The Environmental and Social Sustainability of Biofuels: A Developing Country Perspective

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Introduction

The term biofuel refers to a "wide range of alternative transport fuels made from organic matter such as crops and agricultural residue".[1] The most commonly known forms are ethanol and biodiesel, and to a lesser extent methanol and biobutanol. While ethanol is largely made of starch plants including sugarcane and corn, biodiesels are made out of oil seeds like soybean, palm oil, rape seed and sunflower seed[2]. The two leading producers of ethanol are USA and Brazil, together accounting for around 79% of the world ethanol production.[3] The EU is a major producer of biodiesel, taking a share of around 89% of the global biodiesel production.[4] Within the EU, Germany takes the lead in biodiesel production.[5]

The production of biofuels, in particular ethanol and biodiesel, has grown extremely fast since the start of 2000. For instance, the volume of ethanol produced in the US has doubled between the years 2000-2005 and further

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[1] B. Childs and R. Bradley, *Plants at the pump: Biofuels, climate change and sustainability* (2008), p.9

[2] J. Cheng and G. R. Timilsina 'Advanced biofuel technologies: status and barriers', *World Bank Policy Research Working Paper*, No. 5411 (2010), p.2

[3] T. Harmer 'Biofuels subsidies and the law of the WTO', *ICTSD Issue Paper*, No. 20 (2009), p.3

[4] J. Von Braun, J. and R. K. Pachauri 'The promises and challenges of biofuels for the poor in developing countries', IFPRI Policy Paper (2007), p.3.

[5] Nuffield Council on Biofuels, Biofuels: Ethical Issues (2011), p.26.

tripled in 2005-2010.[6] Also, the production of biodiesel in the EU has grown fourfold between the years 2000-2005 and then threefold more in 2005-2010.[7] Such a rapid growth in the production and use of biofuels is expected to intensify in the years to come.[8]

Such recent intensification of biofuel production is not a purely market-driven incident. It is rather a result of policy choices by the EU, the USA and some other countries which are promoting the extensive use of biofuels to address national and global policy concerns. Under its 2003 Directive on biofuels, the EU sets a clear objective of promoting biofuel production so as to replace petroleum and diesel as transport fuel. Under same Directive, the EU sets two core policy goals which will be met through biofuel production - reducing green house gas (hereinafter GHG) emissions in the transport sector and decreasing dependence on imported energy.[9] In addition to these two mandates, a third policy goal of enhancing rural development through involvement of small and medium-sized enterprises is added to the biofuel mandate under a subsequent EU Directive.[10]

While the first mandate of reducing GHG emissions is part of the global climate change mitigation package, the second mandate (reducing dependence on imported energy) is more of a political economy concern at the national level. Given the fact that global energy consumption is growing, especially in emerging economies, and the price of oil is prone to shocks, domestic production of biofuels is considered to have a promise of reducing

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[6] Renewable Fuels Association, 'Climate of opportunity: 2010 ethanol industry outlook' (2010), p.6

[7] Nuffield, supra note 5, p.27.

[8] International Energy Agency, *World Energy Outlook 2010* (2010), p.9.

[9] The European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport, Directive 2003/30/EC.

[10] The European Parliament and of the Council on the promotion of the use of energy from renewable sources, Directive 2009/28/EC.

import bills and also improving energy security.[11] On the basis of these mandates, both the EU and USA set ambitious targets to expand biofuel production and use.[12] Other countries like Brazil, China and India also have set their own national target of boosting domestic biofuel use.[13]

Beyond setting consumption targets, policy interventions also extend in providing incentives for biofuel producers. As the production cost of biofuels is much higher than petroleum based fuels, major producing countries support their biofuel industries through the imposition of high tariffs on imported biofuels, provision of tax credit schemes, government loans and loan guarantees.[14] The global outlays on biofuel subsidies was estimated at around US$20 billion in 2009 which is projected to increase to US$45 billion in 2010-2020 and further to US$65 billion 2021-2035.[15] The EU takes a leading role in protecting domestic biofuel production through, among others, imposing a tariff of around US$1.10 per gallon of ethanol and 6.5% ad valorem duty on imported biodiesel, together with tax credits of different amount within each member state.[16] The US applies a duty of US$0.54 per gallon on imported biofuels and also provides tax credits of US$0.45 and US$1.00 per gallon of blended ethanol and biodiesel respectively[17].

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[11] D. Rajagopal, S. E. Sexton, D. Roland-Holst and D. Zilberman, 'Challenge of biofuel: filling the tank without emptying the stomach', *Environmental Research Letters*, Vol. 2, No. 4 (2007), p.2.

[12] While the EU intends to increase the share of biofuel consumption in the transport sector from 2.5% in 2007 to 5.75% in 2010 and further to 10% in 2020, the US aims to expand the amount of renewable fuel used for transport by 28.4 billion litters in 2012 and further by 136 billion litters in 2020, See US Energy Policy Act (2005); See also Directive 2009, supra note 10.

[13] Von Braun and Pauchauri, cited above at note 4, p.9.

[14] Harmer, cited above at note 3, p.4.

[15] International Energy Agency, supra note 8, p.10.

[16] D. Mitchell 'A note on rising food prices', *World Bank Policy Research Working Paper*, No. 4682 (2008), p.9

[17] Harmer, supra note 3, p.17.

In recent years, many developing countries, including Ethiopia, have followed the footsteps of the EU and US with the formulation of domestic biofuel policies and strategies which propagate the same policy goal of reducing GHG emissions, decreasing dependency on imported energy and promoting rural development through biofuel production and use.

In Ethiopia, a strategy document on Biofuel Development and Utilization was formulated in 2007 by the Ministry of Mines and Energy, later approved by the Council of Ministers, aiming to foster several policy goals of which main are: saving and earning foreign exchange, boosting rural development as well as reducing GHG emissions.

While countries are expanding the production of biofuels with the hope of fulfilling the above mentioned policy goals, sceptics are concerned about their intended and unintended consequences. Many criticise biofuels for causing further GHG emissions, a loss of biodiversity, rising food prices and many others. After identifying the particular dimensions through which biofuels can benefit and/or harm the environment and human welfare, this article aims to explore the stakes of developing countries in the biofuel business. It also looks at recent and expected developments in the biofuel industry towards a more sustainable biofuel production and how such developments can affect the interests of developing countries as suppliers of feedstock and potential biofuel producers.

This article is divided in to five main parts. The first part looks at the prospects and challenges associated with the first biofuel mandate of reducing GHG emissions. The second part is devoted to issues of energy security and the place of developing countries in the production and use of biofuels. The third part examines how developing countries can gain or lose out from biofuels in terms of rural development. Recent developments in

making biofuels more sustainable are covered under the fourth part. The last part offers conclusion and policy recommendations on how developing countries can benefit more from the prospects of biofuels and at the same time overcome the challenges. While most of the discussion in this article remains general to the case of developing countries, some specifics to the context of Ethiopia will be highlighted in relevant parts.

1. Are biofuels efficient solutions to environmental problems?

Promoting the clean environment agenda is one of the three policy goals that biofuel production is expected to fulfil. For instance, the EU regards increased use of biofuels as one mechanism of ensuring compliance with its commitment under the Kyoto Protocol.[18] However in recent years, there is an increasing doubt against biofuels as environmentally efficient sources of energy. While it is largely agreed that biofuels have certain environmental advantages compared to conventional fossil fuels, they also have their own environmental costs. The following two sub-sections briefly examine the prospects and challenges attached to biofuel production in fulfilling its clean environment mandate.

1.1. Environmental prospects

One of the most alarming environmental problems of the day is climate change, which is mainly a result of GHG accumulation in the atmosphere through emissions and a reduction of carbon sinks.[19] While 80% of total GHG emissions is attributed to CO_2 emissions from fossil fuels, the transport

[18] Directive 2003/30/EC, supra note 9
[19] Nuffield, supra note 5, p.17.

sector alone accounts for around 15% of such GHG emission[20]. In this context, biofuels are deemed to reduce GHG emission by replacing the use of fossil fuels in the transport sector which is generally considered carbon inefficient. Biofuels are characterized as carbon neutral because the carbon emitted from their use is considered as not being additional to the atmosphere but cyclical since biofuel feedstocks absorb carbon from the atmosphere while planted.[21] This is unlike fossil fuels which emit additional carbon as they are extracted from underground.

According to the US National Research Council, the use of corn-based ethanol is believed to reduce carbon emission by 12-19% compared to the emission level from gasoline usage.[22] The same research revealed that use of biodiesels made of soybean have a potential of reducing carbon emission by 41%. Accordingly some estimate that biofuels can contribute around 3% to the overall emission reduction plan with an increasing carbon saving prospect for the future.[23]

1.2. Environmental challenges

The characterization of biofuels as carbon neutral is opposed by some for it only takes in to account the carbon emitted during end use or combustion which is said to be lesser than the carbon absorbed by feedstocks that are used as biofuel input.[24] Such a calculation is, however, not comprehensive since there are several other channels, other than end use, through which biofuels can add to carbon emissions.[25] Hence, if all these channels are

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[20] B. Metz, O. R. Davidson, P. R. Bosch, R. Dave and L. A. Meyer (eds) *Climate change 2007: mitigation of climate change* (2007), p.105

[21] Childs and Bradley, supra note 1, p.10.

[22] Office of the Legislative Auditors, *Biofuel policies and programs* (2009), p.38.

[23] International Energy Agency, World Energy Outlook 2009 (2009), p.44.

[24] Nuffield, supra note 5, p.20

[25] Childs and Bradley, supra note 1, p.10.

properly accounted for, biofuels may no longer be carbon neutral. This sub-section looks at three of these channels through which biofuels can further carbon emissions.

1.2.1. Land use change

The one thing that most writers agree about biofuels is that it is a land intensive investment. The greater the percentage of biofuels in blends, as targeted by the EU, USA and other countries, the higher its production volume becomes and thus the pressure it puts on land.[26] According to an estimation made by the Organisation for Economic Co-operation and Development (hereinafter the OECD), it would take around 72% of EU's and 30% of USA's total agricultural land if these countries are to meet their target of replacing 10% of their transport fuel with biofuels – unavoidably necessitating changes in the existing usage and nature of land.[27]

The effect of biofuels on land use change can be either direct or indirect.[28] While direct land use change refers to the direct conversion of a land for planting biofuel feedstocks, indirect land use change involves conversion of a land for food production or another purpose which is indirectly triggered by biofuel production in other places.[29] An example of local level indirect land use change can be clearing of a forestland by farmers following displacement from their farmland due to biofuel production. Indirect land use change may also be trans-boundary in that increased biofuel demand or production in one

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[26] T. Searchinger, R. Heimlich, R. A. Houghton, F. Dong, A. Elobeis, J. Fabiosa, S. Tokgoz, D. Hayes and Tun-Hsiangyu, 'Use of US croplands for biofuels increases greenhouse gas through emission from land-use change", *Science,* Vol. 319, No. 1238 (2008), p.1238.

[27] OECD (2006) 'Agricultural market impacts of future growth in the production of biofuels', *Working Party Report,* AGR/CA/APM(2005)/Final

[28] Nuffield, supra note 5, p.32.

[29] Searchinger et al., supra note 26, p.1238.

part of the world can cause conversion of land use in another part through price effects.[30]

Indeed, the extensive production of biofuel feedstocks has a considerable effect in changing the nature of lands through deforestation, clearing of grass lands or use of uncultivated land, which in turn can cause further carbon emission from cut plants, reduction of the carbon storage capacity of lands and reduced biodiversity.[31] In terms of carbon balance, conversion of any form of land be it a forest area, grass land or even an abandoned land has the impact of increasing carbon emission, though of different magnitude. According to one study, the carbon emitted from biofuel-induced clearing of grasslands is estimated to be offset only after 93 years of ethanol use, while it requires 48 years of ethanol use to offset the carbon emitted from the use of an abandoned land.[32]

The consequence is even worse when it comes to deforestation that has several environmental implications beyond carbon emission. In this regard, recent intensification of deforestation in places like Brazilian Amazon and Indonesia is mainly attributed to rapid expansion of biofuel production in such places. A similar challenge had been evidenced also in some parts of Ethiopia with the allocation of environmentally protected areas for feedstock cultivation. A popular example can be the allocation of around 10,000 hectares of land for the production of castor oil seed, part of which land

[30] C. Bowyer, 'Anticipated indirect land use change associated with expanded use of biofuels and bio-liquids in the EU – An analysis of the national renewable energy action plans' (2010), p.4.

[31] Ibid

[32] Office of the Legislative Auditors, supra note 22, p.44

forms part of Babile Elephant Sanctuary, a home for several unique animal species.[33]

According to a report by the Food and Agriculture Organisation of the United Nations (hereinafter the FAO), land use for biofuel production in Latin America is estimated to further expand by 12.3 million hectares in 2030, all of which land is expected to come from forest conversion.[34] Also in Africa around 56% of the increase in land demand for biofuel production in 2030 is expected to be met by forest conversion. This indeed will directly contribute to deforestation and climate change, the welfare impact of which is more direct in developing countries where the livelihood of many poor is largely dependent on land and weather conditions.

Besides, those biofuel feedstocks with higher emission reduction potential, for instance soybean, require more land to grow, compared to other feedstocks like sugarcane which demand lesser land to grow but have minimal emission reduction potential[35]. As such, there is a clear trade off between the carbon saving potential and land impact of the different forms of biofuels.

1.2.2. Extensive use of chemicals

Beyond their carbon emission effect through land use change, biofuels can also increase GHG emission through extensive use of chemicals like that of nitrogen and phosphate for fertilization and pesticide[36]. Indeed most lands growing biofuel feedstocks are highly treated with nitrogen so as to ensure

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[33] BirdLife International, 'Fuelling the ecological crisis – Six examples of habitat destruction driven by biofuels' (2008), p. 4; See also Rajagopal et al, supra note 11, p.2.

[34] FAO, 'State of the world's forests' (2011), p.35.

[35] P. Al-Riffai, B. Dimaranan, and D. Laborde, 'Global trade and environmental impact study of the EU biofuels mandate', *IFPRI Study Report* (2010), p.35.

[36] Rajagopal et al, supra note 11, p.77.

high yields. According to the Department of Agriculture of the US, 95% of US corn production for ethanol uses nitrogen fertilizer.[37] This causes emission of nitrous oxide to the atmosphere which is one of the most powerful GHGs in its global warming potential.[38] The chemical intensive nature of feedstock farming is also susceptible of causing a reduction in soil and water quality which again is a very serious concern for many developing countries where majority of the population live in rural areas, mainly relaying on these natural resources for subsistence agriculture.

1.2.3. GHG emission in biofuel processing

Biofuel production is not only land and chemical intensive but also energy intensive. Although the process of converting biofuel feedstocks in to liquid fuel almost always requires some form of energy, the amount of energy demanded varies across different biofuels depending on the type of feedstock they employ as an input.[39] Whereas the process of converting grain to ethanol is estimated to consume around 2/3 of the energy it produces, biodiesel production from soybean and palm oil takes around 1/3 and 1/9 of their energy output, respectively.[40] While the amount of energy consumed in biofuel processing is a central issue in the debate on energy efficiency, what is even more important for the environment debate is the type of energy employed and the resulting carbon balance. Accordingly, while the use of coal in biofuel processing is estimated to have a negative carbon balance with 3% increase in net emission, utilization of natural gas and biomass is said to

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[37] Office of the Legislative Auditors, supra note 22, p.56.
[38] Nuffield, supra note 5, p.32.
[39] S. Kartha 'Environmental effects of bioenergy, in P. Hazel and R. Pachauri (eds) *Bioenergy and agriculture: promises and challenges*, IFPRI Focus Brief, Vol. 14 (2006), Brief 4 of 12.
[40] Childs and Bradley, supra note 1, p.11.

have a positive carbon balance of 28% and 52%, respectively.[41] In general, the net effect of biofuels in reducing GHG emissions appears very minimal given all the different channels through which it also contributes to carbon emission[42].

At the heart of the environmental problem with biofuels is the poor or none conduct of proper Environmental Impact Assessment (herein after EIA) which can allow host countries to make an informed decision on the environmental benefits and costs of biofuel production. Similar to many other developing countries, this problem prevails also in Ethiopia where many agricultural projects, including on biofuels, are either let off from their duties to conduct EIA or subjected to a lenient EIA procedure.[43] This is contrary to the Environmental Policy regime of the country and the EIA Proclamation No. 299/2002 - a strong legal regime requiring the carrying out of EIAs prior to implementation of investment project.

As the chart below shows, biofuels contribute the least to carbon saving when compared to other mitigation strategies including energy efficiency in end use, efficiency in power plants as well as use of nuclear power and other renewables.

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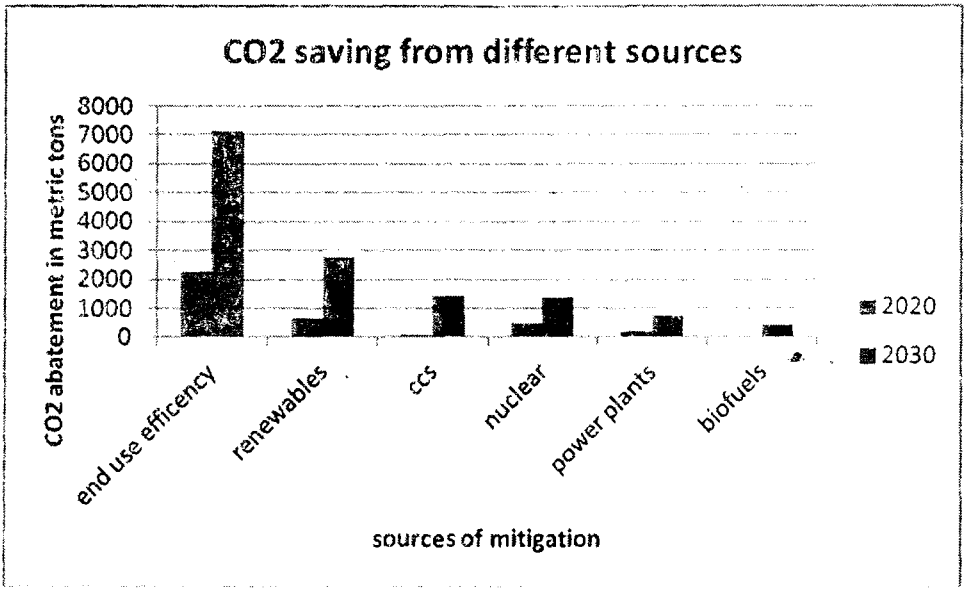
[41] Office of the Legislative Auditors, supra note 22, p.38-39.

[42] J. Franco, L. Levidow, D. Fig, L. Goldfarb, M. Honicke and M. Mendonca 'Assumptions in the European Union biofuel policy: frictions with experiences in Germany, Brazil and Mozambique', *Journal of Peasant Studies*, Vol. 37, No. 4 (2010), p.664.

[43] T. Anderson and M. Belay, 'Rapid assessment of biofuels development status in Ethiopia and proceedings of the national workshop on environmental impact assessment and biofuels'(2008), p. 28.



Source: World Energy Outlook, 2009

Given such minimal role biofuels play in reducing GHG emission, it is indeed questionable whether the clean environment mandate is the underlying policy drive behind extensive production of biofuels. The next section examines the second and perhaps the most sensitive policy goal for biofuel expansion – energy sovergnity and security.

2. Biofuels as a means to energy security: whose energy security?

Given their contentious role in reducing GHG emissions, the key role of biofuels can be seen to centre on their use as an alternative source of energy and thereby reducing the oil import bills of countries and contributing to improved energy security. With a rapid rise in economic growth and resulting industrial expansion and urbanization in emerging economies and some other developing countries, the global energy consumption is ever-increasing and is estimated to further grow by 71% by the year 2030 - developing countries

accounting to three-quarters of such growth.[44] Such increasing demand for energy, coupled with declining oil reserves and geopolitical factors surrounding oil production[45] have contributed to the volatile nature of oil prices with frequent spikes.[46]

In particular, the world has witnessed a significant hike in oil prices during 2004-2008, with oil price reaching US$145 per barrel in 2008, which according to the International Monetary Fund (hereinafter the IMF) signifies the beginning of a "period of increased scarcity of oil".[47] It is during this same period that the production of biofuels has intensified as an alternative transport fuel. This is essentially because biofuels are considered as relatively 'cheap' and 'reliable' sources of energy with a promise of reducing oil demand in the transport sector which now takes around 50% of the global oil supply.[48] The price trend especially during 2007-2008 has incentivised biofuel industries as oil prices have been well above the floor price at which biofuels can stay commercially viable – US$35 per barrel for ethanol from Brazil, US$55 for US ethanol and US$80 for EU biodiesel.[49] Whilst the price of oil has sharply declined after its peak in mid-2008, it again took a rising trend and has persistently stayed over $US80 per barrel as of beginning of 2011.[50]

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[44] US Department of Energy, International Energy Outlook 2006 (2006), p.7.

[45] Uncertainties in oil prices is partly attributed to strategic decision being taken by members of Organization of the Petroleum Exporting Countries (OPEC) to limit oil production well below their optimal production capacity causing global scarcity of oil and price hikes. See J. L. Smith "World oil: market or mayhem?", *Journal of Economic Perspectives*, Vol. 23, No. 3 (2009), p.150.

[46] Ibid.

[47] IMF, World Economic Outlook (2011), p.89.

[48] Id, p.96.

[49] J. Piesse and C. Thirtle, 'Three bubbles and a panic: An explanatory review of recent food commodity price events', *Food Policy*, Vol. 32, No. 2 (2009), p.127.

[50] IMF, cited above at note 47, p.89

Even if volatility and hikes in oil prices is a common concern for all oil importing countries, only few have taken the lead in the biofuel industry. In the year 2007, around 90% of the global biofuel production came from the US, Brazil and EU each respectively accounting 43%, 32% and 15% to the figure.[51] The remaining 10% was produced by China, Indonesia, Malaysia, Singapore, Argentina and Canada. The US and EU are not, however, just the biggest producers of biofuel, they are also the biggest importers. Brazil on the other hand is the biggest exporter of biofuel, followed by China, Indonesia, Malaysia and Argentina.[52] This is indicative of the fact that the demand and consumption of biofuels is relatively very high in the US and EU which indeed exceeds their domestic supply. Biofuel consumption is high also in Brazil which however falls within the domestic supply of the country. One can safely conclude that biofuel production is greatly dominated by few countries and its use is currently limited to these same countries.

Many developing countries, including Ethiopia, take part in the biofuel production process as suppliers of feedstocks, which is at the lowest level of the value chain. The share of developing countries in the export market for some biofuel crops like coarse grain and oilseeds is estimated to increase and even exceed the share of OECD countries in the years 2005-2017.[53] This is essentially because of a higher potential for yield improvement in many developing countries, especially in Africa, despite the general trend of declining yield improvement in most parts of the world.[54] Most African countries have a comparative advantage in feedstock cultivation also because of the relative abundance of arable land, inexpensive labour force and

[51] UNEP, 'Towards sustainable production and use of resources: assessing biofuels' (2009), p.34.
[52] Ibid.
[53] OECD and FAO, 'OECD-FAO Agricultural Outlook 2008-2017' (2008), p.24.
[54] UNEP, supra note 51, p.73

favourable climate in these countries. According to one study, expansion of biofuels and increasing demand for feedstock is estimated to require additional land of 18-36 million hectares in 2020 and further 19-44 million hectares in 2030, of which around two-thirds will come from developing countries.[55]

Ethiopia has already started tapping its potential with extensive cultivation of biofuel feedstocks both by foreign and domestic investors. According to some estimates, cultivation of biofuel crops in Ethiopia lately accounts for around 40% of the total land active in agricultural investment.[56]

Given the strong comparative advantage most developing countries have in producing feedstock, one may reasonably ask why these countries are not actively engaged in biofuel processing. This is partly because establishing new biofuel plants and building processing and distribution facilities require a huge amount of start up capital which is lacking in most developing countries.[57] Given the prevailing uncertainties in the oil market and related investment risks in the biofuel industry, potential biofuel processors may also seek some incentives from governments as is the case in the US, EU and other biofuel processing countries. Hence, biofuel processing is an area that is more suited for high capital foreign investment in developing counties provided appropriate incentives are availed by these countries.

Moving up in the value chain can provide developing countries with several opportunities including satisfying their increasing energy demand and thereby reducing oil bills: creating further employment opportunities in

[55] International Institute for Applied Systems Analysis, 'Biofuels and food security' (2009), p.29.

[56] T. Lavers "Land grab' as a development strategy? The political economy of agricultural investment in Ethiopia", *Journal of Peasant Studies*, Vol. 39, No. 1 (2012), p. 114.

[57] Id, p.41.

biofuel plants; and raising foreign earnings through export of a value added product. Brazil is a good example in this respect with its saving of more than US$100 billion from its import bill and creation of employment for around 1 million of its citizens after starting domestic processing of ethanol in the 1970's.[58]

Countries in sub-Saharan Africa, including Ethiopia, can especially gain the most from domestic processing and use of biofuels as energy prices are relatively very high in such countries, slicing a considerable share of their limited budget. As a net importer of fuel, Ethiopia for instance spends a great share of its financial resource on oil import which is estimated at around US$1.6 billion on the year 2007/08 - an outlay in excess of the country's total export earnings.[59]

Increased export earning is also the other benefit developing countries can gain from engaging in biofuel processing. According to the United Nations Conference on Trade and Development (hereinafter UNCTAD), developing countries could have increased their export earnings by a minimum of US$14.3 billion and maximum of US$294.2 billion in 2010 (based on different trade scenarios) if they exported a processed biofuel of an amount comparable to the feedstock they exported raw.[60]

Nonetheless, the markets of major biofuel importing countries are not all open for potential exporters. As stated in introductory part, both the EU and the US have several trade protectionist policies that favour local biofuel

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[58] J. R. Moreira, "Brazil's experience with bioenergy" in P. Hazel and R. Pachauri (eds) 'Bioenergy and agriculture: promises and challenges', *IFPRI Focus Brief*, Vol. 14 (2006), Brief 8 of 12

[59] Anderson and Belay, supra note 39, p.6; See also D. Mitchell, 'Biofuels in Africa: Opportunities, prospects and challenges' (2011), p.Xxi.

[60] UNCTAD, The biofuels market: current situation and alternative scenarios (2009), p.51.

producers. Though most developing countries, especially least developed countries, already have a preferred access to the US and EU markets and thus can do away with high biofuel tariffs, they will still lose their competitive advantage due to intensive subsidisation of biofuels in the EU and the US. This is essentially because the subsidies provided by the US and the EU are directly tied to production volume which thus have the effect of boosting domestic production and creating artificial reduction of prices, making it hard for unsubsidized biofuels from developing countries to compete on same level. Indeed according to UNCTAD, developing countries have a potential of raising their biofuel export earnings in 2020 by more than US$520 billion if export is made in the absence of EU and US subsidies. Such earnings will, however, reduce by more than twofold if the support measures continue to exist.[61] As such, it is clear that tariffs and subsidies can play a very restrictive or distortive role in the future export of biofuels from developing countries - posing a challenge to the attainment of developing countries' policy goal of increasing export earnings through biofuel processing and export.

Thus, while the prospect of developing countries to actively take part in biofuel processing highly depends on their capability to attract high capital investments, their prospect of effectively exporting biofuels to the US and the EU is reliant on liberalisation of biofuel policies in such major export destinations.

3. Biofuels and sustainable rural development: can the two go together?

The third and relatively less publicized policy goal of biofuels is the promotion of rural development. The EU aspires to meet this policy goal

[61] Ibid.

through involvement of small and medium-sized rural enterprises in biofuel production. Similarly, the Biofuel Development and Utilization Strategy of Ethiopia aims to advance rural development from biofuel production through different ways including through increased job opportunities in feedstock production, biofuel processing and marketing; through direct involvement of farmers in small-scale production of feedstock as well as through the creation of benefit sharing schemes between large-scale producers and small-scale farmers[62].

While it is true that biofuels do actually offer some opportunities for the rural population, they are also susceptible of having an adverse impact on rural wellbeing. This is an important concern in a developing country context where there is large and predominantly poor rural population. The next sub-sections explore three main dimensions through which biofuels can affect rural wellbeing in developing countries.

3.1 Food security

Production trends in the biofuel industry can easily affect the price of food commodities since biofuels largely depend on edible feedstocks as an input and also compete with food production for same agricultural resources. In fact, one of the most serious impacts of biofuels has been their impact on rising food prices. Following years of rapid expansion of biofuels, the world has faced a hike in the price of some important food commodities in 2007-2008. Such price hike was quite drastic as the global food prices were in a relatively stable trend for the preceding two decades.[63] Even though

[62] The Biofuel development and Utilization Strategy of Ethiopia, 2007, paragraphs 4.2, 5.3, 7.2.2.3 and 7.4.5.

[63] Piesse and Thirtle, supra note 49, p.119.

expansion of biofuels was not the only reason behind the price hike[64], it made an important contribution through its impact on the alteration of food demand and supply.

Despite a general consensus on the key role biofuels played in the soaring food prices during 2007-2008, there are different estimates on the exact contribution of biofuels to the price hike. According to the International Food Policy Research Institute (hereinafter IFPRI), biofuels contributed 39% for the total rise in the price of maize and around 20% for rice and wheat prices[65]. The IMF made a greater estimate where 70% of the rise in maize prices and 40% for soybean were attributed to biofuel production.[66]

Biofuels affect the price of food commodities through different channels including through an increase in the demand for food items that are used as biofuels inputs; a decline in supply of food commodities not used in biofuel processing but compete for same resources; and through consumption substitution.

On the demand side, increased biofuel production raises the demand for corn and oilseeds as they are intensively used in the production of ethanol and biodiesel. In fact, the biofuel industry is becoming the largest consumer of these feedstocks. For instance during 2007, one-third of US's total corn production was consumed by the ethanol industry.[67] Even if the global maize production grew by 55 million tons in 2007, the consumption of maize in the US ethanol industry alone increased by almost the same amount, unavoidably

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[64] Of the main drivers behind the price rise were low food stock to utilization ratio; increasing oil prices; declining value of US dollar; and speculation in food markets, Id, p.120-24.

[65] Al-Riffai et al., supra note 35, p.18.

[66] Lipsky in Mitchell, supra note 16, p.4.

[67] Piesse and Thirtle, supra note 49, p.127.

pushing the global price of maize upward.[68] Accordingly the global maize price increased by almost threefold during 2005-2008. The same holds true in the global oilseeds production, 7% of which was consumed by the biodiesel industry in 2007, contributing a part in the tripling of the price of palm oil and soybean during same period.[69]

On the supply side, biofuels affect the price of food commodities which are not used for biofuel processing, mainly through resource diversion. Expansion of biofuel production puts a pressure on agricultural resources, especially land and water, and thus reduces the availability of such resources for food cultivation. This in turn results in a decline in output and a rise in the price of those food items which compete with biofuels for same resource.[70] In the US for instance, the amount of farmland used for maize production increased by 23% during 2007-2008, causing a 16% decline of land available for soybean cultivation and consequently depletion of US's soybean stock by 75%.[71] Also increased planting of biodiesel oilseeds in major wheat exporting countries has attributed to lesser expansion of land for wheat production and thus a decline in total output and a rise in price of wheat.[72]

The third and more indirect channel through which biofuel production can cause a rise in food prices is through consumption substitution. As the price of one food commodity rises, consumers tend to shift their consumption patter and demand more of other substitute goods, bringing a second round effect on the price of substitutes. An example of this can be the increase in

[68] Mitchell, supra note 16, p.18.
[69] Piesse and Thirtle, supra note 49, p.127.
[70] Franco et al., supra note 43, p.672.
[71] Piesse and Thirtle, supra note 49, p.127.
[72] Mitchell, supra note 16, p.11.

demand and price of rice in 2007-2008 following the rising price of wheat and corn.[73]

With expansion of biofuels in the years to come, global food prices also are expected to stay higher. Such impact of biofuels on rising food prices has a considerable implication for food security in developing countries with a broader understanding of food security not just as the physical availability but also the economic and social accessibility of sufficient, safe and nutritious food.[74]

It is generally true that increases in the global price of food commodities may not be directly transmitted into developing country domestic markets because of market imperfection problems such as segmentation of markets and existence of non-traded food items. But to the extent it transmits, its welfare impact is very high. This is because a significant portion of household income in developing countries is devoted for food consumption and thus a rise in food prices can easily push households into a poverty situation.[75] According to a projection by Leturque and Wiggins[76] future expansion of biofuels to meet the 10% target will increase domestic food prices in sub-Saharan Africa only in a small amount compared to the price impact in the EU, North America, Latin America and South East Asia. However, the poverty impact will be highly felt in sub-Saharan Africa than other regions for the above mentioned reason.

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[73] Mitchell, supra note 16, p.13. Rice is neither used as biofuel feedstock nor cultivated in same regions where biofuel feedstocks are extensively harvested. Hence the rise in the price of rice is not directly linked to resource diversion.

[74] FAO, 'Trade reform and food security: conceptualizing the linkages' (2003), p.10.

[75] M. Ivanic and W. Martin, 'Implications of higher global food prices for poverty in low-income countries', *World Bank Policy Research Working Paper*, No. 4594 (2008), p.1.

[76] H. Leturque and S. Wiggins, 'Biofuels: could the south benefit?', *ODI Briefing Paper*, No. 48 (2009), p.2.

The impact of biofuels on food prices is of a particular concern for developing countries also because the price effect is particularly high on maize which is a staple food in many developing countries, especially in Africa, which thus takes a significant share of the total food expenditure.[77]

As such, biofuels pose some threat on the food security of poor populations in most developing countries by affecting both the physical availability and economic accessibility of food items. Nonetheless, it is also worth noting that increased biofuel production can positively affect the food security of rural poor by raising on-farm income and thus enhancing their purchasing capacity. This indeed is a real potential as a significant many of the rural population have farm-based livelihood, making possible the transmission of price effect into rural income. Yet, as it will be discussed under subsequent section, several bottlenecks are there limiting the transmission of increased price of farm outputs into rural income and food security. To make such transmission possible, there indeed is a need for the designing of right policy measures which can enable small-scale farmers to be key beneficiaries of the rising farm income as elaborated under subsequent section.

3.2 Rural income

Despite their impact on rising food prices, extensive production of biofuels and resulting rise in the price of feedstocks is mostly referred as having a positive impact for the rural poor through increased farm income and employment.[78] In most developing countries where a significant portion of the poor live in rural areas, increased farm income is considered central to a nationwide development and poverty alleviation. On this basis, some argue

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[77] Ivanic and Martin, supra note 75, p.20.

[78] P. Hazell and R. K. Pachauri, 'Bioenergy and Agriculture: Promises and Challenges', *IFPRI Focus Brief*, Vol. 14, (2006).

that even the effect of biofuels on increasing food prices is tolerable since such price effect will be offset by growing farm income.[79] Leturque and Wiggins[80] have quantified the potential increase in farm income with their estimate that the earnings of sugarcane and palm oil producers can raise from 5 or lesser US$ to 7-16 US$ per day by supplying for biofuel processors rather than selling them in traditional markets. However it is important to question the extent to which the rural poor are engaged in the production of biofuel feedstocks. This is because the net welfare impact of biofuels will be positive only if the rural poor earn a much higher income to cover their increasing food cost or else if they are net-food producers, which is mostly not the case.

Recent experiences from most developing countries, including Ethiopia, show that cultivation of biofuel feedstocks is mainly dominated by large-scale corporate farming and there is less opportunity for small farmers to directly benefit from biofuels.[81] It is becoming the norm for corporate producers to cultivate feedstock in large plantations, often in more than 10,000 hectares of land and sometimes going up to 500,000 hectares.[82] Hence, much of the increase in farm earnings directly goes to corporate producers and not small-scale farmers.

There are however few exceptional cases where small-scale farmers are well integrated in to the biofuel business. One case is in Brazil where more than 30% of sugarcane for ethanol production comes from around 60,000 small-

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[79] D. G. De La Torre Ugarte, 'Developing bioenergy: economic and social issues', in P. Hazel and R. Pachauri (eds) Bioenergy and agriculture: promises and challenges, *IFPRI Focus Brief*, Vol. 14 (2006), Brief 2 of 12.

[80] Leturque and Wiggins, supra note 76, p.3.

[81] Franco et al., supra note 43, p.676.

[82] K. Deininger and D. Byerlee 'The rise of large farms in land abundant countries: do they have a future?', *World Development*, Vol. 40, No. 4 (2012), p.702

scale farmers in the country.[83] Another case is in Mali where more than 4000 small-scale farmers supply jatropha to a foreign biofuel company through a contract farming arrangement wherein such farmers, through their union, also hold 20% share in the company.[84] Though the Biofuel Development and Utilization Strategy of Ethiopia aspires well integrate small-scale farmers and their cooperatives in the biofuel business through agricultural extension programs, no major achievement is recorded so far on the area.

Perhaps a more visible role of biofuel production in increasing rural earning comes through increased labour participation in large-scale feedstock plantations.[85] While the positive impact of increased labour participation on rural earning is quite undeniable, given the seasonal or irregular nature of employment conditions in most plantations, the net effect in terms of enhancing both rural income and sustainable livelihood can be more promising if small-scale farmers are directly integrated in to the supply chain.

3.3 Access to land

The land intensive nature of biofuel production and resulting land use change can be detrimental not only to the environment but also to the right of local people to have access to land.[86] This is an important concern in a developing country context where biofuel feedstocks are largely produced on large-scale commercial farms while a vast majority of local people lead a poor and land-based rural livelihood. In most developing countries land has several values in the life of rural populations, which goes much beyond its market value. It

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[83] Moreira, supra note 58.

[84] S. Vermeulen and L. Cotula "Over the heads of local people: consultation, consent and recompense in large-scale land deals for biofuels projects in Africa", *Journal of Peasants Studies*, Vol. 37, No. 4 (2010), p.902-03

[85] Franco et al., cited above at note 43, p.690-91

[86] Id, p.665.

is often a reflection of social identity; source of water, energy and grazing, as well as a means to have access to credit.[87]

According to IFPRI, between 15-20 million hectares of farm land in developing countries have been transferred to large-scale investors, mostly foreign, since 2006.[88] Increased biofuel production is one of the main drivers for recent intensification of large-scale land acquisition in developing countries, especially in sub-Saharan Africa.[89]

Because land is not subject to private ownership and purchase in most developing countries, including Ethiopia, transfers are largely carried out through long-term lease agreements negotiated and contracted between host governments and investors. In such cases, the interest of local people will be at stake as prior holders or users of the land. Lately, there is almost a general consensus on the principle that local people should be effectively consulted and compensated when a land they hold or use becomes a subject of investment transfer.[90]

However, because land holdings are not fully registered in many developing countries and customary land rights not formally recognized at all levels of government[91], local people are in reality vulnerable to displacement without consultation, compensation or other alternative arrangements. In case consultations are held, they are mostly meant to inform local people but not

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[87] Vermeulen and Cotula, supra note 84, p.900.

[88] Vermeulen and Cotula, supra note 84, p.902.

[89] K. Deininger, D. Byerlee, J. Lindsay, A. Norton, H. Selod and M. Stickler, 'Rising global interests in farm land: can it yield sustainable and equitable benefits?', (2011), p.51-53.

[90] FAO, IFAD, UNCTAD and The World Bank Group, 'Principles for responsible agricultural investment that respects rights, livelihoods and resources' (2010); See also AU, 'Land policy in Africa: A framework to strengthen land rights, enhance productivity and secure livelihoods' (2009).

[91] Deininger et al., supra note 89, p.99.

involve them in real decision making.[92] Yet, even in cases of transfer of 'marginal' or 'idle' lands which in the eyes of many host governments involve no displacement or harm on local people, the latter tend to suffer in terms of loss of grazing land and source of fuel wood, water and traditional medicine.[93] As such, large-scale land transfers for biofuel production can have an adverse impact on the socio-economic and cultural livelihood of rural populations, especially when land transfers are carried out in disregard of local concerns.

4. Towards environmentally and socially sustainable biofuels: sustainable solutions or technological fix?

The preceding parts have pointed out the major prospects and challenges biofuels bring. In recognition of the challenges, some developments are recently underway to ensure the environmental and social sustainability of biofuels. The prospect of producing biofuels in a more efficient manner and prevailing constraints to that are looked in to under the following sections on second-generation biofuels and the EU certification scheme.

4.1 Second generation biofuels

Second generation biofuels are advanced forms of biofuels which are made from feedstocks like switch grass, jatropha, agricultural residue or wood residue.[94] Their major difference from conventional or first generation

[92] Vermeulen and Cotula, supra note 84, p.913.

[93] J. Von Braun and R. Meinzen-Dick, " 'Land grabbing' by foreign investors in developing countries: risks and opportunities", *IFPRI Policy Brief*, No. 13 (2009), p.2.

[94] Cheng and Timilsina, supra note 2, p. 3.

biofuels is that they are not extracted directly from the edible parts of feedstock but from residues or wastes.[95]

These advanced forms of biofuels are considered both environmentally and socially more efficient than first generation biofuels as they are relatively less demanding in terms of land use, energy consumption and use of food stocks. For instance production of biodiesel from jatropha is believed to minimize deforestation and conversation of arable land for biofuel production since jatropha can be grown on a marginal or semiarid land with less competition against food production and biodiversity.[96] Also ethanol production from switch grass or cellulose is considered to enhance the energy efficiency of biofuels as it takes a considerably lesser energy to convert cellulose in to ethanol than converting corn or sugarcane.[97] The 4th Assessment Report of the Intergovernmental Panel on Climate Change regards the use of second generation biofuels as one of the strategic ways to increase the carbon efficiency of the energy sector in the future.[98]

Second generation biofuels are also efficient solutions to food security concerns since they neither use food stocks nor cause diversion of arable land from food production. Hence, they are assumed to not affect food commodities both in the demand and supply side.

Yet, even these advanced forms of biofuels are not as ideal as they are sometimes presented. There are several technical challenges attached to their production which can in turn limit their future expansion and prospect. For instance, conversion of cellulose in to ethanol involves a very complex process compared to the processing of corn or sugarcane, which makes the

[95] Nuffield, supra note 5, p.47.
[96] Von Braun and Pachauri, supra note 4, p.6.
[97] Childs and Bradley, supra note 1, p.20.
[98] Metz et al., supra note 20, p.60.

whole production process more expensive and thus economically less attractive to producers[99]. Besides the high cost of production, the economic viability of extracting cellulosic ethanol especially from agricultural residue which are land and carbon efficient is very much limited by low level of ethanol yield.[100] The same holds true for jatropha whose prospect for market expansion is highly limited by low yield, if it is to become land and environmentally efficient and grown on degraded land[101] as foreseen in biofuel policies of many countries including the Biofuel Development and Utilization Strategy of Ethiopia.

The above points are illustrative of the fact that the land and input efficiency of second generation biofuels does not come without a trade off. The productive or economic return of almost all second generation biofuels is quite limited, which makes it unlikely for such advanced forms of biofuels to replace the conventional biofuels any time soon, unless with intensive government subsidy or development of advanced technologies to improve yield. Hence where we stand now, much hope is placed on future agricultural and industrial technologies to fix the environmental efficiency and social sustainability of biofuels. A typical example of such a technological fix is the ongoing effort to produce biofuels from algae which is said to provide a high biodiesel yield, with no competition for land, but under a huge investment cost.[102] According to a recent estimate, investment for the production of advanced forms of biofuels involves a cost that is ten times higher than the cost of producing first generation biofuels[103]. This calls into question the

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[99] Nuffield, supra note 5, p.53.
[100] Cheng and Timilsina, supra note 2, p.13.
[101] S. Wiggins, J. Keane, J. kennan, H. Leturque, and C. Stevens, 'Biofuels in Eastern Africa: dangers yes, but much potentials as well', *ODI Project Briefing*, No. 66 (2011), p.2.
[102] Nuffield, supra note 5, p.56.
[103] VDB in Franco et al., supra note 43, p.677.

prospect, if any, of small-scale producers in such a technology and capital intensive future of biofuels and thus whether future biofuels can fulfil their mandate of enhancing rural development through inclusion of small and medium-scale producers.

4.2 The EU certification scheme

The second mechanism recently put in place to mitigate the challenges associated with biofuels has come from the EU, which belatedly recognised the unintended adverse impacts of biofuels on the environment and human welfare. Under its 2009 Directive on biofuels, the EU set up a certification scheme for the sustainable production of biofuels under which scheme eligibility for biofuel subsides and compliance certification are made conditional on the fulfilment of certain sustainability criteria by biofuel producers. These criteria are: contribution to reduction of GHG emission by at least 35%, and further by 50% in 2017 and 60% as of 2018; non-use of feedstock originating from a land that is rich in carbon stock or biodiversity holding (including wetlands, primary forests, wood lands, grass lands with high biodiversity and areas designated for protection of endangered ecosystems or species), and non-use of food stocks originating from peat lands.[104]

While this certification scheme of the EU is the first in its kind and a good move towards addressing the challenges associated with increased biofuel production, it is very much limited in its scope and aapplication.[105] To start with its general application, the scheme is very soft in that it has no direct effect of deterring unsustainable production of biofuels. While it certifies

[104] Article 17 of Directive 2009, supra note 10.

[105] M. Munting, 'De L'expansion des cultures pour biocarburanta dans les pays en developpement' (2010), p.XXXiX.

biofuels produced in a sustainable manner, it neither penalises nor restricts the sell or use of biofuels which are produced without fulfilling the sustainability criteria. One may argue that making sustainability of production a precondition for biofuel subsides already has a deterrent effect since the biofuel industry is heavily reliant on subsides. Even then, given the fact that subsides are provided only for domestic producers, the certification scheme fails short of regulating the sustainability of biofuels imported from other countries.

The certification scheme is also criticised for setting a very narrow list of sustainability criteria despite the far-reaching challenges biofuels pose.[106] To begin with, almost all the criteria address only environmental concerns and thereby ignore the social challenges associated with biofuel production including food insecurity and rural displacement.[107] However, a closer look at the criteria reveals that even the environmental challenges are not fully addressed under the scheme. For instance, by requiring the production of feedstocks on lands which are not rich in carbon stock or biodiversity, the scheme only regulates environmental problems associated to direct land use change and left out concerns of indirect land use change. Also, cases of direct land use change covered under the criteria are those dating after 2008. As per Article 17 of the EU Directive[108], a biofuel can be certified as sustainable if its feedstock comes from a previously forestland that however is converted for biofuel production before 2008. Hence, the certification scheme plays only a preventive role and does not redress pervious land use changes as it has no retrospective application.

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[106] Ibid.
[107] Ibid.
[108] Directive (2009), supra note 10.

In general, the ability of existing EU certification scheme to mitigate the unintended adverse impacts of biofuels is limited given its narrow scope of coverage and weak application. However, also the setting of high environmental and social standards by the EU can have a detrimental impact on the export capacity of small-scale producers especially those in developing countries.[109]

Conclusion and Recommendations

Both first and second generation biofuels have their own prospects and challenges in fulfilling the three core policy goals of reducing GHG emissions, ensuring energy security, and promoting rural development. Under the clean environment mandate, first generation biofuels have a carbon saving potential as they release no additional carbon during combustion. However such potential is rendered moderate by the direct and indirect emissions first generation biofuels cause during land use change and fuel processing. Second generation biofuels hold a much better carbon saving potential as they can be grown in marginal areas causing no threat of conversion of lands with high carbon storage capacity including forests and grasslands.

In relation to energy security, biofuels bring a prospect of reducing oil bills by serving as a cheaper and reliable alternative to traditional transport fuels. With the prevailing biofuel technology, first generation biofuels have a higher energy yield potential than advanced biofuels. Most second generation biofuels provide a very low energy yield if they employ marginal lands to cultivate feedstocks or use agricultural residues for processing. Recent trends show that only a few countries are largely producing and using biofuels as

[109] Wiggins et al., supra note 101, p.4.

alternative sources of energy, and developing countries have not yet taken full advantage of this opportunity for lack of high capital investment on biofuels.

There are some tradeoffs between the prospects of first and second generation biofuels when it comes to rural development. While first generation biofuels can potentially benefit rural populations through increased farm income, they at the same time cause a rise in food bills and loss of access to arable land. Second generation biofuels on the other hand are relatively neutral in terms of food prices and land usage; they however are capital and technology intensive and thus less accessible to developing countries as feedstock suppliers and small-scale biofuel producers.

Because of the dominance of large-scale plantations in feedstock cultivation, most developing countries have not yet capitalized on the prospect of first generation biofuels in increasing earnings of the rural poor. With dominance of large-scale corporate farming, small-scale farmers in the rural parts of developing countries tend to lose out from rising food prices and loss of access to land rather than grasping the opportunity of increased farm income.

As we stand now there is no clear insight as to how the biofuel business will progress in the future. But with the prevailing technology, second and third generation biofuels have a very low prospect of becoming commercially viable any time soon. Hence, first generation biofuels are expected to prevail in the market in the foreseeable future. On this basis, this article proposes the following policy recommendations to enable developing countries better benefit from biofuel prospects while overcoming the challenges:

A) With the aim of promoting the rural development dimension of biofuels, policy makers in developing countries will need to look for

possibilities of integrating small-scale farmers into the supply chain for biofuels. Contract farming or out-growers scheme can be one option where small-scale farmers supply their output to biofuel processors on the basis of a contract made a priori. This can be beneficial in terms of sustainable rural livelihood since small-scale farmers will retain control of their land holding and land-based livelihood as well as benefit from better access to agricultural inputs and knowhow.

B) Increasing the capacity of developing countries to also engage in biofuel processing is beneficial from the view point of both developing and developed countries. Developing countries can immensely benefit from engaging in biofuel processing through, among others, satisfying their increasing and costly energy demand, creating employment opportunities and increasing export earnings. Given the rising demand for biofuels and limited availability of land, there is already an import demand in developed countries which can be satisfied by efficient production in developing countries. But considering the need for huge capital and technology to start and run biofuel industries, developing countries may need to attract foreign investors or solicit for foreign partnerships. Here donor agencies can play a positive role in supporting infrastructural development in developing countries which is essential to facilitate production and distribution and hence attract foreign investors into the biofuel industry. This can also fall under the Aid for Trade framework at the multilateral level, which calls for a provision of technical and infrastructural support for developing countries so that they can take full advantage of global trading opportunities like the one from biofuels.

C) Also, the EU and the US may need to consider reduction of biofuel tariffs and excessive dependence of their biofuel industries on subsidies. Given the trade distortive nature of production subsidies, reduction or elimination of them will allow meaningful market access for biofuels coming from developing countries and also benefit the EU and the US with access to cheaper biofuels. Hence both developing and developing countries can benefit from a more liberal trade regime and resulting increased trade on biofuels. This should be seen as part of the broader move towards decoupling subsides from production volume under the World Trade Organization.

D) Policy makers in developing countries need to create a more favourable business environment for investments on biofuels. This includes provision of policy support or investment incentives such as allowing duty free importation of capital goods and giving temporary tax credits to facilitate establishment of industries (the nature of tax credit proposed here is different from the one being provided by the US and EU since it will only be available for new biofuel industries, without being tied to production volume).

E) Developing countries should also ensure clarity and stability of their policies on biofuels and investments in general which is an important factor to attract high capital investments.

F) Another thing policy makers in developing countries may need to consider is to promote the creation of synergies between biofuel industries and other sectors in the economy so that risks and uncertainties in the biofuel market can be reduced. In this respect, Brazil is a good example where most ethanol industries also engage in sugar production and generation of electricity thereby reducing

risks in the biofuel business.[110] Ethiopia has made a similar move where its major sugar factories are lately expanding into the production of ethanol.

G) Developing countries should also use proper regulatory policies and measures to reduce the potential adverse impacts of biofuels on the environment and human welfare. This may include:

i) Restricting the cultivation of biofuel feedstock only to lands that are less costly in terms of food production, biodiversity and rural livelihood and also regulating the intensity of chemicals applied on lands.

ii) Promoting the planting of energy and food crops in rotation.

iii) Setting safeguard schemes whereby feedstock produced as biofuel inputs may be exceptionally diverted into the local food market in times of severe food shortage (such an exception is already allowed under the World Trade Organization in relation to export ban).

iv) Ensuring that local people get effectively consulted and adequately compensated in unfortunate cases of displacement.

[110] Moreira, supra note 58.