Mechanisms for Driving Sustainability of Biofuels in Developing Countries

Jennifer A. Harrison, Graham P. von Maltitz,** Lorren Haywood,** Annie Sugrue,*** Rocio A. Diaz-Chavez**** and Jaime M. Amezaga**

The mandatory biofuel blending targets of the European Union (EU) have been influential in the establishment of a global biofuels market, as they are likely to be achieved through importation from areas with high potential for biofuel expansion, predominately parts of Africa, Latin America and Asia. Prospects of economic and rural development, fuel self-sufficiency and improved balance of trade, rather than climate change mitigation, typically attract these countries to biofuel production, despite the potential for extensive socio-economic and environmental impacts. A number of approaches aiming to optimise the outcomes from biofuel production have been put forward, including: market-based certification, national policy formulation, national legislation, impact assessments, sustainability planning, land use planning, research, monitoring and evaluation. In this paper the benefits, shortcomings and constraints of each are considered. It is concluded that: (i) sustainability of biofuel production cannot be entirely achieved through a single method, so aspects of all approaches are required; (ii) sustainability criteria are both country and project specific; (iii) the capacity to use different instruments varies between countries; and (iv) a tension exists between the stringent requirement for greenhouse gas mitigation from the EU perspective versus developing country requirements for economic and rural development. If the EU is determined to use certification to ensure the sustainability of biofuels, then it must invest in developing countries to support strong national policy and decision making as well as practical technology support, grants, transfer of skills and more.

I. Introduction

The sustainability of biofuels is a contentious and highly complex issue involving international, national and local concerns, particularly in light of the global debate over the impacts of biofuel cultivation on food prices. Climate forcing has tended to dominate the environmental sustainability debate, but for developing countries this is of less concern, with issues of economic and rural development being of far greater importance. For the foreseeable future, biofuels will be a land use option, so the debate is moving away from whether they should be promoted or not, and towards how to maximise their sustainability when they are proposed. Ensuring sustainability will require a raft of strategies, with no obvious panacea. This paper reviews various options for enhancing sustainability, highlighting current progress, strengths and weaknesses of the various approaches.

* Centre for Land Use and Water Resources Research, School of Civil Engineering and Geosciences, Newcastle University, UK, <j.a.harrison@ncl.ac.uk>; <j.m.amezaga@ncl.ac.uk>.

** Natural Resources and the Environment, CSIR, Pretoria, South Africa, <gvmalt@csir.co.za>; <LHaywood@csir.co.za>.

*** Department of Energy, Environmental Sciences and Geography, University of Johannesburg, South Africa, <annie@ecocity.org.za>.

**** Centre for Environmental Policy, ICEPT. Imperial College London, <r.diaz-chavez@imperial.ac.uk>.

II. Drivers and Consequences of Biofuel Development

Significant oil price increases over previous decades and scares concerning peak oil production have caused sufficient global concern that the use of alternative energy sources including modern forms of bioenergy, previously considered uneconomical, has been reassessed.[1] Considered a renewable resource as the feedstock is derived from different forms of biomass, biofuels are popular principally due to the fact they can easily be used in existing transport infrastructure, thus avoiding the need for major new investment.

For over a decade, the production and use of biofuels has been promoted by net energy consumers such as the European Union (EU). Expected benefits include increasing the share of renewable energy sources in line with global climate agreements, reducing dependency on fossil fuels and, initially at least, providing an assured market for farmers through domestic energy crop production with an expected boost to rural development. The EU's mandatory biofuel blending targets, which will increasingly be met through imports,[2] have been influential in establishing a global biofuels market.[3] The United States biofuels policy has also been globally influential, but for different reasons, as the main driver of the policy is energy security.[4] American import tariffs on ethanol, alongside substantial subsidies for domestic corn-based production, have rendered Brazilian ethanol, in particular, unable to compete despite being more cheaply and efficiently produced.[5]

Parts of Africa, Latin America and Asia have been identified as areas with high potential for biofuel expansion,[6] which has subsequently provided stimulation for feedstock cultivation and/or biofuel production in these regions. It is typically the prospects of national economic and rural development, foreign exchange, fuel self-sufficiency and an improved balance of trade, rather than climate change mitigation, that attract these countries to biofuel production.[7] The link between bioenergy generation and rural development outcomes are regularly reported.[8] It has been suggested that volatility associated with agricultural commodity prices could be reduced by the biofuels market, which may increase and stabilise demand from the traditional food, feed and fibre markets, thus reducing the risk for poor farmers.[9] As biomass is a flexible fuel source, it can meet a range of energy needs and be stored for longer-term fuel security, both of which are useful properties for local provision or export.[10] One of the oft-cited positive rural development outcomes from bioenergy projects is employment opportunities.[11] While employment alone can be a contentious development indicator, it is

1 Jane Earley and Alice McKeown, "Smart Choices for Biofuels", Joint Report of the Worldwatch Institute and the Sierra Club (2009), available on the Internet at <http://www.worldwatch.org/files/pdf/biofuels.pdf> (last accessed on 22 September 2010). See also WBGU (German Advisory Council on Global Change), *Future Bioenergy and Sustainable Land Use* (London: Earthscan Publications, 2009); International Risk Governance Council (IRGC), "Risk Governance Guidelines for Bioenergy Policies", Policy Brief of the IRGC (Geneva, 2008).

2 European Union (EU), "Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC", Official Journal of the European Union (2009). See also Alan Swinbank, "EU Policies on Bioenergy and their Potential Clash with the WTO", 60(3) *Journal of Agricultural Economics* (2009), pp. 485–503.

3 European Commission (EC), "The Impact of a Minimum 10 % Obligation for Biofuel use in the EU-27 in 2020 on Agricultural Markets – Impact Assessment Renewable Energy Roadmap", AGRI G-2/WM D (30 April 2007).

4 FAO, *The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities*, Food and Agriculture Organization of the United Nations Publication (Rome: FAO, 2008).

5 Richard Kessler, "US Lawmakers Seek Ethanol Tax Credits, Import Tariff Extensions", Recharge Article 30th March 2010, available on the Internet at <http://www.rechargenews.com/regions/north_america/article209816.ece> (last accessed on 22 September 2010).

6 FAO, *The State of Food and Agriculture*, *supra* note 4. See also Ed Gallagher, "The Gallagher Review of the Indirect Effects of Biofuels Production", Renewable Fuels Agency (2008), available on the Internet at <http://www.thebioenergysite.com/articles/107/the-gallagher-review-of-the-indirect-effects-of-biofuels-production> (last accessed on 22 September 2010).

7 Jane Earley, "Smart Choices for Biofuels", *supra* note 1, at p. 2. See also IRGC Policy Brief, *supra* note 1, at p. 2.

8 Julije Domac, Keith Richards and Stjepan Risovic, "Socio-Economic Drivers in Implementing Bioenergy Projects", 28 *Biomass and Bioenergy* (2005), pp. 97–106. See also Tilman Altenburg, Hildegard Dietz, Matthias Hahl *et al.*, "Biodiesel Policies for Rural Development in India", report from Deutsches Institut für Entwicklungspolitik (2008), available on the Internet at <http://www.compete-bioafrica.net/publications/publ/Endreport_ final_India2008.pdf> (last accessed on 22 September 2010).

9 Joy Clancy, "Are Biofuels Pro-poor? Assessing the Evidence", 20(3) *The European Journal of Development Research* (2008), pp. 416–431.

10 Ralph Sims and Nasir El Bassam, "Biomass and Resources", in Ralph Sims (ed.), *Bioenergy Options for a Cleaner Environment in Developed and Developing Countries* (Oxford: Elsevier, 2004).

11 IRGC Policy Brief, *supra* note 1, at p. 2. See also Domac, "Socio-Economic Drivers in Implementing Bioenergy Projects", *supra* note 8, at p. 3 and Amy Townsend, Billy Broas, Chelsea Jenkins and Kevin Ray, *Exploring Sustainable Biodiesel* (Atglen: Schiffer Publishing Limited, 2008).

commonly agreed that an increased number of wage earners has indirect social benefits in the local vicinity (multiplier effect).[12]

Despite the positive benefits mentioned, there are complex tradeoffs and numerous potential environmental and social concerns relating to biofuel production. Variables such as the type of feedstock and the farming model used for feedstock production, for example large-scale corporate-owned, mono-cropped plantations versus small-scale farmers with mixed cropping systems, can significantly alter the nature of the impacts and the sustainability potential.[13]

The actual climate change mitigation potential of biofuels has been hotly debated, with many studies suggesting marginal or even negative impact.[14] It has further been suggested that for some crops such as maize the energy required in feedstock cultivation may approach or exceed that from the biofuel, while in crops such as sugar cane and oil palm there are relatively large energy gains.[15] Direct and indirect land use changes can incur large carbon debts, particularly where deforestation occurs or peatlands are drained. Repayment can take hundreds of years depending on the efficiency of the biofuel crop and the amount of carbon released during land clearing. Oil palm plantations have been blamed for deforestation, peatland drainage and methane emissions; however, if planted on abandoned lands and appropriately managed it can rapidly repay its carbon debt.[16] Soybean has also been linked to large-scale direct and indirect deforestation and, since it has low yields, is very slow at paying back its carbon debt, though accounting for co-products greatly improves the GHG balance.[17] Brazilian sugarcane, when grown and processed in Brazil, has limited direct deforestation impacts and most lifecycle assessments suggest comparatively low carbon emissions.[18] In addition to carbon, other gases such as methane, N_2O and NO_x may also be released, or changes in albedo could occur as a consequence of biofuel production and use, all of which have climate forcing impacts.[19] In general, developing countries have low carbon emissions, with per capita emissions one to two orders of magnitude lower than those of developed countries.[20] Though most of these countries have contributed little to global carbon emissions, they are likely to be the most affected by climate change.[21]

Another issue of global concern is biodiversity loss.[22] Due to their typically tropical locations, developing countries tend to have higher biological diversity than developed countries, with the degree of transformation and biodiversity loss relatively

12 Lucia Elghali, Roland Clift, Philip Sinclair et al., "Developing a Sustainability Framework for the Assessment of Bioenergy Systems", 35 *Energy Policy* (2007), pp. 6075–6083.

13 Lorenzo Cotula, Nat Dyer and Sonja Vermuelen, "Fueling Exclusion? The Biofuels Boom and Poor People's Access to Land" (Rome and London: FAO and IIED, 2008).

14 Joseph Fargione, Jason Hill, David Tilman et al., "Land Clearing and the Biofuel Carbon Debt", 319 *Science* (2008), pp. 1235–1238. See also Royal Society, "Sustainable Biofuels: Prospects and Challenges", Policy document (2008); Timothy Searchinger, Ralph Heimlich, R. A. Houghton et al., "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land-Use Change", 319 (5867) *Science* (2008), pp. 1238–1240.

15 Searchinger, "Use of U.S. Croplands for Biofuels", *supra* note 14. See also, Isaias Macedo, *Sugar Cane's Energy: Twelve Studies on Brazilian Sugar Cane Agribusiness and Its Sustainability* (Sao Paolo: UNICA, 2005).

16 Fargione, "Land Clearing and the Biofuel Carbon Debt", *supra* note 14. See also Holly Gibbs, Matt Johnston, Jonathan Foley et al., "Carbon Payback Times for Crop-based Biofuel Expansion in the Tropics: The Effects of Changing Yield and Technology", 3 *Environmental Research Letters* (2008).

17 Fargione, "Land Clearing and the Biofuel Carbon Debt", *supra* note 14, at p. 4. See also Douglas Morton, Ruth DeFries, Yosio Shimabukuro et al., "Cropland Expansion Changes Deforestation Dynamics in the Southern Brazilian Amazon", 103 *Proceedings of the National Academy Sciences*, USA (2006), pp. 14637–14641.

18 Fargione, "Land Clearing and the Biofuel Carbon Debt", *supra* note 14, at p. 4. See also Gibbs, "Carbon Payback Times for Crop-based Biofuel Expansion in the Tropics", *supra* note 16, at p. 4; Isaias Macedo and Joquim Seabra, "Mitigation of GHG Emissions Using Sugarcane Bioethanol", in Peter Zuurbier and Jos van de Vooren (eds), *Sugarcane Ethanol: Contributions to Climate Change Mitigation and the Environment* (Wageningen: Academic Publishers, 2008); Delcio Rodrigues and Lucia Ortiz, "Case Study Sugar Cane Ethanol from Brazil: Sustainability of Ethanol from Brazil in the Context of Demanded Biofuels Imports by The Netherlands", available on the Internet at <http://www.sucreethique.org/Case-study-sugar-cane-ethanol-from> (last accessed on 1 April 2010); Edward Smeets, "Possibilities and Limitation for Sustainable Bioenergy Production Systems", PhD Dissertation (Utrecht: University of Utrecht, 2008); Edward Smeets, Andre Faaij, Iris Lewandowski and Wim Turkenburg, "A Bottom-up Assessment and Review of Global Bio-energy Potentials to 2050", 33 *Progress in Energy and Combustion Science* (2007), at pp. 56–106.

19 Hannes Schwaiger and Neil Bird, "Integration of Albedo Effects Caused by Land Use Change into the Climate Balance: Should We Still Account in Greenhouse Gas Units?", *Forest Ecology and Management* (In Press).

20 International Energy Agency, CO_2 Emissions From Fuel Consumption, 2010 Edition (Paris: OECD und IEA, 2010), available on the Internet at <http://www.iea.org/co2highlights/co2highlights.pdf> (last accessed on 12 October 2010).

21 Millennium Ecosystem Assessment (MA), "Ecosystems and Human Well-being: Synthesis" (Washington D.C.: Island Press, 2005) available on the Internet at <http://www.millenniumassessment.org/documents/document.356.aspx.pdf> (last accessed on 22 September 2010).

22 Lian Koh and David Wilcove, "Is Oil Palm Agriculture Really Destroying Tropical Biodiversity?", 1–5 *Conservation Letters* (2008), at pp. 1–14.

low due to low levels of industrialisation and agricultural development.[23] Current rates of deforestation, however, are alarmingly high in some developing regions, driven in part by biofuel expansion, though in other areas for reasons such as subsistence food production or energy needs.[24] Both direct and indirect land use change have biodiversity impacts, particularly so where virgin land is transformed. Even secondary forest and rangeland have extensive biodiversity that can be impacted. In some cases, however, feedstock cultivation may help reclaim degraded land and have an enhancing effect. A further biodiversity threat is that from the potential introduction of invasive alien plant species.[25] Though biodiversity conservation is of concern to most developing countries, and most are signatories to the UN Convention on Biological Diversity, it may have lesser importance than economic development given the pressing challenges of poverty eradication. Other reported environmental impacts include changes to water quality and quantity, water pollution and air pollution.

The social impacts of biofuels are complex, with positive benefits through both the promotion of national and rural development, and consequences for local livelihoods.[26] Most biofuel projects are recent and there is limited consolidated research on impacts. In addition, feedstocks such as oil palm, sugar cane or soybean are grown predominantly for food, so case studies on these plantations could relate to either food or fuel as end markets. Despite this, there are cases where adverse social impacts have been linked to specific biofuel projects. In particular large-scale, corporate, monoculture plantations would seem to have the potential to cause adverse social impacts when mismanaged.[27] Consequences have included people being removed from farmland, labourers needing to travel far and work long hours, leaving insufficient time for subsistence, or foreign workers being imported with resultant social cohesion tensions. The weak tenure arrangement in many developing countries means that individuals are particularly vulnerable to losing land or resources due to biofuel expansion.[28] Corrupt local authorities, including even traditional authorities, can exacerbate this by supporting biofuel development despite it having detrimental impacts on some community members. Some projects have been initiated with limited or no consultation with affected land users. In Tanzania, though community members have received compensation, it is argued that it is trivial compared to the value of the land.[29] Traditional forest dwelling communities in Malaysia and Indonesia have also been displaced by oil palm expansion.[30] Though biofuel production may create jobs, the jobs do not necessarily go to the displaced people, and in some circumstances total number of jobs may be actually reduced.[31] In addition, the labour is mostly unskilled and badly paid, though there are mixed reports on labour treatment. In Brazil, sugar growers receive higher wages than the agricultural norm, though sugar cane harvesting is low-paid in other developing countries.[32] Taking a national perspective, the

23 Millennium Ecosystem Assessment (MA), "Ecosystems and Human Well-being", *supra* note 21.

24 Morton, "Cropland Expansion Changes Deforestation Dynamics", *supra* note 17. See also Rudi Drigo, Bruno Lasserre and Marco Marchetti, "Patterns and Trends in Tropical Forest Cover", 143(2) *Plant Biosystems – An International Journal Dealing with all Aspects of Plant Biology* (2009), at pp. 311–327.

25 International Union for the Conservation of Nature (IUCN), "Guidelines on Biofuels and Invasive Species", (Gland, Switzerland: IUCN, 2009).

26 Cotula, "Fueling Exclusion?", *supra* note 13, at p. 4.

27 *Ibid*.

28 *Ibid*.

29 Emmanuel Sulle and F. Nelson, *Biofuels, Land Access and Rural Livelihoods in Tanzania* (London: IIED, 2009), available on the Internet at <www.iied.org/pubs/pdfs/12560IIED.pdf> (last accessed on 22 September 2010). See also Andrew Gordon-Maclean, Joseph Laizer, Paul Harrison and Riziki Shemdoe, "Biofuel Industry Study, Tanzania", World Wide Fund for Nature (WWF, 2008), available on the Internet at <http://files.theecologist.org/resources/E-INFO-WWF-TPO_Biofuel_Industry_Study_Tanzania.pdf> (last accessed on 22 September 2010).

30 Ben Phalan, "The Social and Environmental Impacts of Biofuels in Asia: An Overview", 86 *Applied Energy* (2009), pp. 521–529. See also Serge Marti, "Losing Ground: The Human Rights Impacts of Oil Palm Plantation Expansion in Indonesia" (London, Fife and Jakarta: Friends of the Earth, LifeMosaic and Sawit Watch, 2008), available on the Internet at <http://www.internal-displacement.org/8025708F004CE90B/(httpDocuments)/FA89FA0523761115C12574FE00480313/$file/losingground.pdf> (last accessed on 22 September 2010).

31 U. Bickel and J.M. Dros, "The Impacts of Soybean Cultivation on Brazilian Ecosystems: Three Case Studies", Report Commissioned by the WWF Forest Conversion Initiative (2003), available on the Internet at <http://assets.panda.org/downloads/impactsofsoybean.pdf> (last accessed on 22 September 2010).

32 Smeets, "Possibilities and Limitations for Sustainable Bioenergy", *supra* note 18, at p. 5. See also M. Assad, "The Labour Law in Brazil and its Application in the Sugar and Alcohol Sector", in Isais Macedo (ed.), *Sugar Cane's Energy: Twelve Studies on Brazilian Sugar Cane Agribusiness and Its Sustainability* (Brazil: UNICA, 2007), pp. 205–213; Worldwatch Institute, "Biofuels for Transportation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century" (2007), available on the Internet at <http://tinyurl.com/27fdjz> (last accessed on 22 September 2010); and International Centre for Trade and Sustainable Development (ICTSD), *Biofuel Production, Trade and Sustainable Development. ICTSD Policy Discussion Paper* (Geneva: ICTSD Programme on Agricultural Trade and Sustainable Development, 2008).

Washington-based think tank IFPRI published results from a modelling exercise indicating that biofuels can have significant positive impacts on economic growth and poverty reduction in Mozambique.[33] The possibilities of producing alternative crops may also contribute to the creation of new markets in developing countries as has been proposed in the PISCES project.[34]

A further key social concern relates to the suggested link between biofuel production and increasing global food prices, often termed the "food-fuel" debate.[35] Nationally, food security of the poor could be threatened as agricultural land or resources get diverted to biofuel production. Locally, low-paid wage labour may replace crop-growing activities, raising concerns that wage labour may not compensate for food security from previous household crop production.[36] The biggest impacts on food prices are reported to be high oil prices[37] and grain production decreases resulting in less excess (particularly in major exporting countries such as Australia and Canada[38]). The food-fuel debate is not clear-cut, with counter arguments that biofuels may stimulate rural economies and those of poor countries, which will in turn stimulate agricultural production. In addition, a rise in food commodity prices could stimulate developing world agriculture, which has been suppressed by subsidised food surplus exports from Europe and America.[39] In the case of West Africa, the region has the land, resources and demand to improve their agricultural and bioenergy production. It has been considered by the West African Economic and Monetary Union (UEMOA), that policy changes which improve agricultural productivity and include more arable land into sustainable use have the potential to improve food and fuel production. Furthermore, the use of waste and residues for bioenergy also helps to mitigate the fuel and food production problem.[40]

Assessing and quantifying the multitude of issues discussed in this section are major global priorities.[41]

III. Approaches to Driving Sustainable Biofuels

Market-based and legislative mechanisms, as well as research and monitoring, are considered as potential tools for ensuring sustainability of biofuel production. The advantages and constraints of these approaches are discussed below.

1. Market-Based Approaches: Certification

There has been a recent proliferation of certification schemes responding to concerns about the impact of biofuels.[42] Certification schemes cover a variety of issues, but none cover all issues or feedstocks on their own. Examples of voluntary certification schemes relating broadly to biofuels are: The Sustainable Agriculture Network (SAN) and Good Agricultural Practices (GAP) covering agricultural

33 Channing Arndt, Rui Benfica, Finn Tarp et al., "Biofuels, Poverty, and Growth: A Computable General Equilibrium Analysis of Mozambique", IFPRI Discussion Paper (2008), available on the Internet at <http://ideas.repec.org/p/fpr/ifprid/803.html> (last accessed on 22 September 2010).

34 Practical Action Consulting, "Small-Scale Bioenergy Initiatives: Brief Description and Preliminary Lessons on Livelihood Impacts from Case Studies in Asia, Latin America and Africa", Prepared for 'Policy Innovation Systems for Clean Energy Security' (PISCES) and FAO by Practical Action Consulting (2009).

35 The Gallagher Report, *supra* note 6, at p. 3. See also Royal Society Report, *supra* note 14, at p. 4; and Günther Fischer, Eva Hizsnyik, Sylvia Prieler et al., *Biofuels and Food Security* (Vienna: The OPEC Fund for International Development (OFID), 2009), available on the Internet at <www.gbv.de/dms/zbw/601706013.pdf> (last accessed on 22 September 2010).

36 Lorren Haywood, Graham von Maltitz, Kevin Setzkorn and Nicholas Ngepah, "Biofuel Production in South Africa, Mozambique, Malawi and Zambia: A Status Quo Analysis of the Social, Economic and Biophysical Elements of the Biofuel Industry in Southern Africa", CSIR Oxfam draft report, NRE (Pretoria: CSIR, 2008).

37 S. Pfuderer, G. Davies and I. Mitchell, *The Role of Demand for Biofuel in the Agricultural Commodity Price Spikes of 2007/08*, Annex 5, Report of the Global Food Markets Group and the Defra Agricultural Economics Panel (2010), available on the Internet at <http://advancedbiofuelsusa.info/the-role-of-demand-for-biofuel-in-the-agricultural-commodity-price-spikes-of-200708> (last accessed on 22 September 2010).

38 FAO, "The State of Food and Agriculture", *supra* note 4, at p. 3.

39 Cotula, "Fueling Exclusion?", *supra* note 13, at p. 4. See also Andrea Rossi and Yianna Lambrou, *Making Sustainable Biofuels Work for Smallholder Farmers and Rural Households: Issues and Perspectives* (Rome: FAO, 2009), available on the Internet at <http://www.fao.org/docrep/012/i0891e/i0891e00.htm> (last accessed on 22 September 2010).

40 The West African Economic and Monetary Union (UEMOA), *Sustainable Bioenergy Development in UEMOA Member Countries*, UEMOA and the Hub for Rural Development (2008).

41 Royal Society Report, *supra* note 14, at p. 4. See also Rossi, "Making Sustainable Biofuels", *supra* note 39.

42 Jinke van Dam, Martin Junginger, André Faaij et al., "Overview of Recent Developments in Sustainable Biomass Certification", 32 *Biomass and Bioenergy* (2008), pp. 749–780.

production; the Forest Stewardship Council (FSC) targeting forestry; and Fairtrade labelling focusing on labour aspects and pricing. Within the biofuels sector a number of initiatives have been founded: the Round Table on Sustainable Palm Oil (RSPO) focuses on all palm oil products, biofuels specifically were added later; the Round Table on Sustainable Biofuels (RSB) is a generic standard covering all first-generation feedstocks but limited to liquid biofuels; the Round Table on Responsible Soy (RTRS) focuses on soy; and the Better Sugar Cane initiative (BSI) addresses issues relating to sugar cane cultivation.

National standards have also been developed. In the UK the Renewable Fuels Agency started to verify imported biofuels under the Renewable Transport Fuel Obligation from April 2008,[43] though it was actually the world's first operating system. The Dutch government initiated the Cramer Committee for Sustainable Production of Biomass in 2006, which produced the Cramer criteria intended to increase the sustainability of biofuels. The German government released its Biofuel Quota Law in 2007, whereby a biofuel only contributes to the quota if it satisfies requirements. The California Low Carbon Fuel Standard focuses on carbon emissions in an attempt to reduce overall transport emissions. The European Commission (EC) published its Renewable Energy Directive (RED) in June 2009 mandating that 10 % of energy used in transport be renewable by 2020. The biofuel target was the most controversial, with concerns raised regarding the impacts of biofuels and the need to ensure that they meet certain requirements.[44] As a result of the controversy, the issues are still being debated and the EC intends to report on ways to mitigate impacts by the end of 2010. The main focus of the RED sections dealing with biofuels is to prevent loss of biodiversity, avoid using land with high carbon content and achieve greenhouse gas (GHG) emission reductions. The social and economic impacts of most standard schemes refer to working conditions (wages, child labour, child and forced labour), land use rights, health and safety, and gender. Some aspects of criteria may be of greater relevance in developing countries (such as Brazil and a number of African countries). Some, however, also apply to EU Member States, particularly from Eastern Europe.[45] There are technical standards of biofuel characteristics in Europe (CEN standards) and work was initiated on CEN (European Committee for Standardization) sustainability standards as well as another initiative from the International Standards Organisation (ISO).[46]

There are pros and cons to certification schemes. It has been stated that "certification is an economically sound tool to tell products apart with different attributes".[47] Proponents also acknowledge that a certified product can show that a specific goal was achieved, but it does not protect against any of the issues on a country-wide basis. For example, while certification of one operation means that child labour was not used in the production of that specific biofuel, it does not mean that child labour is absent in the country.[48] This can be extrapolated to include other issues such as deforestation, food security or biodiversity loss. One of the most controversial issues in the biofuel debate is that of indirect land use change (iLUC) impacts, which can have consequences for global and local economies, food prices, carbon emissions and biodiversity.[49] Most certification schemes do not have the capabil-

43 The Renewable Transport Fuel Obligations Order 2007 (2007 No. 3072) ("the RTFO Order") legally obliges fossil fuel suppliers for road transport to produce Renewable Transport Fuel Certificates (RTFCs) demonstrating that an amount of renewable fuel has been supplied which is equivalent to a specified percentage of their total fuel sales.

44 The Gallagher Report, *supra* note 6, at p. 3.

45 Rocio Diaz-Chavez and Frank Rosillo-Calle, "Biofuels for Transport- Sustainability and Certification: Where We Are Now and Where are We Going – A Short Review", The New International Energy Agency (IEA) Bioenergy Agreement Task 40 on: 'Sustainable International BioEnergy Trade: Securing Supply and Demand', Report for the Department of Transport, UK (2008).

46 Rocio Diaz-Chavez, "BEST Sustainability Report", EU Funded Bioethanol for Sustainable Transport (BEST) Project (2010), available on the Internet at <http://www.best-europe.org/default.aspx?id=3> (last accessed on 22 September 2010).

47 Ricardo Hausmann and Rodrigo Wagner, "Certification Strategies, Industrial Development and a Global Market for Biofuels", Discussion Paper 2009-15 (Cambridge, Mass.: Belfer Center for Science and International Affairs, October 2009), available on the Internet at <http://www.hks.harvard.edu/var/ezp_site/storage/fckeditor/file/pdfs/centers-programs/centers/cid/publications/faculty/articles_papers/hausmann/Hausmann_Wagner_Biofuels_Certification_2009_web.pdf> (last accessed on 22 September 2010).

48 *Ibid*.

49 Bart Dehue, Jaspar van de Staaij and Jessica Chalmers, "Mitigating Indirect Effects of Biofuel Production: Case Studies and Methodology", Ecofys report for the UK Renewable Fuels Agency, RFA, (2009). See also Klaus Hennenberg, Christine Dragisc, Sébastian Haye et al., "The Power of Bioenergy-Related Standards to Protect Biodiversity", 24(2) *Conservation Biology* (2010), pp. 412–423.

ity to include iLUC impacts and the need to do so has been globally identified.[50] iLUC issues are best addressed globally to avoid leakage, but this becomes difficult when many of the countries involved suffer from weak governance. The EU and RSB are trying to work out ways in which to assess iLUC factors, and the topic is under review by different European and American organisations including the Global Bioenergy Partnership (GBEP).

Certification is most effective in an environment where other related laws and policy already exist, as to achieve national or global sustainability of biofuels requires a range of local and global policy inputs. Hausmann[51] argues that the best way to protect forests might be to pay people to protect them, rather than certifying products that have avoided deforestation. Where state capacity is weak, however, certification schemes requiring significant measurement and assurances could bias industrial development against poor countries. Experts have cautioned that too many standards could constrain the development of a global biofuels market.[52] Where governance is weak, certification needs to be stringent to ensure that the product has achieved the goals of certification. The RSB has developed an approach to deal with the risk factors of certifying in countries with poor state regulation. Its self risk assessment considers factors such as land tenure, state governance and food security status. If the producer is operating in an environment with weak state governance, high food insecurity and risky land tenure, for example, they will fall into a higher risk category. The outcome of being in a higher risk category is that more frequent auditing is required, resulting in higher costs. In addition, reliable indicators are proving difficult to identify, and performance-based indicators require measurement by producers in the absence of accurate in-country databases. This acts as a producer tax in higher-risk countries, potentially making them uncompetitive against more favourable environments. This may be unavoidable if the integrity of the certification process is to be retained and its goals achieved.

Two further issues of concern to developing country producers are biodiversity protection and GHG assessment requirements, both of which are important global concerns. It is argued in many international fora that developed nations should pay for biodiversity protection in developing countries.[53] Conversely, certification schemes require operators to maintain biodiversity at a cost to the producer. Like GHG emissions schemes, some biofuel certification schemes and governments require producers to measure and report on their emissions. Limits are generally defined; requiring the biofuels to match, or improve on, emissions from fossil fuels. If the biofuel does not meet these requirements it cannot be used to fulfil quotas, such as UK, German or EC mandates. Compliance may have certain financial benefits in markets like the EU, but if these do not offset the additional costs accrued to comply, the producer may be unfairly disadvantaged.[54] If producing for national or less-regulated markets, however, these concerns become less relevant and the strength of certification in addressing global environmental concerns is limited. Under the United Nations Framework Convention on Climate Change (UNFCCC) developing nations are not required to reduce their GHG emissions, thus certification schemes may go beyond what is considered fair under international treaties.

50 Nadine McCormick and Andrea Athanas, "Reducing the Risk of Indirect Land Use Change: Credible Landscape Planning as One Meaningful Approach", International Union for the Conservation of Nature (IUCN) Discussion Paper (2010), available on the Internet at <http://cmsdata.iucn.org/downloads/iucn_on_iluc_4_february_2010.pdf> (last accessed on 22 September 2010). See also John Mathews and Hao Tan, "Biofuels and Indirect Land Use Change Effects: The Debate Continues", 3 *Biofuels, Bioproducts and Biorefineries* (2009), available on the Internet at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.167.2652&rep=rep1&type=pdf> (last accessed on 22 September 2010), at pp. 305–317.

51 Hausmann, "Certification Strategies", *supra* note 47, at p. 10.

52 John Devereaux and Henry Lee, "Biofuels and Certification: A Workshop at Harvard Kennedy School", Discussion Paper 2009-07 (Cambridge, Mass.: Belfer. Center for Science and International Affairs, June 2009), available on the Internet at <http://belfercenter.ksg.harvard.edu/files/Biofuels%20and%20Certification%20Harvard%20Workshop%20Report%2009%20web.pdf> (last accessed on 22 September 2010).

53 Brendan Fisher and Christopher Treg, "Poverty and Biodiversity: Measuring the Overlap of Human Poverty and the Biodiversity Hotspots", 62(1) *Ecological Economics* (2007), available on the Internet at <http://www.aseanbiodiversity.info/Abstract/51007255.pdf> (last accessed on 22 September 2010), at pp. 93–101. See also David Huberman and Louise Gallagher, "Developing International Payments for Ecosystem Services: Towards a Greener World Economy", International Union for the Conservation of Nature (IUCN) and United Nations Environment Program (UNEP) Payment for Ecosystem Services brochure, available on the Internet at <http://www.cbd.int/doc/external/unep/unep-iucn-ipes-brochure-en.pdf> (last accessed on 22 September 2010).

54 Hausmann, "Certification Strategies", *supra* note 47, at p. 10.

Some of the shortcomings of certification, such as a requirement for a broad countrywide rather than a project-based approach to sustainability, could be overcome if the majority of producers in a country participate. Thus, issues such as land use change, protection of high conservation value areas and retention of sufficient land for food production, would be dealt with at a broader, more efficient level. However, to achieve this requires strategic regional planning that goes beyond the planning boundary of individual projects. It is unlikely that any but the larger developing nation producers will participate as the costs of certification are high. Additionally, the market is currently being driven by wealthy nations with a stronger environmental focus than developing nations, which focus more on social issues, i.e., job creation and improved livelihoods. It is notable, however, that poor countries are using the sustainability criteria developed by the voluntary certification schemes to inform policy. The Southern African Development Community (SADC), for instance, has developed a draft set of sustainability criteria, largely based on those of certification schemes.[55] Enforcement will nonetheless require the development of supporting policy and legislation across the various sectors, including labour, water, agriculture, forestry and land. Countries with weak state governance may be tempted to require producers to participate in certification schemes, thus offloading the regulatory requirements. If this occurs too early in the development of the biofuel industry, it could prevent the sector from growing. Conversely, if the sector is not regulated soon, the damage to forests, biodiversity and livelihoods could be irreversible.

2. Legislative Approaches

Ideally, national legislation should be the key driver of a country's sustainable biofuel development. As discussed below, however, the national legislative route is often insufficient in developing countries because of weak governance and inability to enforce in some countries. Legislation should reflect national priorities and be country-specific, in principle ensuring that national priorities are met. This section will consider general legislation, the development of specific biofuel policies and specific instruments including impact assessments and land use planning.

a. National Legislation

Biofuel development raises issues cutting across numerous sectors and departments. Table 1 shows different legislation applicable to the biofuels sector, much of which are generic; however, legislation referring specifically to biofuels, and in particular strategic plans for biofuel, should also be introduced (see below). Legislation typically operates by providing incentives and disincentives, though it could also be used to formalise processes such as strategic environmental assessment or land use zoning. Most countries have extensive legislation to which biofuel projects should be adhering as a first priority, but there are nevertheless legislative gaps that developers could exploit. A critical weakness in many developing countries is land tenure legislation; in many cases large land tracts are in customary or national tenure with land users having weak, or no, tenure rights.[56] Tenure reform is proposed or ongoing in a number of countries but remains a key issue. The rights of minority groups, such as forest dwelling communities, who often receive insufficient legal protection are also linked.[57] In cases where the legal aspects of land tenure are in place, enforcement is crucial to protect these rights.[58] Biofuel is an emerging sector, bringing new challenges that may not be fully covered by existing legislation. It is therefore appropriate to develop specific policies guiding its development, taking into account national priorities.

National legislation, as a mechanism for ensuring sustainable biofuel production, may suffer other limitations when used as a mechanism to drive sustainability in developing countries. These include:

– The inability of some countries to enforce legislation.

55 Southern African Development Community (SADC), "SADC Framework for Sustainable Biofuel Use and Production", available on the Internet at <http://www.probec.org/fileuploads/fl06022010194145_SADC_framework_for_sustainable_biofuels_2010.pdf> (last accessed on 30 September 2010).

56 Cotula, "Fueling Exclusion?", *supra* note 13, at p. 4. See also Sulle, "Biofuels, Land Access and Rural Livelihoods", *supra* note 29, at p. 6.

57 Phalan, "The Social and Environmental Impacts of Biofuels", *supra* note 30, at p. 7. See also Marti, "Losing Ground", *supra* note 30, at p. 7.

58 Rocio Diaz-Chavez, "Good Practices Principles", COMPETE Project (2010), available on the Internet at <http://compete-bioafrica.net/bestpractice/bestpractice.html> (last accessed on 22 September 2010).

- Ineffective, dictatorial or corrupt government, i.e., not representing national interests, or those of minority groups.
- Corruption of government officials allowing inappropriate investment, or condoning bad management practices. Bribery of government officials involved in granting development permits is a key issue of concern, especially in countries with poor checks and balances.
- Lack of capacity to formulate appropriate legislation.
- Slow and difficult processes for updating legislation. For instance, biofuel projects in many African countries have preceded relevant policy development.
- Difficulties in developing policy operating across ministries, and ministry-level vested interests.
- Potential conflicts between national policy imperatives and local community rights and needs.
- Insufficient public participation in policy formulation, and/or poorly constituted, disempowered civil society pressure groups.

b. Development of National Biofuel Policies

Given the vast quantities of available arable land, labour and favourable climatic conditions, some African, Latin America and Asian countries are targeted for biofuel feedstock production. Different areas within these regions are underdeveloped, with sub-Saharan Africa having 34 of the 50 poorest countries, characterised by low income, low production, poor markets, low skills, poor access to information and high child mortality.[59] In addition, traditional biomass is used extensively in all three regions. Biomass accounts for 5 % of North African, 15 % of South African and 86 % of sub-Saharan (minus South Africa) consumption.[60] With notable exceptions such as Brazil, countries in developing regions place low emphasis on the global drive for renewable energy. Instead, key drivers include providing affordable domestic and industrial energy sources or the stimulation of economic growth,[61] such as in India where biofuel development has been used primarily to drive rural development and secure internal energy supplies.[62] There has been

Sector	Issues
Environment	– Impact assessments (these should be mandatory for any large-scale land use change or large industry development) – Strategic Environmental Assessments (should be mandatory before an industry sector is introduced) – Pollution legislation (including climate change) – Biodiversity legislation – Greenhouse gas emissions
Agriculture, rural development, forestry and social	– Soil conservation – Land transformation – Agricultural-forestry zoning – Invasive alien species introductions – Subsidies and incentives – Norms and standards – Forestry policy – Livelihood protection – Food security – Outgrower schemes
Investment and treasury	– Forging investment policy – Tax policy – Strategic growth strategies – Import export policy
Industry	– Industry norms and standards – Company legislation
Labour	– Labour wages – Labour conditions – Child labour – Gender equity – Mechanisation and labour intensity
Land tenure	– Security of tenure
Energy	– Fuel blends – Petroleum standards – Energy content
Water	– Water rights – Catchment hydrology – Stream flow – Pollution – Strategic allocation (e.g., agriculture vs. human need)

Table 1. Examples of Key Legislation that have Applicability to the Biofuel Sector and Issues of Concern that could be Addressed in the Legislation. Source: Authors.

59 UNFPA, "Country Profiles for Population and Reproductive Health: Policy Developments and Indicators" (2005).

60 Energy Information Administration, U.S. (EIA), "Short Term Energy Outlook: Africa" (2008), available on the Internet at <http://www.eia.doe.gov/emeu/cabs/chapter7.html> (last accessed on 22 September 2010).

61 Robert Mangoyana, "Bioenergy for Sustainable Development: An African Context", 34 *Physics and Chemistry of the Earth* (2009), pp. 59–64.

62 Avrind Reddy and Sunandan Tiwari, "A Review of the Indian National Biofuels Policy", report for Re-Impact project ENV/2007/114431 (2010).

an Indian Biofuels Programme for over 60 years, and it was among the first countries to develop a specific biofuels policy, which, though delayed in draft stages, was finally published in December 2009.[63] Most of the national energy policies/strategies within African countries have been developed over the last five years, with many still in the process.[64] Biofuels do not feature prominently in many energy policies or national development frameworks, either being mentioned only in passing or discussed under broad areas such as renewable and non-renewable energy sources.[65] Only in the last few years has large-scale biofuel production been seriously considered in developing regions, and this is mainly a result of pressure from foreign investors. Many developing countries are extremely underprepared due to the lack of legislation and regulation around renewable energy, thereby rendering them unable to protect their natural resources and citizens' interests when foreign investors embark on large-scale biofuel exploitation.[66]

Key to any biofuel policy is the identification of the country's strategic intent from biofuel, i.e., whether the intention is to promote or retard the development of a biofuel sector and the expected strategic benefits if it is to be promoted. Policy is then required to ensure that these benefits are achieved. The key issues to be incorporated in biofuel policies include: regulatory frameworks and strategies to protect the poor, taking advantage of opportunities, lowering trade barriers to biofuels and ensuring environmental sustainability.[67] Some countries, such as Mozambique, have experienced pressure from foreign and local investors that preliminary regulations have been hurriedly developed in order to foster large-scale biofuel production without a national strategy. Most policies have been formulated without analysing the impact of sector development on employment, food security and the environment as this information is not available. The development of a viable biofuel sector requires a strong, supportive policy and a firm legal, regulatory and institutional framework to ensure that measures are put in place to harness the contribution to socioeconomic development whilst safeguarding rural livelihoods and the environment.[68]

A key limitation of biofuel policy development globally is the lack of reliable data on biofuel sustainability, as well as country-level capacity to undertake the required background studies on feasibility and tradeoffs. A lack of commitment to social and environmental concerns could also be problematic, and these might be overruled by national economic development imperatives.

c. Planning and Zoning

Strategic land use zoning is potentially a powerful mechanism to ensure that biofuel development does not take place in socially or environmentally sensitive habitats. Zoning of areas where feedstocks must not be cultivated (no-go areas) and then leaving developers to decide where they can cultivate is more practical than identifying where cultivation should take place. Zoning can either be geographic or established against set criteria. Examples of no-go areas for biofuels include those of high biodiversity value (including but not limited to formal conservation areas and subject to both international and national interpretation); with high carbon sequestration value; of historic or cultural importance; identified for urban expansion; or important for food crop production. For many reasons beyond the scope of this analysis, conservation areas are seldom aligned with conservation priorities, and whilst almost all countries have defined conservation areas, strategic conservation plans based on biodiversity assessments, such as those in South Africa, are less common.[69]

Zoning could incorporate the possibilities of producing food and bioenergy crops as alternatives and should try to avoid being remote and prescriptive, which can limit national possibilities. In order to achieve this, the identification of globally accepted no-go zones such as those with high conservation value (including, for instance, primary

63 Ministry of New and Renewable Energy, Government of India, "National Policy on Biofuels", available on the Internet at <http://www.svlele.com/nbp.pdf> (last accessed on 30 September 2010).

64 Charles Jumbe, Frederick Msiska and Michael Madjera, "Biofuels Development in Sub-Saharan Africa: Are the Policies Conducive?", 37 *Energy Policy* (2009), at pp. 4980–4986.

65 *Ibid*.

66 *Ibid*.

67 *Ibid*.

68 *Ibid*.

69 Amanda Driver, Kristal Maze, Amanda Lombard et al., *South African National Spatial Biodiversity Assessment 2004: Summary Report* (Pretoria: South African National Biodiversity Institute, 2004).

forests, wetlands and areas with significant biodiversity) should be supported. This is often called ground-truthing and involves local-level mapping using participatory techniques to further classify areas and ensure that those with potential are not disregarded without good reason.[70]

National-level zoning covers only one aspect of biofuel sustainability, so other processes are also required. In most developing countries there are insufficient resources to carry out detailed site-specific assessments across the country, though this would be desirable. Zoning is therefore a broad-based approach to ensure that biofuels are not grown in sensitive areas, but it in no way negates the need for detailed site-specific investigations in proposed development areas.

d. Impact Assessment

Most countries have environmental legislation and regulations that require an environmental impact assessment (EIA) be undertaken when proposed activities are thought to threaten the receiving environment. Impact assessments are also mandatory by many funding agencies and finance institutions. Each country has different variables or criteria that trigger an EIA. It is not a planning tool but rather an assessment methodology to provide decision making information based on the level of impact that is considered acceptable, or which can be managed through mitigation. EIA could be a useful tool, once land use planning has been done and no-go areas excluded, to assess a particular project for a location. Although the use of EIA has brought environmental concerns into project-level development planning, its success in promoting sustainable development has been limited.[71] In developing countries, where legislation and strategic planning and land use mapping to support large-scale biofuel development is limited, EIAs are less effective due to the insufficient planning and data availability on biodiversity, ecosystem type, available water resources, carbon sinks, climate variability, local community reliance on natural resources, and likely future threats to ecosystems. Equally, the rigour of EIA is undermined if there are weak civil society pressure groups capacitated to mobilise environmental and social concerns. EIA has a limited integrative nature in that it considers ecological, social and economic effects separately and does not address potential cumulative effects that could manifest over time – in practise often providing only a snapshot. The impact assessment should incorporate additional environmental management tools including life cycle assessment, sustainability assessment or even strategic environmental assessment, followed then by a site specific environmental and social impact assessment.

e. Planning for Sustainability

Biofuel developments are outpacing normal planning and feasibility evaluation. Sustainability assessment, unlike EIA, is a tool that can be used expressly to prepare and design a biofuel development policy, plan, programme or project with sustainability as the desired outcome, rather than merely to prevent or mitigate potential environmental impacts.[72] The approach is inherently positive as well as prospective, and considers the relationships between social, ecological and economic factors. Since sustainability is an integrative concept, sustainability assessment should be an integrative process that provides a framework for better, long-lasting decision making at all levels of development planning.[73] These relationships need to be characterised and explored early in the assessment process to inform the accurate generation of appropriate sustainability criteria. Standards and certification systems are currently being promoted as sustainability tools; however, a process that pro-

70 Helen Watson, "Third Periodic Activity Report", COMPETE – Competence Platform on Energy Crop and Agroforestry Systems for Arid and Semi-arid Ecosystems – Africa" (2010), available on the Internet at <http://www.compete-bioafrica.net/current_land/Annex1-3-2-COMPETE-032448-3rdReport2009-D1.3-PolicyGuidance-Final.pdf> (last accessed on 22 September 2010).

71 Robert Gibson, "Beyond the Pillars: Sustainability Assessment as a Framework for the Effective Integration of Social, Economic and Ecological Considerations in Significant Decision-making", 8 *Journal of Environmental Assessment Policy and Management* (2006), pp. 259–280.

72 Jennifer Pope, David Annandale and Angus Morrison-Saunders, "Conceptualising Sustainability Assessment", 24 *Environmental Impact Assessment Review* (2004), pp. 595–616. See also Jenny Pope and William Grace, "Sustainability Assessment in Context: Issues of Process, Policy and Governance", 8 *Journal of Environmental Assessment Policy and Management* (2006), pp. 373–398.

73 Gibson, "Beyond the Pillars", *supra* note 69, at p. 17. See also Lorren Haywood, Benita de Wet, Graham von Maltitz and Alan Brent, "Development of a Sustainability Assessment Framework for Planning for Sustainability for Biofuel Production at the Policy, Programme or Project Level", in Carlos Brebbia and Andrea Mammoli (eds), *Energy and Sustainability II* (Southampton:WITS Press, 2009), pp. 355–365.

motes vigorous sustainability planning for the lifespan of the biofuel production could help strengthen trade agreements.[74]

At a local level the perception of principles that need to be considered for sustainable production may also differ from international initiatives. For instance, as mentioned earlier, GHG is not considered as important an issue in many developing countries, whereas the participation and opinion of the community, and the conservation of local resources, particularly water, is highly regarded.[75] Sustainability assessment is a new and developing science that lacks an institutional framework to legislate and fund its implementation.

3. The Role of Research and Monitoring

Research and monitoring are vital instruments to ensure that biofuel production is sustainable in practise. International action is required to improve data, models and controls, which should then aid understanding and managing overall impacts and policy improvement.[76] Research will also be critical to reduce costs and improve performance of bioenergy technologies, allowing them to be more competitive against fossil fuel-powered systems.[77] Progress monitoring is equally important, and international commitment to this cause was confirmed in 1992, after the Rio de Janeiro Earth Summit, when a set of action points for sustainable development were agreed – collectively termed Agenda 21. The importance of ongoing monitoring was clearly identified, with a mandate for the UN to establish a set of "indicators of sustainable development" to measure progress.[78]

The current trend in both research and monitoring of bioenergy projects is to focus on the GHG emission component. Carbon sequestration is often cited as a driver behind biofuel policies and there is much global debate (and some consensus) on methods for measuring the GHG balance of a project or policy.[79] In a draft communication from 2009 the EU proposed to provide its own guidelines for the calculation of carbon stocks, and require that all Member States set their own national system; alternatively, projects could be certified by certain accepted voluntary schemes, bilateral or multi-lateral agreements.[80]

Setting measurement criteria for monitoring social and other impacts of biofuel production is not as globally advanced or financially assured, despite extensive agreement that in most countries socio-economic benefits are a significant motivating factor.[81] Methodologies such as social impact assessment and planning for sustainability are concerned with establishing potential impacts and scenarios rather than observing existing programmes, though both do include a monitoring component.[82] There are other important considerations such as iLUC that are extremely complex to track, measure and include in monitoring, though they constitute a significant part of – particularly environmental – impacts from biofuel production as discussed in Section II.[83]

The cross-cutting global biofuels agenda has increased emphasis on research and monitoring of bioenergy production, with the need for interdisci-

74 Haywood, "Biofuel Production in South Africa", *supra* note 36, at p. 8.

75 Diaz-Chavez, "Good Practices Principles", *supra* note 58, at p. 13.

76 The Gallagher Report, *supra* note 6, at p. 3.

77 Uwe Fritsche, Bettina Kampman and Geert Bergsma, "Better Use of Biomass for Energy", Position Paper of IEA RETD and IEA Bioenergy (2009), available on the Internet at <http://www.iea-retd.org/files/IEA_RETD_BIOENERGY_position_paper091215.pdf > (last accessed on 22 September 2010).

78 Simon Bell and Stephen Morse, *Sustainability Indicators: Measuring the Unmeasurable?* (London: Earthscan, 2008).

79 Eric Larson, "A Review of Life-cycle Analysis Studies on Liquid Biofuel Systems for the Transport Sector", 10(2) *Energy for Sustainable Development* (2006), pp. 109–126. See also Francesco Cherubini, Neil Bird, Annette Cowie et al., "Energy- and Greenhouse Gas-based LCA of Biofuel and Bioenergy Systems: Key Issues, Ranges and Recommendations", 53 *Resources, Conservation and Recycling* (2009), pp. 434–447.

80 European Union (EU), "Communication from the Commission to the Council and the European Parliament on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels" (2009), available on the Internet at <http://www.foeeurope.org/agrofuels/EC_implementation_sustainability_scheme.pdf> (last accessed on 22 September 2010).

81 Domac, "Socio-economic Drivers in Implementing Bioenergy Projects", *supra* note 8, at p. 3.

82 Christopher J. Barrow, *Environmental Management for Sustainable Development* (New York : Routledge, 2006). See also Henk A. Becker, "Social Impact Assessment", 128 *European Journal of Operational Research* (2001), pp. 311–321; and Mike Burns and Alex Weaver (eds), *Exploring Sustainability Science: A Southern African Perspective* (Stellenbosch: African Sun Media, 2008).

83 Cherubini, "Energy- and Greenhouse Gas-based LCA", *supra* note 79, at p. 19.

plinary studies and evaluation being abundantly clear.[84] Methodologies to identify impacts of discrete aspects of biofuel production have encountered difficulties in the attempt often made to streamline multiple aspects in planning and monitoring. Nonetheless, there are distinct opportunities for advances in research and monitoring approaches given the breadth of crosscultural, and even international experience with bioenergy production and consumption in different countries.

The monitoring of impacts presents net importing countries with a key role in ensuring sustainable development of the global bioenergy industry.[85] This is crucial because of a previous low focus on developing country priorities. The importance of trade and export as vehicles for evaluating developing country producers is obvious; the real challenge is ensuring sustainability of production through research and monitoring. Concerns have also been raised over the unreliability of monitoring only what is seen at the large scale, and allowing invested companies to be the monitors when independent actors would be more likely to remain objective.[86]

Research into more energy and cost-efficient biofuels has been extensive over the past decades; however, existing practical examples of such technologies are limited. Whether being developed by private companies cautious about releasing information that could affect their competitive advantage, or encountering numerous barriers including cost, resource availability and environmental concerns, the reality is that sustainable biofuel production on a scale competitive with fossil fuels remains a distant, if not impossible, scenario.[87] Published monitoring of existing programmes is also limited; only those implemented by large-scale funders are mandatorily evaluated, and even then there is very little consensus on appropriate methods.[88]

The EU, through various funding streams, has been influential in financing global networks and initiatives concerned with identifying impacts from bioenergy production, evaluating existing and producing new methodologies for assessment and generating policy awareness both nationally and internationally. Two such examples are the Re-Impact: Forest-based Bioenergy for Sustainable Development[89] initiative and the Competence Platform on Energy Crop and Agroforestry Systems for Arid and Semi-arid Ecosystems – Africa (COMPETE).[90] Both of these projects involved cooperation of European and local partners, with work packages on wide-ranging aspects such as social, carbon, sustainability, policy, biodiversity and water resource outcomes of biofuel production. The Global Bioenergy Partnership (GBEP) has also considered monitoring as part of the guidelines for countries and is also promoting dialogue for policy advances in several countries.[91]

IV. Conclusions

Sustainable biofuel production should be driven through sound national policy and legislation. Certification and sustainability criteria are powerful tools, but with some constraints that might not lead to best land use, resource use, energy generation or development potential. In addition, they will only work if the market requires certification; if there are markets without certification requirements, then biofuels produced unsustainably will be diverted there.

84 The Gallagher Report, *supra* note 6, at p. 3. See also Fritsche, "Better Use of Biomass for Energy", *supra* note 77, at p. 19 and WBGU, "Future Bioenergy and Sustainable Land Use", *supra* note 1, at p. 2.

85 FAO, "The State of Food and Agriculture", *supra* note 4, at p. 3.

86 Neth Daño, "Biomass Production: Social and Economic Sustainability and Impact on other Resources", side event presentation at UN Commission on Sustainable Development, New York (7 May 2008).

87 IRGC Policy Brief, *supra* note 1, at p. 2.

88 Celine Tan, "No Additionality, New Conditionality: A Critique of the World Bank's Proposed Climate Investment Funds", Third World Network Briefing Paper 5; Bangkok Climate Change Talks (31 March–4 April 2008), available on the Internet at <http://www.twnside.org.sg/title2/par/Paper.by.Celine.doc> (last accessed on 22 September 2010).

89 Funded by the European Aid Cooperation Office, Contract Number: ENV/2007/114431, project website <http://www.ceg.ncl.ac.uk/reimpact> (last accessed on 22 September 2010).

90 Co-funded by the European Commission in the 6th Framework Programme – Specific Measures in Support of International Cooperation, Contract Number: INCO-CT-2006-032448, project website <http://www.compete-bioafrica.net/index.html> (last accessed on 22 September 2010).

91 Global Bioenergy Partnership (GBEP), "Programme of work", available on the Internet at <http://www.globalbioenergy.org/programmeofwork/en/> (last accessed on 22 September 2010).

Certification should provide a powerful mechanism for driving sustainability in countries where policy and enforcement are weak. Consideration of how different sustainability tools operate when policy breaks down is an area requiring additional research. Though certification may be a mechanism suited to policy failure, this does not negate its applicability for areas with sound policy frameworks, whereby local certification standards ideally should be based on national legislation. In such circumstances certification may be a useful tool for both national and international markets. If the EU is determined to use certification to ensure sustainable supply, it must invest in developing countries to support strong national policy and decision making as well as practical technology support, grants, transfer of skills and more.

Mechanisms are needed to conduct trade off analyses between different land use options covering both energy and agricultural/forestry production. Biofuels from a developing nation perspective centre around development and energy security. Whether biofuel production is the best land use option remains a key consideration. Results on this need to be context-specific with more than just a tick-box methodology (which is particularly unsuited to assessing social impacts), and looking at more than one impact, i.e., not just carbon emissions. European needs are not the same as developing nations' needs and thus will not be met in the same way.

Sustainability of biofuels needs to be considered from a global as well as a national perspective. There is, however, a clear disjuncture and tension between the drivers for biofuel production from developed and developing nations. Whilst climate forcing, biodiversity and forest preservation are all issues of global environmental concern, countries facing extreme poverty and food insecurity prioritise developmental issues. Short-term economic growth and the sustainability of livelihoods therefore tend to command greater attention than long-term environmental sustainability. Even within a single developing country there is potential conflict between national development and local social or environmental concerns. When considering sustainability, the question therefore is how, and from whose viewpoint, is it defined?

It is likely that much of the developed world's biofuel targets will be achieved through importation from the developing world. Whilst imposing environmental and social standards may be intended to drive sustainability, it could also be interpreted as First World mechanisms to limit or prevent growth. It seems hypocritical that countries that have historically been deforested and emitted vast amounts of carbon are preventing others from using the same mechanisms to fuel their development. There is, therefore, a strong argument for developing countries to receive compensation, possibly in the form of payment for environmental services or technological assistance, to offset the lost opportunity costs of not producing biofuels that would cause deforestation, destroy biodiversity or have other globally significant impacts. In addition, the financial barriers of compliance with developed world market requirements should be offset through mechanisms such as policy development support, assistance in the development of sustainable agricultural practices as well as certification processes and reduced trade barriers.

There is also the need to consider the consequences of not undertaking a biofuel project, i.e., biofuel crops should be considered against the most likely alternative land use, which may be the ongoing current use. Current land use options may have more negative consequences than biofuel production and it must be remembered that not initiating a project also has consequence. In addition, it is possible that the production of biofuels could contribute to boosting agricultural development in some countries where commercial-scale agriculture has suffered for many years. The possibilities of producing alternative crops may also contribute to the creation of new markets in developing countries.

Sustainability of biofuels would ideally comprise a win-win situation where many or all sectors benefit, and need not always be an environment versus development debate. Understanding the direct and indirect consequences of biofuel development is, however, extremely complex. Detailed planning is needed, based on sound scientific evidence. In addition, careful monitoring is required to ensure there are not unintended negative consequences. A key concern is indirect impacts that may occur in unrelated sectors or spatially separated areas. Accounting for these concerns remains problematic and requires further investigation.

Drivers for biofuel production and sustainability concerns change with location so that, although there may be some global truths concerning sus-

tainability, in practice most options have negative tradeoffs to some extent (even if there are many positive benefits) and therefore locally-specific compromises must be negotiated between key stakeholders. In different locations acceptable tradeoffs will change since they are context-specific. The final compromise will be situation-dependent, considering that sustainability is largely socially defined by current stakeholders, though a consideration of inter-generational equity is certainly required. To achieve sustainability it needs to be understood that there are clear "no-go" areas for development and these must be avoided at all costs. The trading of environmental capital for social benefit and vice versa may be justifiable, though there could be unintended consequences (e.g., climate change was not foreseen during the early years of fossil fuel use). Clearly, participation of stakeholders – most importantly local ones – is key to achieving sustainability; but this must be done in a framework of sound evidence-based research so that decisions are not emotive, but rather based on sound empirical data. Development of tools to facilitate this is a priority. From a developing country perspective ensuring suitable livelihoods is a key concern, and unless this is achieved, other aspects of sustainability are unlikely over the long term.

Finally, no single tool can solve all problems. Feedstock, management, location and country specific issues all need consideration. A multi-faceted approach is required, including, but not necessarily limited to, the mechanisms and issues outlined above as well as possibly new ones yet to be identified.