Adoption of biofuels technologies by smallholder farmers in Zimbabwe.

By Chipo Nyamwena- Mukonza

Abstract

The study seeks to investigate factors that influence adoption of biofuel technologies by smallholder farmers in Zimbabwe. There has been growing interest in southern Africa regarding biofuel development, diffusion, and implementation. Of the 40 countries in Africa 14 of them are landlocked and they depend entirely on fossil fuels from the Middle East and other oil producing contries.Biofuels are envisioned as a solution to the twin problems of energy crisis and environmental problems.Smallholders farmers have been targeted as the major producers of biofuels and in Zimbabwe they constitute the majority of the farmers after the land reform. Technology adoption is strongly linked to the asset base of the smallholder.The study aims to use the livelihood innovation development model, to assess the factors influencing adoption of biofuels technologies to smallholder's farmers in Zimbabwe. The livelihood innovation development model follows the national innovation systems approach whereby it is necessary to analyse innovation and the institutional environment in which it takes place. Data was drawn from 200 farmers together with in depth interviews and focus group discussions.Logit regression model was used to analyse the factors influencing adoption of biofuels technologies in Zimbabwe.

Key words: biofuels, adoption, technology, smallholder, innovation, livelihood

1.0 Introduction

The adoption of biofuels internationally has been driven by many factors such as the need to improve energy supply and economic development and improve the environment. Following the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC 2007) which declared that major driving force behind global warming is the unsustainable human consumption pattern driven by the desire to industrialize. Subsequently global leaders and other key stakeholders have agreed to keep global temperatures rises to no more than two degree celcius.The situation is further exacerbated by revelations that fossil fuels are depleting. According to Ragauskal et al (2006) ,fossil fuels are a finite source for which demand is predicted to increase by more than 50% by 2025(Ragauskal et al 2006:3).Agro fuels haven been championed worldwide as a solution to climate change by fossil fuel consumption and to the threat of dwindling oil reserves.

On 16 February 2005 The United Nations Framework Convention on Climate Change (UNFCCC) and its related Kyoto Protocol came into effect. The Kyoto Protocol obliges countries to reduce its gas emission by at least 5% compared to 1990 levels over 2008 to 2012, primarily by investing in cleaner technologies in developing countries and Zimbabwe is signatory to this protocol. There are a number of implications of this protocol especially to the smallholder farmers. Firstly since biofuels have the potential to reduce greenhouse gas emissions, the Kyoto Protocol's Clean Development Mechanism (CDM) offers potential for funding biofuels projects in developing countries. However, because of the complex rules, processes and politics of the CDM, access to the CDM by the Least Developed Countries is restricted, and smaller producers are bypassed in those countries (Peskett 2007). Secondly smallholder farmers are less able to access the carbon market because they lack expertise in implementing complex methodologies, ex-post payment systems mean there is a lack of up front funding for projects and investors are less interested in smaller projects with high risks and long timescales. Small-scale methodologies with simpler requirements and processes for bundling projects have been developed to address some of these issues, but there is currently no small scale methodology for liquid biofuels, and only one large scale methodology based on use of waste cooking oil for biodiesel (CD4CDM 2007).Thirdly despite their potential for bringing sustainable development benefits (a core aim of the CDM) biofuel projects are less attractive to

investors because of high abatement costs, difficulties in proving additionally for projects and difficulties in calculating reduced greenhouse gas emissions of projects (Bakker 2006).

Zimbabwe is an agriculture based economy with about 70% of its population living in rural areas and earning a living largely from subsistence agriculture (Zim stats survey 2010). In the past ten years agriculture productivity has been declining largely due to declining land productivity (soil erosion, deforestation), agrarian reforms in the country that disturbed farming activities and the floods and drought the country has been experiencing. In the energy sector the country does not produce oil it relies heavily on foreign oil hence the need to build up energy systems towards energy security. Research and trial projects for alternative energy in the country have been going on and still under way. Renewable energy technologies are an integral part to the development of energy security. The principal energy problem in the country is that its energy needs are not adequately met. Energy in Zimbabwe accounts for between 8-9 %of the country GDP, but it only contributes 1% to formal employment. About 900 million liters is required for diesels and 730 million liters of petrol per annum (energy balance 2009).The Zimbabwean government envisages that biofuels will solve the fuel problems in the country to this Jatropha and sugarcane have been promoted.

Quite a number of theories have been propounded relating to technology adoption and the structural elements driving adoption. This theories include the Technology innovation systems (Markard and Tuffer 2006, 2008, Negro, S, 2007 and Hekkert et al 2010), theoretical approaches relating to technology adoption and the factors influencing or affecting adoption of the technology. After the work of Rodgers (1962) several studies have also studied adoption behaviour, farmer characteristics or farmer perceptions to explain the adoption process the works of Aikens 19975 Shivery 1997, Sander 1996, 2008 , Dankiyi , A, Andah et al 2005

Also there a burgeoning literature on studies that have assessed the socio economic factors affecting adoption for instance, Adeogun, et al (2008) did a study in Nigeria which was aimed at estimating and explaining the parameters of the adoption process of Hybrid Clarias "Heteroclarias" by fish farmers in Lagos State, Nigeria. The main objective in introducing the hybrid was to introduce a viable and fast growing stock for distribution to fish farmers in order to alleviate the problem of short supply of fish fingerlings and increase fish production. In this study, a conceptual framework was developed for the decision to adopt or not to adopt and

econometric analyses of the diffusion process are presented using Logistic regression model. While appropriate low-input, cost production system and technology package should be emphasized, the knowledge, accuracy and technical responsibilities become more significant to the success of the technology as well as aquaculture industry.

Farmer's perceptions are crucial and should be analysed before a technology is introduced. This was a conclusion derived by Sinja et al (2004) after they had investigated farmers' perception of technology and its impact on adoption using a case study of legume forages in central Kenya highlands. Data from a random sample of 131 farm households in four districts in central Kenya was used. Participatory techniques, four most important fodder legume attributes to farmers in their adoption decision were identified. These were then used in conjoint analysis. An ordered probit model was estimated to assess relative importance of each attribute to the farmer. A Tobit model was also estimated to show the effect of farmers' perception of calliandra and desmodium on probability and intensity of adoption. The study found out that dry season tolerance and economy on land are most important characteristics of fodder legumes to the farmers. It was also found that Calliandra and desmodium were more relevant to the farmers in the area than other fodders. Farmers 'perception of the two fodders had a significant impact on their adoption. Adesina et al 1993 also concur with this notion of the importance of farmers.

In another study a T obit model was used to test the hypothesis that farmers characteristics and ecological zones in which farmers cultivate maize influence the size of the field put under improved maize cultivation, They discovered that extension contact , gender, total maize area and land tenure significantly affect the area planted to improved maize varieties. Household size was significant though it was positively related

Knowing the factors influencing the adoption of biofuels will assist in the diffusion of the biofuels technology to meet the need of the producers, distributors and consumers as well as putting in place other key services that would enable them quicker adoption.This analysis is important as it contributes to the empirical and theoretical debate on the determinants of technological adoption and considers a more detailed set of explanatory variables which enable us to set up a well-specified empirical model. A study carried out to determine the factors determining the determinants of technology adoption by agriculture firms in Uganda, postulates

that it is important to disclose the factors driving technology adoption and diffusion as it is important and relevant for both research and policy.

A compounding factor in carrying out this study is the fact that smallholder farmers have been targeted as the major producers of biofuels in Zimbabwe. Technology adoption is strongly linked to the asset base hence the adaption of the livelihood innovation model. The main dimensions that will be looked at include the assets of the rural households, the strategies that influence access to those assets (institutions, environment, regulations and laws) and the livelihood outcomes. Another motive in carrying out this study is that there is a clear disparity between theory and practice. On one hand we have a well-established theoretical literature on new technology adoption, but on the other hand empirical evidence on adoption of biofuels technology by smallholder's farmers is still limited. Yet from a policy perspective a wide and fast adoption of technology is desirable, hence it is essential to decipher the factors that are likely to influence and increase adoption of biofuels technologies.

The following section discusses the methodology and the theoretical framework. Section 1.3 outlines the empirical strategy and model specifications. Section1. 4 present and discuss the main result and section 5 summarizes the main conclusions.

Section1. 2: Methodology

Objectives

The main objective of the study is to identify factors affecting/influencing adoption of biofuel technologies by smallholders in Zimbabwe;

The primary objective is to assess assets of biofuel farming household and how these assets influence their livelihood objectives, option, activities and outcomes. Other objectives:

- To assess the performance of biofuel production when compared to non-adopters
- To what extent does the adoption of biofuels technologies influence the livelihood outcomes of households

Motivation /justification

The study was also influenced by the interest shown by the government of Zimbabwe on biofuels. A number of biofuels projects have been implemented in the country. An ambitious drive has been set by the Zimbabwean government to replace fossil fuels by 10% in 2017 through localized production of biodiesel and bioethanol (Draft biofuel policy 2007). To move the entire science system in the direction of these ambitions will require a clear assessment of existing production capacity, a realistic account of resource capacities to deliver on these goals, and a creative plan for moving the different elements of this system in the same direction. The study is expected to contribute the livelihood innovation development theory. The study will give a better understanding on the factors influencing biofuels adoption, and inform policy makers to provide better measures to increase production in future.

In many of the adoption behaviour studies the dependent variable is constrained to lie between 0 and 1 and the model used are exponential functions while univariate and multivariate logit and probit model include their modified forms have been used extensively to study the adoption behaviour of most farmers (Adeogun et al 2008).

Generally from literature it can be deducted that there are three

The economic constraint model (Aikens et al 1973, Chambers 2000): which is in favour of the distribution pattern of resource endowments.Institutons, resource availability plays a greater role in adoption behaviour. Mansfield, 1963, 1968 argued that the time taken before a firm starts using a new technology is inversely related to its size. The relationship of farm size and adoption is conditioned by such factors as fixed adoption costs, risk preference, human capital, credit constraints, labour requirements and land tenure arrangements (Feder and Zilberman 1985). Hicks and Jonson 1974 reported that a higher labour requirement explained non-adoption of high yielding varieties in India.

Innovation diffusion: led by Rogers 1962 which puts forward the notion of access to information as the main Determing factor in adoption behaviou.Rodgers in 1964 observed that wide availability of mass media (television, radio and images) is often limited by costs and literacy. He noted that localized source of information such as neighbors and friend could play a greater role in the diffusion of technologies than formal extension services.Willim 2005 have

also hypothesized that greater exposure to appropriate information through various communication channels subjective to uncertainty and encourages adoption.

Adopter perception (Adesina and Zinnah 1993): suggests that the perceived attributes of innovations are the key determinants of adoption behaviour.

Information and incentives to adopt: Awareness of the profitability of potential referential benefits of new technology is necessary to trigger the diffusion of an agriculture innovation. However for the adoption process to be sustained the new technology must be compatible with farmer's economic resources and supported by institutions responsible for providing inputs and technology advice. Extension visits and on farm demonstrations exposure to mass media, literacy level of education and time spent outside one village are some proxies or awareness or new innovation that are perceived to be economically compatible with farmers value and resources and are often readily to adopted(CIMMYT,1993)

The study employed a combination of qualitative and quantitative research methods incorporating case studies and survey questionnaire. The qualitative research method (use of multiple case studies) enables the researcher to compare findings and make generalizations across social settings, the quantitative research method (use of survey questionnaire) ensures validity and reliability of research findings through data triangulation (Yin R, K 2008). Preliminary comprehensive literature review on technology adoption, and Diffusion of innovation theory, the concept of the technology innovation system and the sustainable livelihoods framework was done .These theories were adapted to fit within the confines of the Zimbabwean biofuels industry. The second stage involved qualitative research using multiple case studies. The case study protocol provides a research methodology that concentrated on the collection of replicable data relating to technology adoption. Structured and unstructured questionnaire was used to solicit for information

The final stage was the analysis of data collected. The data was coded and entered into SPSS software to enable data manipulation for statistical testing. Logistic regression analysis was undertaken to assess the factors influencing the adoption of biofuels technologies. Of course there are similarities between the probit and the logit making it difficult to choose, but in this

study the Logistic model was chosen because the dependent variable is dichotomous and the model is computationally simpler

The empirical strategy consists of testing the hypotheses explicitly outlined earlier, that the asset base of the more farmers influences adoption, those with more assets are more likely to engage in the adoption of advanced technology if they have better access to complementary inputs, face stronger market incentives, and have better access to information. Rate of adoption was based on those growing agro fuel crops that is jatropha and sugarcane

Sampling Procedure: A Muilti stage purposive sampling was used to identify farmers to be included in the sample , for this study a farmer who is growing jatropha or sugarcane for biofuel purposes was defined as an adopter, And those who are not growing it as non-adopters. In addition in-depth key interviews and focus group discussions were held to determine the factors influencing adoption.

Data collection:

Data was collected from 140 farmers in Mudzi and Mutoko district of Zimbabwe were jatropha is being grown extensively. 50 farmers in Chisumbanje and Middle Sabi, Chipinge District were interviewed were sugarcane is being grown by out growers farmers. Of course caution should be exercised when handling the data, although the data set is comparable to other surveys in other countries, useful comparisons were made between the results obtained from the survey data and those obtained in other African countries.

Survey Procedure: Preparatory phase of the study involved introductory visits to the districts agricultural offices were discussion were held. The questionnaire was discussed and refined and pretested on some smallholder farmers. Zilberman 1985 revealed that many models used in adoption studies fail to meet the statistical assurance necessary to validate the conclusion based on the hypothesis tested and they advanced the use of qualitative response model.

1.3 Empirical model specifications: Rate of adoption: The rate of adoption is the relative speed with which members of a social system adopt an innovation. It is measured as the number of individual who adopt a new technology within a specified period. Measuring the rate of adoption

of Biofuel technologies the area allocated to biofuels crops relative to the total are size was used as criteria. The dependent variable is measured by dichotomous variable

Farmers who are used the technology or are still using the technology……….0 (1)

Farmers who are non-adopters…………………………………………………..1(2)

B_t=f(X_1,X_2,……………………………………………………………………..X_{10})+e……………………………….(3)

Where Bt

X_1 is the age

X_2 is the level of education

X_3 is experience of the farmer

X_4 hectarage size

X_5 access to extension officers

X_6 access to markets

X_7 Access to credit

X_8 livestock

X_9 land tenure

X_{10} Access to radio, TV etc: access to radio or TV can diffuse extension messages

X_{11}Household size

X_{12}area planted

X_{13}Gender

Formation of the model was influenced by the working hypothesis that socio economic factors have an influence on the adoption of biofuel technologies.

Discussion of the variables

Age: it is expected to be positively related. Farmer's age can generate or erode confidence

Household size; total household size is measured as a continuous variable .The lager the household the larger the labour that might be provided hence the household size is expected to increase the probability of adoption.

Level of education: Exposure to education will increase farmer ability to adopt process information and utilise it.

Farm size is an indicator of wealth and perhaps a proxy for social status

Credit: access to credit is expected to increase the probabilities of adoption. Measured as a dichotomous variable where accesses to credit is 0 and non-access 1

Livestock ownership is hypothesized to be positively related to adopt on of new technologies

Hire labored: ability to hire labour is also likely to increase the adoption of biofuels technologies especially sugarcane which is said to be labour intensive

Non-farm employment: an extra income is likely to increase the adoption of new technologies

Contact with extension officers: major source of information

Gender: it plays a part in terms of different adoption rate.it is measured as a binary variable 0 male and 1 female

Land tenure hypothesized to have either a positive or negative effect on the adoption depending on the opportunity the farmers perceive in a given tenurial arrangement/this had a dichotomous variable 0 farmer renting the land 1 farmers owning the land

Econometrics issues such as endogenity and measurement errors were addressed. The question of causality was addressed for example, household asset base to adopt in biofuels technologies because they have a large asset base or otherwise. To some extent both explanations hold to some degree, and may be the reason why some farmers are unwilling to adopt the technology. The same applies to other endogenous variables. The endogeneity issues were addressed by using lags of variables that are endogenous to reflect the farmer's information set at time t.

1.4 Results of the empirical model

This part of the section is not complete as these are still preliminary results. The survey is still under way .Data from sugarcane farmers is yet to be processed. Only Data from the 140 jatropha farmers interviewed shall be presented

Socio economic demographics characteristics

Results of the logistic regression model showed that the use of hired labour, age, and gender area planted contact with extension officers were statistically significant when it comes to adoption of biofuels technologies by jatropha farmers in Zimbabwe**.**

In trying to figure out the relationship between gender and adoption of biofuel technologies a cross tabulation was carried out. Of the 98 farmers who were adopters, 67 were male and 31 were female revealing that more male farmers were adopter as has been expected. Women are constrained with labour and tenure issues. These findings are consistency with the findings of CIMMYT (1993).

assessing whether the farmer has adopted jatropha or not * gender of the head Cross tabulation

Table 1.1

		gender of the head		
		male	female	Total
assessing whether the farmer has adopted jatropha or not	Yes	67	31	98
	No	32	10	42
Total		99	41	140

As highlighted earlier the level of education plays a part in adoption of biofuel technologies.to that end a relati was also established to assess the extent of adoption versus the level of education. The table 2 below show the relationship

Table 1.2

	level of education of the head					
	formal education	adult education	some primary education	completed education	vocational training	Total

assessing whether the farmer has adopted jatropha or not	ye s	23	14	29	27	5	
	no	13	5	9	10	5	
Total		36	19	38	37	10	

Age erodes the confidence of adopting or not to adopt.in this study it was found that it was mostly the middle aged going upward who were adopting jatropha .The younger generation is not interested in taking jatropha ,this may be explained by the fact that jatropha is not paying like other cash crops and the younger generation are interested in quick cash.

Table 1.3

		age of the head						
		0-20yrs	20-30yrs	30-40yrs	40-50yrs	50-60yrs	+60yrs	Total
assessing whether the farmer has adopted jatropha or not	Yes	1	1	14	34	35	13	98
	no	0	3	3	9	8	19	42
Total		1	4	17	43	43	32	140

Table 1.4:Assessing area allocated for jatropha and the probability of adoption

		area allocated for jatropha production			
		no jatropha	0-3ha	3-6ha	Total
assessing whether the farmer has adopted jatropha or not	Yes	0	96	2	98
	no	42	0	0	42
Total		42	96	2	140

Table 1.5: Assessing the type of agriculture equipment and how it influences adoption.

		What type of agriculture equipment do you have?			
		not applicable	(cart,wheelbarrow,cultivator)	plough	Total
assessing whether the farmer has adopted jatropha or not	Yes	38	59	1	98
	no	20	22	0	42
Total		58	81	1	140

Table 1.6 source of income and its influence on adoption of jatropha

		What is your number one source of income?				
		cropping	jatropha	livestock	employment	Total
assessing whether the farmer has adopted jatropha or not	Yes	88	1	6	3	98
	no	42	0	0	0	42
Total		130	1	6	3	140

Family labour has been found to be the most common form of labour available for jatropha production. This can be explained by the fact that most of the jatropha is being grown as a hedge or fence around the homesteads hence there little labour that is required.

Table 1.7

		What type of labour is easily available?				
		family	hired	communal	not at all	Total
assessing whether the farmer has adopted jatropha or not	Yes	76	12	3	7	98
	no	2	0	5	35	42
Total		78	12	8	42	140

Cross tabulations were carried out to determine the relationship between perceptions and adoption of growing jatropha for biofuels. Literature revealed that most of the studies tend to neglect to look at the perceptions of the farmers towards adoption of new technologies. It was against this background that this study sought to found out the perceptions of the farmers. Generally most of the farmers felt that the crop is good as it is environmentally friendly and helps to curb erosion. Others who had adopted jatropha felt it was good for income diversification .it was interesting to note that some were not adopting the crop as they perceive that crop was not supposed to be placed near homesteads as it is a snake hideout.

Table 1.8 perceptions of the farmers towards jatropha

		What are you perceptions about this project?					
		good for income diversification	helps to curb for erosion/environmentally friendly	the project success is insignificant	must not place near homesteads as it is a snake hideout	Cake can add fertility to the soil	goo the
assessing whether the farmer has adopted jatropha or not	Yes	19	40	9	7	6	
	No	2	9	9	14	2	
Total		21	49	18	21	8	

1.6 Conclusion

The Adoption of Biofuels in Southern Africa has been basically a knee jerk response to the fuel and environmental crisis. Such an analysis will shed light on the factors inducing or blocking adoption of biofuels .The asset base (physical capital, social capital, natural, human and financial capital) of the famer play a crucial role in adopting a technology. The study discovered that perception's towards a crop play a greater role in adoption of jatropha. Evidence from the results show that education, contact with extension agents, type of labour available , source of income, area planted are significant variables that influence biofuel technologies.

The study contributes to the empirical analysis of the determinants of new technologies adoption behaviour and it has implications for research and policy aimed at enabling faster and greater adoption of biofuel technologies. To increase adoption of biofuels technologies in Zimbabwe there is need for incentives and subsidies towards promotion of biofuels. A lot of burgeoning literature reveals that in USA and Europe were biofuels have prospered there has been a lot of subsidies and incentives. In Zimbabwe the selling price for jatropha is not appealing for one to take up jatropha. The findings demonstrated the need government and private organisations to promote and support adoption of biofuels technologies. Educating the farmers is of paramount importance as it tends to benefit the economy from improved farm management skills acquired by literate farmers.

References

Adesina and Zinnah.1993). Technology characteristics, farmer perception and adoption decision. A Tobit model application in Sierra Leone. Agricultural economics.

Adeogun, O,A ,.Ajana, M,O. Aynla,O,A Yaarhere, M.T and Adeogun, M,O. Application of logit model in Adoption Decision. A study of hybrid Clarias in Lagos state Nigeria,

Bakker, S. J. A. (2006) 'CDM and biofuels: Can the CDM assist biofuel production and deployment?' Energy Research Centre of the Netherlands (ECN).

Binswanger, H, (1978). The Economics of tractors in South Asia. An analytical review. INCRISAT.

CD4CDM (2007) 'CDM Pipeline Overview', March 2007, available at: http://cd4cdm.org/ (Accessed March 2012)

CYMMYT Economic program 1993. The adoption of Agricultural technologies. A guide to survey design, Mexico.

Dankyi,A, Anda, K, Moris , MM, Fisu,Y. (2005). Farmer Characteristics, ecological Zones and adoption decisions. A Tobit model application for maize technology in Ghana

Department of Science and Technology (2009).Republic of South Africa. Public Understanding of Biotechnology. A policy brief.

Economic commission Africa 2006.Suistainable Energy: A Framework for new and renewable energy in Southern Africa.

Easterly, W. and R. Levine (2001). "What Have we Learned from a Decade of Empirical Research on Growth? It's Not Factor Accumulation: Stylized Facts and Growth Models," World Bank Economic Review 15(2), 177-219.

Feder, G,.Just.ER,. And Zilberman, D(1985).Adoption of Agricultural innovation in developing countries. A survey economic development and cultural change 33:255-298

Hall, B. and B. Khan (2003). "Adoption of New Technology", NBER Working Paper No. 9730.

Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Synthesis Report, Summary for Policy Makers

Jacobson and Johnson. (2000).The diffusion of renewable energy technologies. An Analytical framework and keys issues for research. Energy Policy (625-640)

Mansfield, E.(1963). The speed response of firms to new techniques. Quarterly Journal of economics 77: 290-31

Negro.S.(2007) .The dynamics of technological innovation sysyems.The case of biomass. PhD thesis.

Negro.S and Hekkert.M 2010.Seven typical system failures that hamper the diffusion of sustainable energy technologies.

Nanyenja, N W, Mutetika, M,. and Mwangi, W,. 2001. An assessment of factors affecting adoption of maize technology in Igandya District, Uganda

Niringiye A. (2012). Determinants of technology Adoption in Ugandan Agricultural manufacturing firms.

Ragauskas, A.J., Williams, C. K., Davison, B.H. et al. 2006. The Path Forward for Biofuels and Biomaterials. Science 311:484-489

Pavlova, A. (2001). "Adjustment Costs, Learning-by-Doing, and Technology Adoption

Under Uncertainty," MIT Sloan Working Paper No. 4369-01.

Prescott, E. (1998). "Lawrence R. Klein Lecture 1997: Needed: A Theory of Total Factor

Productivity," International Economic Review 39(3), 525-551.

Peskett, L., Slater, R., Stevens, C. and Dufey, A. (2007)'Biofuels, Agriculture and Poverty Reduction' Paper produced for the DFID Renewable Natural Resources and Agriculture Team, ODI, London.

Rodgers E,M(1962): Diffusion of new innovations.

Sinja , J., Karuguia, J,.Balteneck, l,.(2004). Farmers percpetions of technology and its impact on technology uptake:the case of foder Legume in Central Kenya highlands.

Ministry of Energy, Power and Development. Zimbabwe Energy Policy 2007

Draft energy policy 2007.Ministry of energy and power development.

World Bank(2008). Global Economic Prospects 2008: Technology Diffusion in the

Developing World.