presents the findings focusing on a description of the activities along the chain, the movement of product from primary sugarcane production to consumption of bio-ethanol as a fuel using supply utilisation accounts (SUA), and analysing the different actors along the chain applying value chain governance and political economy analysis.

Objectives

The overall objective of the paper is to characterise the emerging sugarcane bio-ethanol value chain in Zimbabwe tracing ethanol pro-

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duced at the Chisumbanje ethanol project. The paper interrogates the typology of the key elements of this emerging value chain. The researchers test the hypothesis that the emerging bio-ethanol value chain is characterised by the pervasiveness of monopolistic tendencies and dominance of powerful private corporates being supported by powerful sections of the community including government institutions.

METHODOLOGY

The empirical data used in the analysis was collected along the ethanol value chain starting from the primary sugarcane production process in Chisumbanje to the level of ethanol consumption. 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 area, while at least 10 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.

The characterisation of the value chain presented in this paper entails the 'functional' analyses of the value chain. The approach identifies, quantifies and describes the physical organisation activities to bring the product from primary production through processing and marketing to its final consumption. The analysis focuses on:

- ♦ Unpacking the technical aspects of operations involved from primary production to final consumption;
- ♦ Quantifying the inputs used and intermediate outputs produced at each stage of the chain and quantifying the physical flows of the product among the different economic agents at different stages of the chain; and
- ♦ Characterising the economic agents involved at the various stages and their roles.

As an important addition to this framework, this study deepens the analysis of the roles of different economic agents along the sugarcane ethanol value chains. The analysis goes further

to analyse political economy and governance and issues related to power along the value chain. Johnston et al. (2007) define value chain governance as the dynamic distribution of power and control among agents in a value chain. This analytical dimension is important as governance becomes a determinant of socio-economic outcomes. Humphrey and Schmitz (2008) explain that value chain governance pays attention to the relationships among the actors interacting to bring a service or product from point of inception to end use (buyers, sellers, service providers and regulatory institutions). The implications of these explanations is that governance in itself focuses on ability and power to exert control at any point along the chain by actors. The methodology applied entails that once the economic agents and the activities they are engaged in are matched, the information is presented in a flow chart and a functional analysis table. The flow chart shows how different economic agents are linked whilst the functional analysis table shows the agents, the activities there are engaged in and the outputs they produce.

Context of Sugar Bio-ethanol Production

Contemporary Global Biofuels Production and Use Trends: Status, Drivers and Projections

The main biofuels produced and used globally are bio-ethanol, biodiesel¹, and HVO². According to the REN21 Global Renewables Status Report (REN21 2014), liquid biofuels account for the largest share of transport fuels derived from renewable energy sources. As of 2013, biofuels met about 3 percent of total road-transport fuel demand, and around 2.3 percent of final liquid fuel demand and a very small but growing portion of aviation fuels, although the share increases in some countries such as Brazil and the USA. The world's top five ethanol producers are the United States, Brazil, China, Canada, and France. Production is dominated by the United States and Brazil accounting for 87 percent (61% and 26%, respectively) of the global total basing on 2012 figures (REN21 2014).

Governments have been at the forefront of driving investments in biofuels by creating an enabling environment and proving the necessary incentives. Mussatto et al. (2010), support this observation pointing out that the use of Ethanol as a direct fuel source or an additive

became popular as a result of governmental mandates and regulations and in some cases economic incentives to deal with environmental concerns, and in some cases to reduce dependency on oil imports. The result has been that a number of countries have become interested in developing internal ethanol industries and local markets.

The Issue of Biofuels as a Driver for New Wave of Large Scale Land Investments

There is a double coincidence of the world economic crisis of 2008 and associated investment risk in the developed world investment markets on one hand, and the emerging biofuels sector as a safe and well supported investment destination for world capital on the other hand. Starting in 2008, the world experienced a crisis driven by i) rising global imbalances (capital flows), (ii) monetary policy that might have been too loose, (iii) inadequate supervision and regulation of local economies (Merouche and Nier 2010). It became more risky for investors to invest in their traditional markets because of these developments. Investors began to look for alternative investments opportunities as destinations for capital.

The main investor groups in large scale land markets in Africa in general are oil-rich Gulf States such as Saudi Arabia, United Arab Emirates, Qatar, Bahrain, Oman, Kuwait and Jordan; populous and capital strong Asian countries such as China, South Korea, Japan and India; as well as western and multinational private companies (Daniel and Mittal 2009; Görden et al. 2009; Smaller and Mann 2009). Hall (2011) identifies four drivers of large scale land investments in Africa as i) securing of food supply by Asian powers, ii) land and water poor but oil rich Gulf States, iii) Impacts of financial crisis on Western and North American banks, sovereign funds and other financiers, and iv) African governments/ domestic investors in partnerships with foreign capital.

Typology of the Generic Global Bio-ethanol Value Chain

Chan and Reiner (2011) provide a characterisation of the typical generic global bioethanol value chain. The characterisation done by these researchers show three components of the bio-ethanol value chain depicted as 1) an upstream

agri-commodity segment; 2) a midstream ethanol manufacturing segment; and, 3) the downstream transport fuel segments. The researchers note that a crossover of two value chains produces this typical integrated agro commodity value chain and energy value chain. The traditional agricultural value chain is the upper tail of the industry characterised by the production activities on land, marketing, trading and transportation and distribution of agricultural produce. The manufacturers and traders of ethanol are found at the middle. The providers and suppliers of technology and other production inputs such as enzymes, yeast chemicals, and utility are captured as an 'auxiliary stage', which is not necessarily a typical stage of the main value chain. Further downstream, the stages resemble chains of conventional transport fuel, where ethanol is typically blended and distributed to retail service/filling stations.

Overview of Zimbabwe's Energy Sector

Zimbabwe uses coal, fuel wood, and electricity and petroleum fuels as the main sources of energy (GoZ 2008). According to the draft energy policy document, the national energy balance of 2000 shows that wood provides the bulk (53%) of the total energy supply, followed by coal (20%), liquid fuels (14%) and electricity (13%). According to Mashange (2007) Zimbabwe's energy sector accounts for 8-9 percent of the country's GDP. Mashange (2007) also notes that although it contributes about 1 percent to formal employment, it contributes significantly to foreign borrowing and debt as well as aggregate investment. It is important to highlight that the sectors high foreign exchange requirements and intensity tend to strongly influence economic policy decisions. However, the country still has to import all of its petroleum requirements although it is 84 percent self-sufficient in energy requirements.

Statistics from Energy Information Administration (EIA 2015), in 1980 the country's daily average consumption stood at approximately 1 526 278 million litres (12,800 barrels per day), peaking in 1999 at 3 696 455 million litres (31,000 barrels per day). The same report also highlights that in 2009 the lowest consumption was recorded at 12,500 barrels per day. Petroleum consumption has been on the increase since the adoption of the multi-currency regime, peaking to 2 500 473 million litres per day in 2012 before

declining to 2 266 761 million litres in 2013 (EIA 2015).

Mashange (2007) highlights that since the last quarter of 1999; Zimbabwe has intermittently experienced fuel shortages. Supplies became erratic to the extent that the country times operated with as low as 40 percent of at normal supplies. This was mainly witnessed before the multicurrency regime. These shortages have been attributed mainly to alleged mismanagement, forex shortages and corruption at NOC-ZIM. As the forex shortages became more severe, problems of product shortage began to unfold. Questions were raised on the industry's policies with respect to sustainability of the liquid fuel sector. Concerns were on policies regarding pricing, distribution, regulatory mechanisms, and utilisation of storage facilities, supply routes and NOCZIM management.

Sugarcane and Bio-ethanol Production Trajectory in Zimbabwe

Overview of Sugarcane Production

According to Shumba et al. (2011), the sugar sector accounted for 1.4 percent of the country's GDP prior to 2000. Two companies namely Triangle Limited and Hippo Valley Estates contributed 85 percent of the total sugar output. Zimbabwe's processing capacity is approximately 600 000 tons of raw sugar as well as 260 000 tons of refined white sugar. This is against a high national sugar demand (white) of 230 000-250 000 tons annually during the 1990s, with surplus being exported. However, the same author notes that low sugar cane production in the last few years led to sugar imports. For example, Shumba et al. (2011) highlights that 39 330 tons of sugar had to be imported imported in 2009 following the production of only 2.4 million tons of sugarcane. It is also noted that Zimbabwe's two sugar mills produce molasses, a by-product of the sugar making process. The molasses are used to produce ethanol at the Triangle distillation plant.

A number of researchers (Deenanath et al. 2012; Shumba et al. 2011; Thomas and Kwong 2000) examined historical bio-ethanol production in Zimbabwe. These researchers show that ethanol production in Zimbabwe was planned in the 1970s but actual production commenced

in 1980. Thomas and Kwong (2000) particularly highlight that this was mooted as a mechanism to 'burst' the economic and trade sanctions imposed on Rhodesia (the colonial name for Zimbabwe) in the 1970s. According to these researchers, the issue of sanctions had generated the need for an independent, self-sufficient source of automotive fuel. Triangle has 40 million liters of annual ethanol production capacity and during the 1980s total annual ethanol production of the plant was about 30MI.

The same literature also shows that the termination of this first phase of ethanol production was triggered by the 1992 drought, during which the contractual relationship with government expired. After the drought when the Triangle refinery resumed production, the managers opted for export since they realised they could get a better price. For the Triangle plant all ethanol has been exported since then.

The Government of Zimbabwe through the Agriculture and Rural Development Authority (ARDA) went into a partnership with the Zimbabwe Bio-Energy Ltd operating as Green Fuels in February 2009 to set up the Chisumbanje ethanol project. The project involves primary production of sugarcane and processing it into anhydrous bio-ethanol. The 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. The Chisumbanje plant has capacity to produce 120 million litres of anhydrous ethanol per annum. It is public that the price of ethanol produced at the plant was set at an average of \$0.95 per litre.

In February 2014, The Biofuels Digest (Sapp 2014) reported that Triangle was set to supply 3 million litres of ethanol to the local fuel market to help fill the gap left by Green Fuel which was having production problems due to incessant rains. Supposedly Triangle was planning to sell the ethanol at 80 cents per liter and could supply up to 4 million litres.

In terms of competitiveness of ethanol production, Shumba et al. (2011) posited that Zimbabwe's ethanol production is relatively competitive within the region, basing on the Triangle Plant. It is argued that the cost of producing 1 litre of ethanol in Zimbabwe ranges between \$0.25 and \$0.40 compared to \$0.50 and \$0.60 in Malawi. The costs are all however higher if com-

pared to the costs in Brazil, which range between \$0.19 and \$0.25.

RESULTS

The Characteristics of the Sugarcane Bio-ethanol Value Chain in Zimbabwe

The analytical framework espoused in this paper included: 1) unpacking the technical aspects of operations involved from primary production of sugarcane to final consumption of bio-ethanol; 2) defining the inputs used and intermediate outputs produced at each stage of the chain; and, 3) characterising the economic agents involved at the stages of the sugarcane bio-ethanol value chain. The product is a characterisation that is presented as a flow chart and functional map of the value chain.

Activities Along the Sugar Ethanol Value Chain

To assist in characterising the sugarcane bio-ethanol value chain in Zimbabwe, it is important to begin by delineating the stages along this chain. According to Hellin and Meijer (2006), this is important because the stages along the value chain need to be identified for effective value chain analysis. Basing on the information collected along the sugarcane ethanol value chain, the stages in this chain can be broadly categorised into three to include 1) 1-O relationships in production (farm level) of sugarcane; 2) 1-O relationships in the processing of sugarcane into bio-ethanol; and 3) 1-O relationships in the marketing and distribution of bio-ethanol.

Primary Production of Sugarcane

Sugarcane is the feedstock that is used in ethanol production in Chisumbanje. In interviews, officials explained that the sugarcane that is used in the ethanol plant is grown under a highly mechanised system of production. Field production of sugarcane takes place at two main sites, namely Chisumbanje and Middle Sabi. As a key economic resource land is one of the important inputs in the production of sugarcane. The interviewees also explained that in Middle Sabi, Greenfuels through its subsidiary Rating Private limited is utilising 3500ha of original ARDA land with no displacement of the community. It was highlighted that there is a plan to

develop 6000ha in Middle Sabi for an out grower scheme under the A2 model³. In Chisumbanje again through another subsidiary known as Macdom Investments Pvt (Ltd), the company is utilising 6500 ha of land. Recent publications in public media show that the company is planning to extend the land under sugarcane by another 1000 hectares at Chisumbanje.

In Chisumbanje part of the land being used is under conflict. All interviewees concurred that there is significant displacements of smallholder farmers to pave way for the large-scale sugarcane production. At the time of interviews in 2014, there were indications that there are 1008 families who lost land ranging from 2 to 40ha depending on the family size. Out of the 1008 families who lost land 172 families were compensated with the 0.5ha of irrigated land. In the Chisumbanje area the 10 affected villages are *Tazwa 1, Tazwa 2, Guwarekipi, Madhwayi 1, Madhwayi 2, Madhwayi 3, Mazembe, Vhutuza, Muyondozi and Ndofeni*. In Chinyamukwakwa, 388 families out of the 694 families affected were compensated, again with 0.5ha of irrigated land⁴. This paper is not focused on the issue of land. Other scholars, for instance Mutopo and Manase (2014) and Matondi and Nhliziyo (2015), provide richer accounts of the conflict around the land at the Chisumbanje site.

The production systems at Greenfuels' sister subsidiary companies Macdom and Rating are identical. From land preparation to the point of harvesting, the production system is the class of any First World highly mechanised process. The production cycle takes roughly 300 days for a sugarcane crop to be planted, harvested and sent for processing into ethanol. Table 1 shows some of the characteristics of the primary production cycle.

It takes less than an hour from the stage the sugarcane is harvested for it to be fed into the processing plant to produce ethanol. There is a highly mechanised and well-timed continuous process of harvesting the sugarcane from the field and transporting it to the plant for processing. This well-timed process stems from the quality control requirements associated with a highly sophisticated chemical process to follow in the processing stage. The quality of the feedstock for ethanol production has to be maintained at a constant level. This has important implications for the overall discussion on the character of the emerging bio-ethanol value

Table 1: Some characteristics of primary production process

<i>Parameter</i>	<i>Value</i>
Length of sugarcane production cycle(days)	300 days
Approximate size of land planted annually(hectares)	10000 hectares
Estimated yield per hectare(t/ha)	135 t/ha
Remuneration of labour/days(\$)	\$4
Amount of fertilizer(kgs/hectares)	500 kgs
Cost of fertilizer/hectare	\$37/ bag

Source: Primary interviews with Greenfuels officials

chain, particularly with respect to the involvement of smallholder farmers in the actual primary production process.

The issue of out growers raises an important analytical dimension with respect to the inclusivity of the business model in the Chisumbanje sugarcane bio-ethanol value chain. In interviews officials explained that there are 116 out growers under 400ha of land and 125 war veterans under 250ha of land. However, the model is a unique model in that the farmers are not much involved in the production but they are just land owners and the company does everything for them and pays them at the end of every harvest. From the company's perspective this is because the farmers do not have expertise in the production of the expected quality of the sugar cane required for the production of ethanol. This means smallholder farmers are actually automatically excluded from actively participating in the primary production because of the sugar quality requirements for processing.

This issue of out growers becomes particularly important given the debates around inclusivity of the business model. As evidence in the interviews shows, the company has often used the 116 people on 400 hectares and 125 war veterans on 250ha as evidence of the out grower scheme the company has. In theory, an out grower is described to represent contractual partnership between growers or landholders and a company for the production of commercial agricultural products (Desmond and Race 2000). The lack of evidence of use of independent smallholder producers or out growers in the primary production process, poses serious questions on how inclusive the Chisumbanje ethanol value chain is. One question is why in the primary production process does not see large numbers of smallholders being involved by supplying the

processing plant. Therefore, it is justified to conclude that the primary production process in the Chisumbanje bio-ethanol value chain is dominated by the two companies.

Processing of Sugarcane into Anhydrous Ethanol

The processing of sugarcane into ethanol takes place at the processing plant in Chisumbanje. Greenfuels acquired from Brazil and installed at Chisumbanje village a plant that processes sugarcane into anhydrous ethanol. Informant interviews with company officials showed that the plant can process 1.5 million tonnes of cane in a 300 day season. The annual ethanol output is estimated at between 105 million litres, which convert to 350 kilolitres per day of 14,580 litres per hour. Although the stages can be defined in terms of the scientific process occurring, the processing stage can be viewed as one big event in value chain parlance, since it takes hardly three hours before the crushed cane is turned into anhydrous ethanol. Further, all these activities are carried out in the processing plant at Chisumbanje.

Marketing and Distribution of Ethanol

Transportation

Greenfuels has its own transport system. Ethanol is transported from the Chisumbanje ethanol plant to registered fuel blenders. While the interviews could not establish the exact number of trucks that Greenfuels uses to transport the ethanol, it is clear that this is a huge fleet since it has to transport all the ethanol from Chisumbanje to specific blending sites. The transport system involves state-of the-art fuel tankers specialised to carry ethanol. There is no evidence of outsourcing of transportation of ethanol from Chisumbanje to various registered fuel blenders in the country. The transportation is therefore integrated with the processing just as the primary production process is.

Blending and Wholesaling

Blending of petroleum with ethanol takes place at different places and is carried out by licensed blenders. Zimbabwe Energy Regulatory Authority has licensed 36 fuel oil importers,

(10 players import the bulk of the fuel) while there are six wholesalers. With regard to blending, ZERA indicates that as of October 2013, ten blending licences had been issued to four companies – Engen Petroleum Zimbabwe, Green Fuel, Zuva Petroleum and Sakunda Energy. The licences are site specific with the bulk of the blending to take place in Harare (5 sites) followed by Bulawayo (2 sites), Mutare (2 sites) and Triangle (1 site). The National Oil Company of Zimbabwe also blends fuel at its Msasa (Harare) and Feruka (Mutare) facilities.

Retailing of Blended Fuel

An important activity in the sugarcane bio-ethanol chain is fuel retailing. Fuel retailers source the bio-ethanol blended petroleum from the registered blenders. Whilst there appears to be no issues with regard to quantities of bio-ethanol blended petrol, there appears to be some issues around its pricing. Based on information available in the public media the blending companies are selling blended fuel at different prices. For example, an article published in a local daily paper performed a comparative analysis of the prices of wholesale prices of blended fuel at different locations and shows the disparities as seen in Table 2.

What is not clear is whether these differences in prices are a result of the quality of the fuel or a result of other factors or value-addition processes such as transportation to the convenient proximity of the user, associated services at pumps.

Another key dimension to the analysis of the pricing of fuel is the role of government. The government charges duty on imported petrol and diesel and often uses this as a means to raise revenue; and often in many cases unbudgeted expenditure. For example, it is highlighted in the

country's 2014 Medium Term fiscal policy (Government of Zimbabwe 2014) that government was increasing excise duty on diesel and petrol from 25 and 30 cents per litre to 30 and 35 cents per litre, respectively. This was with effect from 15 September 2014. The stated reason was in order to raise additional revenue to finance inescapable expenditures. In addition the government through its revenue authority charges a petroleum importer's levy. The levy is pegged at US\$0.04 per litre of petroleum products imported by a petroleum importer and transported by road. The levy should be accounted for on a bill of entry and paid on entry. All importers of petroleum products are required to complete a declaration form indicating the destination of the products imported.

Further to this, with respect to ethanol, the government has the major say in the determination of the price of ethanol. The price of ethanol is fixed by the Zimbabwe Energy regulatory Authority and is currently fixed at US\$0.95 per litre as of 2015. Government is in partnership through ARDA with Greenfuels in producing ethanol, and at the same time it has to enter into negotiations with Greenfuels as the sole licensed producer in negotiating a price for ethanol. This shows how government is a key factor in the pricing of fuel in the country.

Supply Utilisation Accounts Along the Sugarcane Bio-ethanol Chain

The preceding sections provided a description of the activities along the sugarcane bio-ethanol chain. In this section, Supply Utilisation Accounts (SUA), consisting of double-entry accounts that allow for one to check consistency, at each stage of the chain, between the quantities of the commodity supplied by upstream agents and the quantities absorbed by

Table 2 : Retail prices of petrol in Zimbabwe

	Harare		Bulawayo	
	29/07/12	17/10/12	29/07/12	
Wholesale price	\$1.46	\$1.48	\$1.51	\$1.53
Pump selling price	\$1.51	\$1.53	\$1.56	\$1.58
Margin	\$0.05	\$0.05	\$0.05	\$0.05
% margin	3.42%	3.33%	3.31%	3.21%

Source: Compiled from Daily News (2012)

the downstream ones. The emerging characteristics of the sugarcane bio-ethanol chain still allow for the SUA analysis. However, the fact that in many of the stages along this chain, there is only one player, which is the company, makes the analysis slightly different from situations where for instance there are many primary level producers, and many processors. It is important, however, for purposes of tracing value and how it is shared among economic agents. Table 3 summarises the flow of product from the level of primary production to the level of consumption.

Governance of the Sugarcane Bio-ethanol Value Chain

An analytical dimension pursued is the governance of the sugarcane bio-ethanol value chain. Value chain governance is denoted as dynamic distribution of power and control among agents in a value chain. In this paper, value chain governance analysis closely performed along political economy analysis. This type of analysis goes deeper beyond the formal structures to analyse the relationships among the buyers, sellers, service providers and regulatory institutions that operate within or influence the range of activities required to bring bio-ethanol from inception to its end use. Value chain governance analysis enriches economic

analysis by unpacking what drives certain behaviour along the value chain, how this shapes particular policies and programmes, who are the main winners and losers, and what the implications are for development strategies and programmes. The analysis focuses on agents both directly and indirectly involved in the sugarcane ethanol value chain.

For purposes of ease of analysis agents are categorised as primary and secondary economic agents. The primary agents are directly involved in performing activities along the sugarcane bio-ethanol chain and these include Greenfuels, Macdom and Rating, various fuel blenders and numerous fuel retailers and dealers. The secondary agents are involved as service providers to the primary agents along the chain and these include ARDA, ZERA, Ministry of Energy, local community, war veterans, Security sector (Police, President's office) local traditional leaders, local interests groups, political party leadership, (Member of Parliament, Councillors), Chipinge district administration, Chipinge Rural district council. The analysis goes beneath the formal structures to show the underlying interests, incentives and institutions driving the activities.

Analysis of the structure of the investment that has occurred in Chipinge reflects complex relationships between various economic agents.

Table 3: Flow of product along the sugarcane bio-ethanol value chain

<i>Stage of value chain</i>	<i>Parameter</i>	<i>Estimates based on potential</i>
<i>Primary Production Process (Sugarcane Production)</i>	Land area (per annum)	10000ha
	Number of farmers	1 ⁷ (subsidiaries of Greenfuels doing the farming, in addition, war veterans and settler farmers do not do the farming but are just paid at end of season)
	Yield per hectare (tons)	135
	Total sugarcane harvested per year (tonnes)	1 350 000
<i>Processing Stage</i>	Raw sugarcane feed (per year)	1350000
	Number of processors	1
	Conversion rate (ethanol/t sugarcane)	75L
	Total ethanol per year	101250000
<i>Blending and Wholesale Stage</i>	Total amount of ethanol (litres)	105 000 000
	Number of economic agents	10
	Total amount used for blending (litres)	105000000
	Total amount of ethanol	105000000
<i>Retail Stage</i>	Number of economic agents	400
	Number of consumers (all motor petrol users)	All petrol users

Source: Computations from primary data by Author (based on 2013/14 season estimates)

In this paper, what is critical is to analyse how the various players participate along the value chain.

Primary Economic Agents in the Sugarcane Bio-ethanol Value Chain

1. Greenfuels, Macdom Investments (Pvt) Ltd (MACDOM) and Rating Investments (Pvt) Ltd (Rating)

Evidence shows that Greenfuels is a private company that owns the ethanol plant at Chisumbanje⁵. What is also emerging is that govern-

ment has entered into a joint venture with Macdom and Rating, which are two private companies. This joint venture agreement facilitates the investors to utilise ARDA's facilities including land to produce sugarcane to supply the ethanol plant. Government through this joint venture is involved in primary production of sugarcane.

The arrangement is a clear mechanism for ensuring sugarcane supplies to the plant, and therefore can be seen as a vertical integration process confirming earlier argument on vertical integration by Msangi and Tokgoz (2009). These researchers bring to attention that securing a



Fig.1. Flow chart and functional analysis table
Source: Author

stable and consistent biomass supply is crucial for favourable feedstock costs and profit margins. There are some issues that deserve to be interrogated further as one characterises the emerging value chain. The first issue is around ownership structure. According to Zimbabwean laws, all investors can own up to 49 percent only with 51 percent reserved for Zimbabweans.

In FGDs the community highlighted that they are not happy to be driven out of the ARDA land to pave way for white farmers. It was highlighted that ARDA is part of government and in principle government owns the land on behalf of the people. A group of war veterans in Chisumbanje highlighted that during the war of liberation that brought the country's independence, they were motivated to go to war and fight to resist being driven out of this ARDA land. So the question is if people went to war because of this land, what will stop them from doing anything in the future? Considering the influence the war veterans have on the country's political scene, there is no guarantee that the Greenfuels subsidiaries, Macdom and Rating can continue using this land peacefully.

2. Agricultural and Rural Development Authority (ARDA)

ARDA is an important actor because it provided the mechanism through which government contributed to the joint venture with the private investor. ARDA is a parastatal under the Ministry of Agriculture Mechanisation and Irrigation Development MoAMID. The government through the MoAMID appoints a board of directors to run the affairs of the authority. According to a report by the Zimbabwean Parliamentary Portfolio Committee on Agriculture Water Land and Resettlements (Government of Zimbabwe 2010), at its establishment in 1965, the purpose of ARDA was to boost agricultural production and rural development as well as productive utilisation of State land. ARDA's function was to provide education and management services to small-scale farmers on both communal land and property purchased by the government.

According to government reports (Government of Zimbabwe 2010), in 2008 ARDA embarked on a turnaround strategy and drive to find investment partners to rehabilitate their properties and pursue a vibrant social responsibility agenda for the benefit of the rural population. ARDA entered into a Build, Operate and Transfer arrangement with private investors Macdom

(Pvt) Limited and Rating (Pvt) Limited on the Chisumbanje and Middle Sabi Estates in Chipinge, Zimbabwe. ARDA has not been spared by the poor performance and poor management that generally characterises most government parastatals. In 2010 a parliamentary portfolio committee was set up to investigate the viability of ARDA operations and their impact on agricultural productivity and food security. The report on the investigations highlighted two important findings as follows (ibid):

- ♦ The contract between ARDA and Rating Investment Ltd, Macdom Ltd was poorly drafted and that the Government of Zimbabwe, represented by ARDA, was short-changed of proceeds that were to be harvested from the joint venture. This is so particularly because the agreement did not specifically state the expected harvest or product and the percentage that must be allocated to ARDA; and,
- ♦ Villagers, while welcoming the developments happening at Chisumbanje, were being displaced by the expanding sugar cane plantations and that there seems to be no plan in place to ensure the villagers benefit from the scheme since they are not being consulted in the whole process.

As other parts of this paper have shown, there are protracted conflicts over some of the land that ARDA has used as part of its contribution in the joint venture entered with Macdom and Rating. ARDA maintains the land belongs to it and therefore has not grabbed land from the communities. ARDA's position is supported by all the local authorities – the Member of Parliament, the District administrator and the CEO and the Ministry of Energy.

3. Fuel Blenders

As highlighted in earlier sections, there were at least 10 licensed fuel blenders as of October 2013. The licences are site-specific since blending requires specialised infrastructure. As shown in earlier sections, the licences are shared by four companies namely Zuva Petroleum, Engen Petroleum Zimbabwe, Green Fuel and Sakunda Energy. Officials from Greenfuels highlighted that ZERA closely regulates the blending process. In interviews, Greenfuels highlighted that it receives instructions on the destinations of the ethanol from ZERA. The companies that blend

petroleum become the *de facto* wholesalers of the product because of the special blending and additional storage facilities that need to be installed.

4. Fuel Retailers

There are an estimated 400 retail outlets for petroleum in Zimbabwe. To operate the fuel retail business one has to be registered by ZERA and has to have three sets of licences: one from the local authority, one from ZERA and one from the environmental management agency. Fuel retailing is perhaps one part of the sugarcane bio-ethanol chain where there are many agents who appear to be operating in a competitive environment. The only issue as alluded to in earlier sections is that these retailers are price takers, and they maintain their mark up or margin by simply passing on the cost to the consumer. It has also been shown that the retail price of blended petrol is determined not only by the blenders' wholesale price but also by other factors, which include import laws, prices of ethanol, and transport costs.

Secondary Agents in the Sugarcane Bio-ethanol Value Chain

1. Zimbabwe Energy Regulatory Authority (ZERA)

The Energy Regulatory Authority Act of 2011 established ZERA. At its establishment, the mandate of ZERA was to regulate the procurement, production, transportation, transmission, distribution, importation and exportation of energy derived from any energy source' (section 4(1) (a)) (Government of Zimbabwe 2012). The National Energy policy highlights that ZERA makes decisions on development, monitoring and enforcement of product and service standards, energy prices, dispute resolution, and the issuing, enforcement, renewal, amendment or cancellation of licences.

Through the establishment of ZERA, the government also sought to address the weakness in the legal framework that did not provide the adequate degree of independence required for regulatory efficiency. The ZERA is an important agent in the sugarcane bio-ethanol value chain. Its roles in this chain include licensing of all other agents; namely producers and import-

ers, wholesalers and distributors. The other important function is the recommending of the appropriate pricing for petroleum products. The country's energy policy particularly highlights that it is an important mandate for ZERA as a government regulator to ensure sector-wide regulation with a common vision to protect consumers and ensure affordable pricing.

There has been some debate emanating from the escalations of the mandatory blending levels vis a vis pricing of ethanol and the subsequent pump price of blended petrol. One emerging issue appears to be the overpricing of ethanol by Green fuels. There also seems to be some controversy around how ZERA has allowed overpriced ethanol to be used as a basis for mandatory blending. The pricing according to government policy would be determined using a cost reflective approach. However, in reality, it is often a big challenge to determine the costs involved in bringing a litre of ethanol to the consumer. This is particularly so, given the information asymmetries surrounding the operations at Chisumbanje plant.

There is always debate on the figures that the investor shares as official for public consumption; for instance, the initial investment for the whole operation was first publicised as being worth US\$600 million. There was much hype as players and decision makers got excited about the size of the investment, and many decisions could have been made on the basis of this figure. However, later on there was protracted debate around this figure with others questioning the authenticity of this figure and pointing out that the plant was only worth less than US\$40 million in Brazil. In the interviews company officials highlighted that the investment was worth USD\$300 million.

Another dimension is the pricing of ethanol. This becomes an issue when the prices of ethanol are compared with some international producers for instance in Brazil and the US. On average, the gate price of ethanol per litre in Brazil is between 35c to 75c depending on distance from the plant (Fetcher 2010). Green fuels in collaboration with ZERA quotes the wholesale (to blenders) price at USD\$0.95c which is higher than the prices in Brazil. The investor has defended this citing high costs of production compared to the production systems in Brazil and in South Africa. The issue of the true costs

is therefore a very problematic. It is understandable for any private investor to inflate their costs figures in order to maximise profit in cases where the prices of the final product is regulated.

2. Ministry of Energy and Power Development

The Ministry of Energy and Power Development is an important secondary actor in the sugarcane bio-ethanol as it provides policy direction and mechanisms for regulation in the petroleum sector. The Ministry is mandated with developing appropriate legal frameworks to facilitate orderly operations of the oil industry and to ensure adequate supplies of petroleum products to facilitate economic turnaround and sustainable economic development. The ministry also has the mandate to develop and implement policies to promote indigenisation in the petroleum sector. The blending levels as well as mandatory blending scenario that the country is operating under are policy matters that are dealt with by the ministry. The ministry passed various pieces legislation with respect to blending level. For instance, in October 2013, the Government of Zimbabwe announced a 10 percent mandatory blending for all petrol coming into the country⁶. The ratio was raised to E15 in November 2013 under terms of Statutory Instrument 147a of 2013. The plan was to get to E20 by March 2014. These pieces of legislation have been the basis for sustaining the operations at the Chisumbanje project.

3. Local Smallholder Farming Community

The issue of displacement of smallholder farmers in the Chisumbanje project has been raised by a number of scholars (Mutopo 2011; Manase and Mutopo 2014). The interviews reflect that villagers in over 12 villages are claiming that they have lost the land that they have worked on traditionally. As discussed in earlier sections, out of the 1008 families who lost land 172 families have been given the 0.5ha irrigable land. Analysis of household-level interview data shows that agricultural production is the main source of livelihood as indicated by 90 percent of the respondents. Other sources of livelihoods include agricultural labourer (1.1%), government worker (1.1%), trade (1%) and other technical artisanal work such as building, welding, carpentry etc. (6.6%). The main cash crops grown

are cotton (82%) and beans, while the most important food crops are maize and sorghum.

One striking finding from the dataset is that there is no local smallholder community member who is growing sugarcane for sale to the company for processing into ethanol. In focus group discussions, the local community members reflected that before the villagers lost the land, they could afford to live decent lives including paying school fees using proceeds mainly from cotton production.

The investments in Chisumbanje have changed the farming system and livelihoods for a significant part of the local community population. The land that has been historically used for cotton production by smallholder households is now being used for large-scale sugarcane production for processing into ethanol by Greenfuels. Although the smallholder farmers who lost land have been promised compensation in the form of 0.5ha irrigated plots, this new farming system appears to be problematic. In interviews and FGDs smallholder households in Chisumbanje revealed some challenges that typify the new production economics being faced by the smallholder farmers who lost land. Some of the issues include:

- ♦ Although the 0.5ha plots are irrigated, they are too small to be economic and can never be compared with the situation before, Further some families are polygamous but were still given the same 0.5ha plots in this regard; they have lost their source of livelihood;
- ♦ The plots are too far away from their homesteads and most have to travel more than 10 kilometres to get to the plots and this has potential negative bearing on labour productivity, an argument supported by a number of scholars (Karangwa 2010; McCall 1985; Holden and Koru 2008);
- ♦ The plots are located at the margins/periphery/boundary of the large-scale sugar plantation owned by the company and therefore they are being implicitly used as buffer for stray cattle and wild animals by the company; and,
- ♦ smallholder farmers have to learn new production techniques for the new crops they have to farm on the plots on their own and this is not easy; The irrigation scheme

is not supported by adequate technical advice for the small-scale irrigators.

4. Liberation War Veterans

Liberation War veterans in Chipinge can be considered an important economic agent in the Sugarcane ethanol value chain. In interviews, the local war veterans explained how they were very influential in 'educating' the communities on the goodness of the Chisumbanje investment, a decision which they now regret. In these interviews the War veterans were very clear that they currently feel they sold out the community by using their esteemed position and power to convince the community to accept the project by surrendering their land.

They also explained that they were promised sugarcane plots on which they would work as out growers. They highlighted that is out of the 500 war veterans in the district, 125 war veterans were given 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. The company harvests once per year.

From these developments, a number of key issues can be raised which further corroborate the issue raised earlier in this paper. First, is that the primary production process emerging in the sugarcane bio-ethanol value chain does not include out growers. The second issue is how the company is setting the price for the output, and also dictating the yield per hectare with little or no room for negotiation with the land owner. The amount being paid to the War veterans per annum can be seen as a rental since they are not in any way involved in the production process. In other words, the rental for the land is being dictated by the tenant, instead of the land owner.

5. ARDA Farmers

The ARDA farmers are settler farmers who had valid lease agreements with ARDA. Just as the war veterans, the ARDA farmers/settler farmers are also implicitly renting out their land to the company. They too used to grow maize and cotton on the land but now the land has been

lost to the company, which is now using the land for growing sugarcane. They are also paid US\$4 per tonne of sugarcane assuming 100 tonnes per hectare. The case of these settler farmers closely resembles that of the war veterans described earlier. The only difference is that the settlers are paid according to the size of their land on the original lease agreement with ARDA.

These two cases demonstrate the concentration of power in the company as it dictates the yield levels, the prices and in general the terms of the agreement. It also shows how impossible it is for smallholder households to be meaningful participants in the emerging sugarcane bio-ethanol value chain.

6. Security Sector

The security sector has also been part of the developments around the Chisumbanje ethanol project. The role of the security sector which for this paper includes the Zimbabwe Republic Police and the President's Office has been maintaining law and order. In addition, the security sector has also been very important in maintaining and protecting the interests of the investor. It is also public knowledge that a number of villagers have been arrested for different types of resistance, which might have been classified as threats to the project's security and, therefore, to national security.

7. Local Traditional Leaders

Traditional leaders are influential among a large majority of the population in Sub-Saharan Africa (SAfAIDs 2010). They wield influence and command respect among their local communities. According to the Traditional Leaders Act of Zimbabwe (Chapter 29:11) (Government of Zimbabwe 1998), traditional leaders in Zimbabwe consist of the Chiefs and their apex bodies, headmen, village heads, village assemblies, ward assemblies and development committees. The Traditional Leadership Act provides for the role of traditional leaders in Zimbabwe's rural local government. Because they yield much influence among the people, the leadership in Chisumbanje was also involved in the processes around the establishment of the Chisumbanje ethanol project.

Interviews with the Chief and his aides showed that the area in question falls under Chief

Garahwa. The area has four headmen and over 200 villages that cover wards 26, 27, 28 and 29 of Chipinge rural district council. The area under Chief Garahwa's jurisdiction is commonly referred to as *Ndowoyo* Communal Lands, *Ndowoyo* meaning black rich soils that do not require fertiliser for plant production. They have never used fertilizer in agricultural activities. The people under this chieftaincy have been growing maize, ground nuts, cowpeas and sorghum for food and cotton as a cash crop. The area of land under dispute was land that belongs to the communal areas and under the Chief's jurisdiction as the traditional leader. The perspective of the traditional leadership is that some of the disputed land belongs to ARDA, as it was leased to some farmers who would have trained as master farmers. Since ARDA was not utilising all of its land it leased the land to the local farmers. These farmers hold valid lease agreements and they have been paying for the land to the rural district council.

The interview with the Chief also showed that some of the land that Greenfuels took from the people belonged to the community and was not original ARDA land, implying that the company encroached into communal land. The Chief was involved in the consultation meetings, such that they even asked the company that what would become of the people who would have lost land; to which the company responded by promising jobs and other means of livelihood so that the people 'would not need their plots'. When Green Fuel came in, they made promises to the Chief and to the community as a whole, which they are now not fulfilling. According to the Chief, the investment is no longer benefiting the community as promised when the company came in. Some of the promises as highlighted by the Chief include:

- ♦ Upgrading of the Mathikwa-Mabee road, which by time of data collection had not been upgraded;
- ♦ Building an office for the chief, which had not been done;
- ♦ Electrification of the chief's homestead which had not been done;
- ♦ An 8-roomed house for the chief and a tractor which had not been done; and,
- ♦ Creation of jobs for the community.

The chief gave the permission to construct the project the traditional way in anticipation of the benefits based on these promises.

8. The Local and National Party Leadership

The local and national political party leadership are an important piece in the developments around the Chisumbanje bio-ethanol project. This is because they are at the centre of any community mobilisation that occurs. Interviews with the local politicians seem to suggest that politicians are in support of the project. The support is based on both seen and unseen benefits in the form of many promises that have been made by the company, with respect to rehabilitation of infrastructure.

Opportunities for rent seeking exist as the powerful politicians mobilise to protect and create an enabling environment for the investor's operations. According to Marrota and Russell (2015), rent seeking occurs when property rights are weakened and the ownership of someone's wealth or goods is debatable, and others gain more by trying to appropriate that wealth than by producing themselves. The ownership of land in Chisumbanje is highly contested and those in power are supporting the company to acquire the land from people who are not really seeing the benefits. Interviews with the senior politicians reflected that the company created employment and rehabilitated infrastructure. It was highlighted that the company is also assisting in the rehabilitation of roads and schools and there are plans to construct a factory for furniture (in Checheche) to supply 63 primary schools. On the ground however, most of these promises have not been fulfilled as some of the benefits especially that of transforming the community for the better, have not been released.

9. Chipinge Rural District Council

The Chipinge rural district council and the administrator's office also have secondary roles in the chain. They administrate bylaws, which interpret national legislation, and therefore they are local custodians of land national legislation for the benefit of the people. The Chisumbanje ethanol project falls under the jurisdiction of the Chipinge rural district council. Interviews with these authorities showed that in the 1960s the then government of Rhodesia earmarked the area for irrigation purposes, and this was referred to as the "Greater Chisumbanje Plan" but because of financial constraints the government could not develop the whole area. About, 5172 ha was developed for irrigation, (original ARDA land)

which was leased to TILCO by the then Department of Native Affairs. At independence, the Zimbabwean government ratified that decision to reserve that area for future expansion.

According to these authorities, a number of studies were carried out but nothing took place in terms of expansion until 2008 when an investor came and revised the programme, initially taking the 5172 ha and then moving on the Chisumbanje side (western side) adding some 1000ha and moving to Chinyamukwakwa taking 2600ha as part of the expansion. From the interviews, the local authorities concede that there is contestation over the land and that the local communities should be compensated. They also concede that their role as the local authority comes in on the land and the allocation of the 0.5ha to the farmers who lost their land is a process that involves the rural district council, the company, Agritex and the Department of Irrigation in the Ministry of Agriculture. The authorities are very clear that the investor expanded into the Chisumbanje area, which is communal, but earmarked for this project, and that is when the 0.5ha came in. From these interviews, it appears the Chipinge RDC is caught in a difficult situation where they have to legitimise a project with which they actually see problems. But because of broader and bigger pressures they have to support the project.

DISCUSSION

The Character of Sugarcane Bio-ethanol Value Chain

The activities, agents and accounts of product movement along the sugarcane bio-ethanol value chain discussed in preceding sections can be depicted in a value chain flow chart and map. Figure 1 shows the sugarcane bio-ethanol value chain showing the distinct stages, a pictorial flow, supplying utilisation accounts, primary agents and secondary agents along chain.

As noted by Rasheed and Geiger (2000) and Gereffi et al. (2005) the form of value chain governance can change as an industry evolves and matures, and governance patterns within an industry can vary from one stage of the chain to another. Based on the analysis done, a number of conclusions can be drawn with respect to governance along this value chain – with respect to integration, information asymmetries, pervasive-

ness of monopolistic behaviour, barriers to entry and related issues of inclusion of out growers and smallholders farmers and associated changes in socioeconomics and livelihoods.

Integration Along the Sugarcane Bio-ethanol Value Chain

At the primary production stage, there is prevalence of two vertically and horizontally integrated companies that face no competitive pressure. The arrangement is a clear mechanism for ensuring sugarcane supplies to the plan and, therefore, can be seen as a vertical integration process.

Inclusion of Out Growers Along the Chain

The primary production process does not include conventional out growers. Rather, there are interest groups who get paid on a per hectare basis. The amount being paid to the war veterans per annum can be seen as a rental since they are not in any way involved in the production process. The nature of involvement of war veterans and settler farmers in the value chain demonstrate the concentration of power in the company as it dictates the yield levels, the prices and in general the terms of the agreement. It also shows how impossible it is for smallholder households to be meaningful participants in the primary production level of the emerging sugarcane bio-ethanol value chain. In addition, the analysis showed that there are no local smallholder community members growing sugarcane for sale to the company for processing into ethanol.

Changes in the Socio economics and Livelihoods for Local Communities

The investments in Chisumbanje have changed the farming system and livelihoods for a significant part of the local community population. The land that has been historically used for cotton production by smallholder households is now being used for large-scale sugarcane production for processing into ethanol by Greenfuels. These new developments have potentially changed the livelihoods of the people whose land has now been placed under sugarcane production. They have been introduced to new farming systems without adequate knowledge, the plots have been found to be too far away from homesteads and the distance has potential negative impacts on labour productivity.

Information Asymmetries and Barriers to Entry into the Value Chain

Information asymmetries are apparent most at the primary production, processing and distribution of ethanol, which act as a barrier to entry into this business. The issue of ownership has been shrouded in secrecy and under these circumstances it is objective to conclude that there are fair chances that the public may be losing. According to Zimbabwean laws all investors can only own up to 49 percent with 51 percent reserved for Zimbabweans. There have been many articles in the public media on this issue highlighting that the partnership was not compliant to the investment laws. What makes the situation more complex is that ARDA is a public enterprise and thus must advance the welfare interests of the public. Complications are arising from this arrangement where a private investor driven by the desire to make profit has partnered with a public entity that should, in principle, advance the interests of the public. This is also partly emerging from how the partnership has managed some sensitive issues particularly on land as a major source of livelihood for the rural community in Chisumbanje.

Pervasiveness of Monopoly Behaviour in the Value Chain

The analysis showed that the primary production, processing and distribution levels are carried out by Greenfuels. There are strong indications of regulatory agencies being manipulated by the company through systematic benefits to those in power to make decisions. There is apparent manipulation of powerful institutions involved in the whole chain to gain monopolistic advantages while there are apparent losses to powerless agents. Powerful agents are in support of the investments. The support is based on both seen and unseen benefits in the form of many promises that have been made by the company, with respect to rehabilitation of infrastructure. One can easily tell that there are opportunities for rent seeking as the powerful politicians mobilise to protect and create an enabling environment for the investor's operations.

CONCLUSION

In conclusion, the analysis carried out showed some salient features of the emerging bio-ethanol value chain. It showed that the sug-

arcane bio-ethanol value chain is a typical First World agro-industrial value chain, which is systematically vertically integrated in primary production, processing and transport and distribution. These arrangements do not appear to create any entry points for real out grower schemes as the line of production is carefully timed and calibrated from the point of planting to processing. One major characteristic is the dominance by powerful agents, namely the investing company deriving their power from the financial capital. They are supported by and protected by state institutions in relationships that lend themselves to rent-seeking situations. Information asymmetries are apparent most at the primary production, processing and distribution of ethanol, which act as a barrier to entry into this business. Arguably, there is potential that local politicians and the security sector and to some extent war veterans at some point have provided protection to the company in exchange for some financial rewards.

RECOMMENDATIONS

There is need for promotion of inclusive incorporation of smallholder farmers in primary production process through favourable policies. Since government is already controlling many aspects of the value chain, it could as well control the price of raw sugarcane paid to any smallholder growers. In addition, mechanisms to compel the company to buy from smallholder farmers at market-related prices should be explored. This would also reduce the concentration of power in one economic agent in dictating the yield levels, the prices and, in general, the terms of the agreements.

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Paper received for publication on April 2015
Paper accepted for publication on August 2016