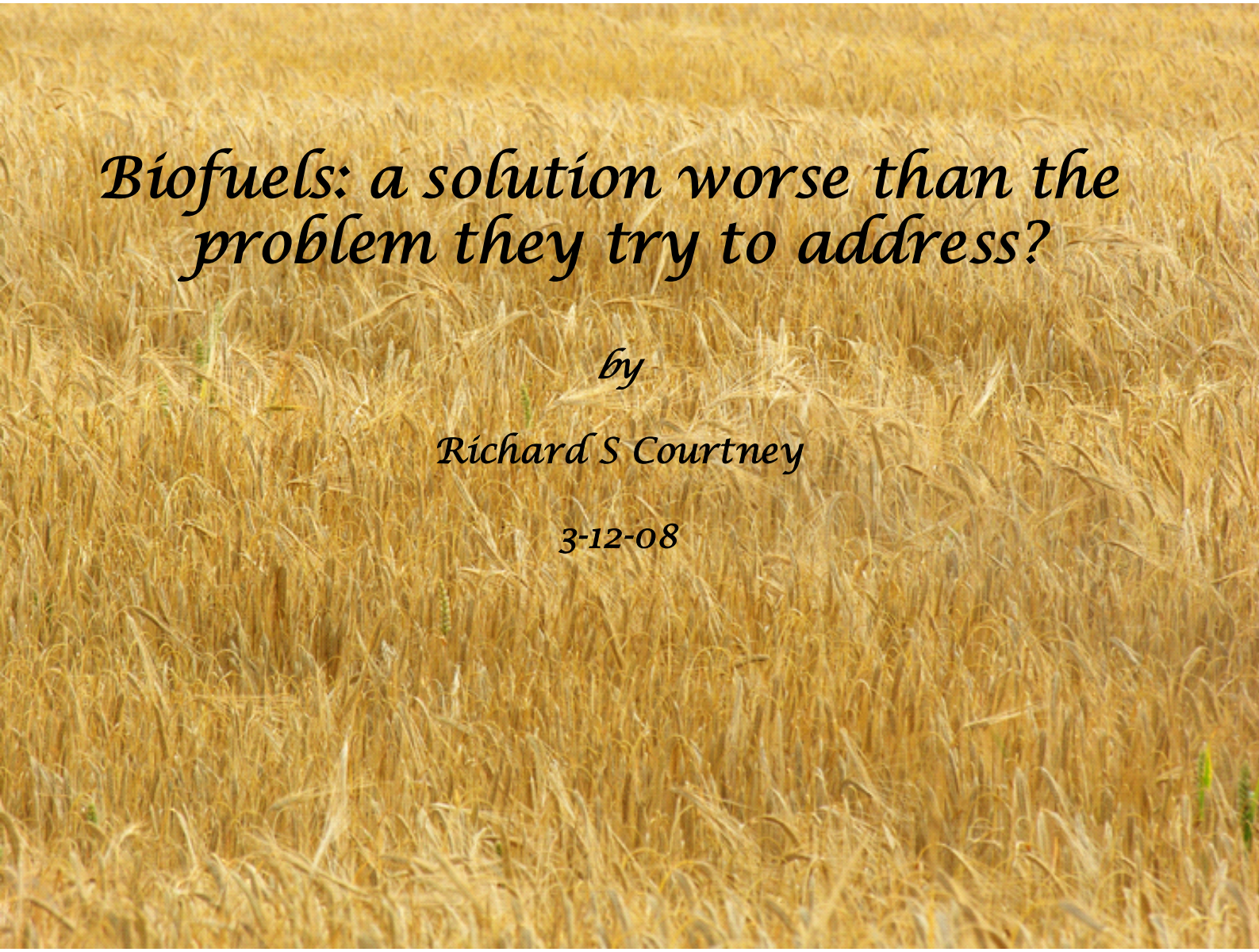

Biofuels: a solution worse than the problem they try to address?

by

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Synopsis

This paper reviews effects of large use of biofuels that I predicted in a paper published in August 2006 prior to the USA legislating to enforce displacement of crude oil products by biofuels. The review indicates that policies (such as that in the EU), subsidies and legislation (such as that in the USA) to promote use of biofuels should be reconsidered. The use of biofuels is causing significant problems but providing no benefits except to farmers. Biofuel usage is a hidden subsidy to farmers, and if this subsidy is the intended purpose of biofuel usage then more direct subsidies would be more efficient. But the problems of biofuel usage are serious. Biofuel usage is

- damaging energy security,
- reducing biodiversity,
- inducing excessively high food prices, and
- inducing excessively high fuel prices, while
- providing negligible reduction to greenhouse gas emissions.

All these effects were predicted in my paper on the use of biofuels that was published in August 2006 and can be seen at
http://ff.org/centers/csspp/pdf/courtney_082006.pdf [1]

My 2006 paper also predicted objections from environmentalists if large use of biofuels were adopted although this then seemed implausible because many environmentalists were campaigning for biofuels to displace fossil fuels. But this prediction has also proved to be correct.

1. Introduction

In August 2006 I published a paper which can be seen at
http://ff.org/centers/csspp/pdf/courtney_082006.pdf [1]

The synopsis of that paper said:

Biomass is biological material used as fuel, and biofuel is biomass that has been converted into a form that makes it useful as a displacement for a fossil fuel; for example, petroleum. Biomass is solar energy collected by photosynthesis over a small area and a few growing seasons in plants that are not compressed and not dried. Simple calculations of the solar energy collection at the Earth's surface demonstrate that no developments of biomass can provide significant amounts of energy because the energy required to farm and harvest it is a substantial proportion of the collected solar energy. And biomass cannot be economic because the net amount of energy

harvested can only be small. Indeed, governments would not need to subsidise bio-mass if it were an economically competitive fuel. But the production of biomass has potential for environmental damage by reducing biodiversity, and reliance on the use of biomass threatens energy security.

Also, that paper predicted that large use of biomass would increase costs of food supplies

That paper was controversial when it was published. The EU was pressing for large use of biofuels, and the USA intended legislation to enforce biofuel being used to displace 10% of petroleum for transport fuel. These policies had the stated intentions of

(a) reducing emissions of greenhouse gases and
(b) increasing energy security by reducing oil imports.

But my 2006 paper predicted that the policies would not make significant change to the emissions – indeed, the policies could result in increase of the emissions – and would reduce energy security by increasing fuel imports while making local fuel supplies (i.e. biomass) vary with the weather each year. Also, many environmentalists were then campaigning for adoption of large use of biomass, but my 2006 paper predicted objections from environmentalists if large use of biomass were adopted.

This paper reports an assessment of the effects that were predicted in my 2006 paper (summarized above). The assessment has been conducted nearly a year after the USA legislation to displace 10% of petroleum for transport fuel, and this paper reports that all the predictions in a paper published in August 2006 have subsequently proved to be correct. The problems are already very evident after only one year and, therefore, it is reasonable to suppose that their severity will increase with time as the usage of biomass increases. Furthermore, the only solution to the reduced energy security would be very expensive increases to strategic fuel stocks, and there is no discernible solution to any of the other problems except a reversal of the policy of large biomass usage.

2. The Problems predicted in August 2006

The following Sections of this paper consider the development to date of each of the problems predicted in my paper published in August 2006[1]. These predictions were:

1. damage to energy security,
2. reduction to biodiversity,
3. induction of excessively high food prices, and
4. induction of excessively high fuel prices, while
5. failure to provide significant reduction to greenhouse gas emissions.

2.1 Damage to energy security

In my 2006 paper[1] I wrote:

"The EU 'Biomass Action Plan' published December 2005 set a target for the EU to replace 5.75% of its fossil fuel usage with bio-fuels by 2010. At their annual spring summit in March 2006, EU heads of states and governments suggested that this target could be increased to 8% by 2015, pending further impact analysis. The stated intention of this target is to reduce carbon dioxide emissions as part of a policy to avoid AGW in accordance with the Kyoto Protocol.

According to the EU-sponsored *Well to Wheels* study, Europe would have to use 14-27% of its agricultural land to reach this 5.75% target. The study concludes that this amount of agricultural land is too large for the target to be met by domestically produced biofuels alone. Hence, meeting the target would require significant imports from countries like Brazil and Indonesia."

And "Imports of biomass to the EU from large producing countries like the US or Brazil will be needed while the EU waits for a significant contribution of second generation biofuels to the EU's transport sector needs. These imports have potential for longer-term problems. The governments of the potential supplying countries are also promoting use of biomass, and they can be expected to put priority on their internal supply. Hence, a growing EU dependence on imports from these countries would threaten EU energy security.

The low solar collection efficiency of biomass provides similar problems of energy security to any country that adopts significant use of biomass. Little fuel can be grown within any country (see Section 3) and, therefore, imports of biomass would be required."

So, to make a direct assessment of these predictions it is necessary to discern

I. if biomass exporting countries are developing their own use of biomass, and
II. if those countries have surplus agricultural land to permit conduct of that development while maintaining their biomass exports.

Such a direct assessment would permit quantification of potential biomass supply for each exporting biomass producer country.

Unfortunately, this direct assessment has not proven to be possible. Few assessments are known to have been conducted for major biomass exporting countries (e.g. Brazil, South Africa and Indonesia) and the assessments that are known to exist are possessed by national governments who are keeping the information to themselves. (This causes some suspicion that these countries' available future biomass production may be more limited than their politicians publicly suggest). Also, requests to organizations within those countries (e.g. major agricultural producers and agricultural trades unions) have not yielded the needed data.

Information on potential internal biomass production for major biomass importing countries (i.e. USA and EU) is available. A particularly good example is the estimate of potential for biomass production within each EU Member State provided by Nikolaou et al.[2] (this report contains much information and a bibliography of use to all interested in the subject). However, importing countries admit that their potential domestic biomass production is not sufficient to supply their needs (which is why they want to import), and the required information is of the potential supply of imports that could be available to meet those needs.

So, in the absence of reliable quantitative data, a qualitative assessment was used. And the qualitative information validates the prediction.

As explained in Sections 2.2 and 2.3 of this paper, countries that are net exporters of biomass are meeting the demand for biomass by transferring agricultural production to biomass growth – with resulting significant increase to prices of agricultural products, notably food – and by cutting down forests for export as biomass.

The net exporters of biomass are poor countries. And their transferring agricultural land from food production to biomass production demonstrates that they have little surplus land that could be put to growing food or biomass.

Farmers want maximum profits and will choose to grow the most profitable products. So, farmers will choose to grow biomass when biomass is more profitable than food. But governments promote food production because they can be toppled by food shortages. Also, all governments need their countries to have a positive balance of payments and, therefore, each country's economy needs export earnings that will pay for required imports (e.g. raw materials). Poor countries cannot afford to increase their food imports. Hence, governments of poor countries desire a balance between indigenous food production and biomass production for exports. And governments of poor countries will oppose transfer of agricultural land from food production to biomass production unless there is no other way to obtain the biomass for export. But, as explained in Section 2.3 of this paper, governments of poor countries are permitting transfer of agricultural land from food production to biomass production at a time of rising food prices. Therefore, this transfer of agricultural land for biomass production demonstrates that poor countries have little surplus land that could be put to growing food or biomass.

And the agricultural prices would not have significantly increased if there were sufficient surplus agricultural capacity to meet the increased demand.

Also, forest material would not be being exported if agricultural biomass was cheaper to produce.

Hence, the evidence in Section 2.3 of rising food prices resulting from transfer of agricultural land from food production to biomass production is also very strong evidence that there is little spare capacity in the land available for agricultural production of food or biomass. Thus, it is known that biomass production from agriculture is – or soon will be – near its maximum capacity.

Agricultural production is notoriously dependent on the weather and so harvests are highly variable from year to year. And the lack of spare agricultural capacity in the biomass exporting countries ensures that their biomass exports will vary with the size of their harvests each year.

Extreme weather events have occasionally affected fuel supplies. For example, in 2005 Hurricane Katrina damaged infrastructure in the USA with resulting difficulties to distribution of oil products in the USA. But, until now the supply of fuel has not depended on normal variability of weather. ***In the past year the USA and EU have deliberately adopted energy policies that require significant imports of biomass from poor countries***. As explained above, those policies make fuel supplies to the USA and EU dependent on the weather in their supplier countries.

It seems that this problem may be recognized in the US because much of the US biofuel production is exported notably to the EU (see Section 2.5). This transforms the problem of bad harvests to the exported countries, but the exported fuel makes no contribution to supply of US fuel demand.

Energy security has been reduced by the addition of normal weather variability as a risk to energy supplies. This reduction to energy security can only be overcome by a reversal of the recently adopted energy policies that require significant imports of biomass from poor countries or, alternatively, the very expensive establishment and maintenance of strategic fuel stocks sufficient to meet the needs of a poor biomass harvest. (It is interesting to note that this latter solution is not

novel. It was the solution to the problem of variable harvests that the Bible says Joseph proposed to Pharaoh in the Bronze Age: ref. Genesis 41: 34-36).

2.2. Reduction to biodiversity

Palm oil prices have been rising in response to rising demand from China, India and Europe, where biofuels should comprise 10 percent of motor fuels by 2020.

Malaysia is the world's largest producer of palm oil although Malaysian palm oil producers privately say they anticipate that Indonesian production of palm oil will overtake Malysian production in 2007. Indeed, Malaysian producers are being attracted to Indonesia because of the large amount of cleared land that is there.

Malaysian plantations minister Peter Chin insists palm oil production does not damage the environment. He asserts that Malaysian companies will boost productivity by replanting with higher yielding clones and adopting good agronomic practice. And he says, "We are committed to ensuring that whatever we do now is not at the expense of the environment and our future generations".[3]

But the Malaysian Palm Oil Board says 65 % of Malaysia's total land area (of almost 33 million hectares) is comprised of forest and palm oil plantations use 12 %, then only 23 % remains for use by agriculture, industry, urbanization and all other purposes. And not all of that 23% is usable terrain. Alvin Tai, plantation analyst at OSK Securities, says most of the palm oil companies listed on the Malaysian bourse are expanding in Indonesia because the available land is so limited in Malaysia. But he adds that the pressure for land is reducing the Malaysian forest, explaining that such forest clearance is below acceptable Malaysian environmental standards. He says most major plantation firms are RSPO members and "they have the resources to maintain those standards. It's the smaller plantation owners that are a concern".[3]

This raises the question of how much concern there should be at the clearance of rainforest by "the smaller plantation owners".

The Malysian rainforest contains many unique species, and reduction of the forest would potentially eradicate some of those species. Clearly, total removal of the Malysian rainforest would destroy the habitats of these species and thus eradicate all these species, but anything less than total destruction of the rainforest may reduce the populations of these species but it may not eradicate any species. But loss of any of the species would be a reduction to biodiversity.

Any reduction to the rainforest is likely to destroy some species and thus reduce biodiversity. This is because there are many species of microbes and insects that tend to be have localized habitats. In terms of biodiversity, loss of a species of bacterium is as serious as loss of a species of mammal. However, it is not known what proportion of Malaysian rainforest removal would significantly reduce biodiversity by alteration of an ecosystem or ecosystems. Many simplistic assertions are made but none can be substantiated. The problem derives from two unknowns. Some species are restricted to parts of the rainforest and it is not known if they can move into other areas without displacing unique species that may be there. And it is not known how small the population of each species can be before the species becomes non-viable and disappears.

However, environmentalists are concerned at any reduction to biodiversity.

Meena Rahman, of Friends of the Earth Malaysia, says the group is particularly concerned about projects in Sarawak, on the Malaysian side of Borneo Island. She disputes the government's claims concerning land use and says there is evidence that 1.5 million hectares of land that was to be set aside for protection and water catchment purposes has been planted with oil palm as well as pulp and wood trees. Expressing her concern at loss of biodiversity, she says, "Maybe what Peter Chin is saying is that they are planting palm oil in areas that have already been logged, but they should allow reforestation to take place instead of allowing palm oil expansion." [3].

Whatever the truth of Rahman's desire for reforestation, the facts are that

- expansion of palm oil in Malaysia is reducing biodiversity,
- there is no evidence that the reduction is significant in terms of ecosystem destruction, and
- it is not known to what degree Malaysian palm oil production can continue to increase before the reduced biodiversity becomes significant.

Although Malaysia is the largest producer of palm oil, Indonesia is Southeast Asia's largest economy, and Indonesia has launched an ambitious biofuels expansion programme that intends to source 17 % of its energy needs from renewable sources by 2025. Evita Herawati, an assistant to Indonesia's minister of energy, says 5.5 million hectares (13.5 million acres) will be set aside for biofuel plantations by 2010, 1.5 million hectares of which are for oil palm. She says the programme's main purpose is "to create jobs and alleviate poverty," with some 3.5 million new jobs being intended by 2010.[3]

However, there is a clear disagreement between the claims of Indonesia's government that new oil palms will not create undue demand for needed land, and the claims of Indonesian non-governmental organizations that palm oil plantations have been used as a pretext to clear land and take the more valuable logs from the rainforest.

Herawati says, "A lot of forest has been cut down but they didn't use it at all. We would like to use it for this [biofuels] programme," adding that so far 58 deals worth a total of 12.4 billion dollars have been signed with companies. She estimates that about 5.5 million hectares are available for use in Kalimantan, the Indonesian portion of Borneo island (5.5 million hectares is an area far larger than Denmark and almost as large as Sri Lanka). And she claims that nine million additional hectares are available elsewhere. [3]

But Rudi Lumuru, from Sawit Watch, an industry monitor, claims that much of this "empty" land is actually used by local people. He claims that more than 500 communities have been involved in conflicts with more than 100 palm oil companies, typically from Malaysia. And he says, "This land has been used since a long time ago by the people. They live on the land, they grow on the land. The government says people can make money, but it's about transition of culture. The culture of the farmers; it's rice, coffee, cocoa -- it's not palm oil." And he added, "While compensation payments may be meted out, they end up being meager thanks to endemic corruption".[3]

Lumuru is not alone in disputing Herawati's claims. Rully Syumanda, of Indonesia's environmental watchdog Walhi, says that in Indonesia in recent years proposals for palm oil plantations have been used "as a pretext to clear land and take the more valuable logs". He estimates that nearly 17 million hectares of Indonesia's forests have been cleared ostensibly for oil palm plantations since the 1960s, but only six million hectares have been cultivated. Though

he concedes that the government is now making efforts to reforest, catch offenders and audit the industry, Syumanda says these are "insignificant compared to the damage that is being inflicted on the environment."[3]

Changes to land use have other environmental effects, too. Environmentalists point out that much of Indonesia's peatland forests have already been destroyed to make palm oil plantations, and the ***destruction of these peatlands has released huge amounts of carbon dioxide (CO2)*** [3]. Reduction to CO2 emissions is claimed to be the main reason for production and use of biofuels (see Section 2.5).

Significantly, the palm oil industry sides with those who dispute the claims of the Indonesian government, but the industry says it is changing its ways. Derom Bangun, executive chairman of the Indonesian Palm Oil Association, says, "The industry now is trying to avoid destroying land". "Companies no longer clear land by burning or in ways that harm the environment or wildlife." And he adds that Indonesian companies have joined the Roundtable on Sustainable Palm Oil (RSPO), a WWF-led initiative to engage palm oil companies, and is trying to abide by their principles.[3]

Technology minister Agusman Effendi said that economic factors as well as "sustainability of the environment and the way the government can give extra support to the poor" needed to be considered. "The 'what' has been defined clearly, but the 'how to' is the thing that has been criticised by the public," he said. [3]

So, there is clear evidence that the palm oil industry is having similar effects on biodiversity in Indonesia to those it is having in Malaysia.

Malaysia's northern neighbour Thailand is also expanding palm oil production but an official from Thailand's agriculture ministry said, "we don't have environmental issues linked to palm oil like those in Thailand and Malaysia". High prices for palm oil, driven by Bangkok's search for alternative fuels, have encouraged farmers to convert rubber and fruit plantations to grow oil palm, she said. Local prices of palm oil have almost doubled to more than four baht (seven cents) per kilogramme (2.2 pounds) from two baht last year.

Thailand had some 32,000 hectares planted with oil palm in 2006, but the area is expected to increase to 81,000 by the end of 2007. An additional 400,000 hectares of unused farmland in the south could also be used, the agricultural ministry official said. (So, she expects a production increase of over 1,500 % with 250 % increase in 2007 alone). The government is providing soft loans to help farmers make the transfer of production from rubber and fruit to palm oil and is considering a floor price for palm oil.

Whether or not Thailand does not have "environmental issues linked to palm oil like those in Thailand and Malaysia", such large increase to palm oil production could be expected to generate such problems if it were to continue.

The dash for palm oil is not only happening throughout South East Asia. The Philippines has approximately 25,000 hectares put to growing palm oil, and its agriculture department says about 454,000 hectares of "disposable land" (in the form of pasture or shrubbery) has also been earmarked for palm oil production. However, to date it seems that only one Singapore-based company seeking at least 25,000 hectares of land has expressed interest.

Some reports say that such destruction of rain forest is not necessary; at least it is not necessary in Brazil where the largest rainforest is situated. For example, the fast food chain McDonalds is sensitive to environmental issues following concerted campaigns against the company by environmentalists. So, in Brazil, McDonalds (which buys chicken fed with Brazilian soy) established its Rules. This project is operated by McDonalds, the US commodities multinational Cargill, and The Nature Conservancy (an environmental group). Cargill has funded the Project with $390,000, and The Nature Conservancy oversees compliance that is intended to ensure that soy farmers produce grains without reducing the area of forest.

The Responsible Soy Project is based on compliance with Brazil's Forest Code which dictates that Amazonian landowners must keep natural vegetation on 80 percent of their land and farm only 20 percent. This project attempts to help farmers in the northern Amazon meet those legal requirements. It began in 2004 after Greenpeace launched a Europe-wide campaign targeting McDonald's and Cargill as advocates of deforestation.

According to the Rules of the 'Responsible Soy Project', farmers in two municipalities in the northern Amazon can only sell soy to Cargill if they promise to plant trees on denuded land. Conservationists claim this is a potential model for sustainable development not just in the Amazon but all over Brazil.

Valmir Ortega is a senior environmental official with the Para state government. He has said, "This is an important step in the sense that it is initiating actions to stop the deforestation of new areas. This is being done only in a small region as of yet but it has stopped the expansion of soy [farms] in that region. We are seeing similar pressures to open other areas for other products like ethanol and palm oil and so this experience can be very illustrative."

However, according to the Christian Science Monitor, many laws are ignored in Brazil and so is compliance with the 'Responsible Soy Project'. ***Around 17 percent of the Amazon has disappeared, with much of the recent deforestation coming to make way for massive soy plantations on the southern edges of the jungle.*** Brazil is now the world's largest exporter of soybeans. [4]

Furthermore, the project is a pilot program that is obtaining significant opposition from local farmers in the municipalities of Santarem and Belterra where it is being applied. These municipalities are distant from the large plantations that produce most of Brazil's soy exports, but they were ideal for the pilot because more than 80 per cent of their soy farmers bring their soy to the Cargill's port in Santarem. The pilot scheme was implemented when Cargill agreed to only buy soy from farmers who are complying with the 80/20 law or who have agreed to take steps to become compliant.

The Nature Conservancy used satellite photographs to plot the farmer's land and produced charts showing how much each farmer needed to reforest to meet the 80/20 code.

The scheme has over 200 participating farmers and it forces them to undertake a laborious and costly reforesting exercise: Cargill stops buying from them if they don't. Several of the farmers openly express resentment at this and try to avoid compliance. Most of them work less than 200 hectares and setting aside 80 percent of it means they would have insufficient land to produce a profitable crop.

The Nature Conservancy and the Brazilian state authorities are seeking ways to overcome these problems. One possibility is having the farmers pool their money to buy a large area of forested

land elsewhere in the state and then to designate it protected. That solution would bring them into compliance with the 80/20 law if the purchased area were equivalent to 20 per cent of the area of land that they farm in total.

Ana Cristina Barros, The Nature Conservancy's country representative in Brasilia says of this idea, "That land could be used as an agricultural frontier, or to create biodiversity corridors or as fire breaks" and "The compensatory forest could even be given over as reserves to indigenous communities."

Other businesses in Brazil are expressing an interest in adopting similar sustainability measures, and The Nature Conservancy has already had talks with other soy producers and now ethanol firms. This encourages David Cleary who is director of conservancy programs for South America at Nature Conservancy and is based in Rio de Janeiro. He asserts that they are making progress towards major expansion of the program and, thus, forcing farms and other businesses into line with Brazil's Forest Code.

Cleary says, "We've always said to businesses, 'You wouldn't ignore environmental laws in Iowa, so why do you ignore them here?". And he says, "If Cargill accepts this in Santarem, then they become vulnerable and we can ask the question, 'Why only in Santarem?' It sets a precedent."[4]

But the scheme requires poor farmers to either

(a) lose the use of 20 per cent of their land, or
(b) spend much of their little money to purchase land that they cannot use.

It is not surprising that they resent it. And they openly state that they will do all that they can to avoid it. It can be anticipated that they will avoid it to some degree and it remains to be seen how much they can avoid it.

Gordian Energy Partners is one of the Ethanol firms intending expansion in Brazil. The firm is run by Diomedes Christodoulou, the former boss of Enron South America, and is seeking US$150 million from US and European investors to fund sugar cane plantations and refineries in Brazil. Christodoulou claims that by 2030 all the cars in the world could be powered by an ethanol blend produced from sugar cane obtained from planting an additional 37 million hectares of land in Brazil. At present, about 65 million hectares of land are under cultivation in Brazil.[5]

He argues that the Brazilian rain-forest will not be cut down for the plantations because sugarcane does not grow well in tropical climates. This argument is contentious for several reasons; not least that 37 million hectares of additional arable land is difficult to find in Brazil without displacing rainforest. However, if his argument succeeds then Brazilian ethanol producers will not need to comply with the 80/20 law for their planting of sugar cane.

In summation, measures to avoid rainforest displacement by biomass farming are being attempted in some places (notably Brazil) but investigation of the attempts indicates that they are being resisted and/or avoided in the regions of the world's major rainforests.. Reduction of rainforest reduces the ecosystems that inhabit the rainforests with resulting reduction to biodiversity

2.3 Induction of excessively high food prices

An assessment of the effect on food prices from a switch of agricultural from food to biofuels requires that an assessment be made of all the changes to supply and demand for crops.

Food prices have risen throughout the developed world in the past year and much of the reason is short term. Droughts and very poor harvests in many of the world's largest food-growing regions, including Australia, have driven up the price of grains, particularly wheat. In Britain meat prices have also risen as a result of the foot-and-mouth and blue-tongue outbreaks that have affected local cattle. Also, the growing affluence of China and India with the resulting increase in their demand for food is giving putting upward pressure on food prices.

In September 2007 two independent studies were published that assessed the increases to world food prices being induced by adoption of biofuels.

Tthe Organisation for Economic Cooperation and Development (OECD) published a review of the adoption of biofuels and concluded that biofuels may "offer a cure that is worse than the disease they seek to heal" [7]. And a paper published in 'Atmospheric Chemistry Physical Discussions' provided a similar conclusion. [8]

The OECD report says, "The current push to expand the use of biofuels is creating unsustainable tensions that will disrupt markets without generating significant environmental benefits".

Importantly, the OECD report supported an OECD view that sees biofuels keeping food prices at high levels into the next decade. The OECD asserts that "Any diversion of land from food or feed production to production of energy biomass will influence food prices from the start, as both compete for the same input", and this leads to an unavoidable "food-versus-fuel" debate.

The OECD report therefore called on governments to cut their subsidies for biofuels and instead to encourage research into technologies that would avoid competing for land use with food production. Its conclusion could not have been more blunt: it said***, "Governments should cease to create new mandates for biofuels and investigate ways to phase them out."***

"Governments should cease to create new mandates for biofuels and investigate ways to phase them out."

In plain language, in the US ethanol production is subsidized to the tune of $7 billion a year. This encourages crop production for fuel, not food, and the competition for a finite crop of corn – a basic commodity – forces up the price of many other commodities, too.

Ninety-five per cent of the ethanol produced in the United States is distilled from corn. Ethanol is used as an additive to gasoline, comprising as much as 10 percent of the fuel mixture in most automobiles.

Simply, the OECD has reviewed what is happening as a result of biofuel production and has concluded that the effects predicted in my original paper are happening to a degree that warrants governments stopping their promotion of biofuels before the problems become unacceptably severe.

The OECD report says tax incentives put in place in many regions, including the European Union and the United States, to encourage biofuel output could hide other objectives. It says, "Biofuel policies may appear to be an easy way to support domestic agriculture against the backdrop of international negotiations to liberalise agricultural trade."

Instead, the OECD Report suggests that governments should attempt to reduce demand for transport fuels and calls on members of the World Trade Organisation to improve efforts to lower barriers to biofuel imports from developing countries that have ecological and climate systems more suited to biomass production access to their markets.

However, the reduction to barriers to imports of biofuels from developing countries would exacerbate the rainforest loss reported in Section 2.2.

Jeff Rubin is chief economist at CIBC World Markets, a bank based in Ottowa, Canada. He says that corn prices have already jumped by 60 per cent over the past two years as American ethanol producers have expanded capacity. [9]

"In 2008, food inflation would top five percent and the following year would approach 7 per cent, its highest level in more than 25 years", Rubin predicted. He explained this prediction as follows:

"This diversion of an ever-increasing share of the American corn crop from human consumption and livestock feed to energy production is putting steady and unrelenting pressure on food prices. Soaring corn prices not only pass directly into animal feed costs and corn-based food prices like tortillas, but they are spilling over to other grain prices as farmers scramble to expand corn production at the expense of other crops."

The US administration has set a target to raise ethanol production from one billion gallons a year in 2000 to 35 billion gallons a year by 2017. But Rubin insists this will have "negligible impact on US energy independence."

Corn for ethanol currently accounts for 13.5 per cent of all corn production in the United States, yielding roughly 6.2 billion gallons of ethanol which is equivalent to only a one percentage point reduction in US gasoline consumption. ***Even if the United States achieved President George W. Bush's 2017 target, "that would only reduce gasoline consumption by an estimated 6.5 per cent",*** Rubin said. And he added, "Ethanol indeed has certain benefits, but only for those who grow corn and distill it into alcohol. The only thing Bush's renewable energy policy will fuel is inflation."

So, the OECD, academic reports, and banking assessments are all showing that biofuel usage is already forcing up food prices in the US.

However, this pressure for demand for biofuel crops is not forcing up prices for biofuel crops everywhere, at least not yet. For example, the demand for biofuels has induced a rush to provide supply that is reaching a glut in Brazil.

Brazil's sugar cane crop (see Section 2.2) has been growing at an average rate of 9.9 percent each year since 2000, boosted by increasing ethanol demand. And the price of Brazilian sugar cane has fallen this year according to Plinio Nastari, president of Datagro Consultancy. He says, "The industry is growing faster than a sustainable rate. That is why prices are falling so much." [10] Nastari says, "With expected demand for 720 million tonnes of cane by 2013/14, the sector should not grow more than 7.3 percent per year to avoid worsening the current oversupply,"

Datagro projected demand for cane is currently higher than expected by the consultancy a few years ago, but investments in new mills have surpassed what was forecast and, according to Nastari, they are at an exceedingly high level.

Roberto Rodrigues, director for the Inter-American Ethanol Commission, said "I think there is still not any (international ethanol) market. We're all working irrationally. There is not any strategy either from the private sector or from the government". Adding, "How much ethanol do we want to produce? Nobody knows, but the potential market is huge." [11]

Indeed, Brazilian sugar and ethanol prices have fallen around 35 percent since the beginning of the 2007/08 cane crop, and Brazils governmet is concerned at the effect of this on Brazil's industry.

Manoel Bertone is Production and Agroenergy Secretary in the Agriculture Ministry. He is reported to have said, "The market will not grow if we do not organize all parts of the production chain in a way to keep security and stability (in supply)." He said the disorganized way the market is growing will not match the rise in demand and this could lead to even lower prices. Bertone also said, "Besides that, if we do not have a regulatory basis, possibly no country will buy ethanol from us." He ruled out intervention in the sector but defended a dialogue between producers and the government, saying, "In order to develop the market we need to increase output faster than demand, but at what price? Especially considering that this is an extremely controlled market abroad."

Some analysts argue that the supply and demand imbalances will create market forces which will encourage technological solutions. Simon Hayley is a commodities analyst at Capital Economics and he says historically high food prices were likely to encourage farmers and agribusinesses to improve technology, and extract more from each hectare. "Biofuels are a genuinely new lump of demand hitting the market," Hayley said. "Short term, supply doesnt respond. But if you look at the long term, it does, surprisingly so." And he predicts that genetically modified crops will create another 'green revolution' similar to that of the past 50 years. Hayley may be right, but the needed technology does not yet exist so there are no signs of it happening in the near future. [13]

"Filling the 25-gallon tank of an SUV with pure ethanol requires over 450 pounds of corn -- which contains enough calories to feed one person for a year."

Others are less optimistic. In a study published online in *Climatic Change* on 15 February 2007, for example, Johansson and Azar (2007) analyzed what they call the "food-fuel competition for bio-productive land," by developing "a long-term economic optimization model of the U.S. agricultural and energy system".[15] Their model indicates that the competition for land to grow crops for both food and fuel production leads to a situation where "prices for all crops as well as animal products increase substantially." Also, in the May/June 2007 issue of *Foreign Affairs*, Runge and Senauer (2007) report that corn-based ethanol in the United States already "takes so much supply to keep ethanol production going that the price of corn -- and those of other food staples -- is shooting up around the world." And to put the situation in words anybody can understand, they write ***that "filling the 25-gallon tank of an SUV with pure ethanol requires over 450 pounds of corn -- which contains enough calories to feed one person for a year."*** [16]

Consideration of the above points gives reason for concern. Food prices are being forced up in developed countries as agriculture is diverted to biofuel supply. Meanwhile, there is little international trade in biofuels. Anticipation of future biofuel demand from developed countries is inducing overproduction of biofuel in some developing countries, and this threatens collapse of

an over-expanding agricultural industry with eventual crop shortages in those developing countries.

These concerns could be a temporary problem if international trade were to be freed for biofuel products, but there is no sign that this will happen soon. And if the international trade were freed then the rainforest loss with associated biodiversity loss (see Section 2.2) would inevitably occur.

2.4. Induction of excessively high fuel prices

Several countries are attempting to adopt biofuels as a displacement for transport fuels. The EU has announced a target of replacing 10 percent of its transport fuel with biofuels by 2020. China is aiming for 15 percent share of transport fuel to be biofuel. The US is already on track to exceed Congress's 2005 goal of doubling the amount of ethanol used in motor fuels to 7.5 billion gallons by 2012. In his 2007 State of the Union speech, President Bush set a new goal of 35 billion gallons of biofuels by 2017, and in June, the Senate raised this target to 36 billion gallons by 2022. Congress said that 15 billion gallons should come from corn and 21 billion from advanced biofuels that are nowhere near commercial production. [14]

The present scale of EU and US biofuel consumption is already large. In 2006 the US produced 250 million gallons of biodiesel from soybeans, and US biofuel producers used more than 550 billion pounds of corn. By 2016, Europe is expected to turn more than 39 billion pounds of wheat into fuel each year.

The US situation is especially strange. The US provides a tariff of 54 cents a gallon on ethanol from Brazil. Then the government provides a tax break of 51 cents a gallon to American ethanol producers in addition to generous subsidies that corn growers already receive under the farm program. (As explained in Section 2.3, the trade restrictions are causing problems for Brazil's ethanol producers.) Hence, the US provides large incentives for US farmers to convert from food to biofuel production.

Meanwhile, the US is exporting much of the product.

Since the start of the 2007, US biodiesel comanies have flooded the European markets with cheap fuel. The volumes are so large that they account for more than 50% of EU demand for biodiesel. Some EU companies (e.g. including Biofuels Corporation, the UK's largest producer, and listed group D1 Oils) say the glut of cheap American imports could drive many firms out of business. American companies have been exploiting federal government subsidies and rebates offered by European countries. Under the US scheme, biodiesel producers are paid a subsidy of $1 per gallon, or 11p per litre. But the groups can also claim 20p per litre in excise duty rebates by importing biofuels to the UK, thus, in effect, 'double dipping' on tax relief.

According to a recent report by accountants Ernst & Young, US biofuel exports to Europe were expected to reach more than 500,000 tonnes by the end of 2007. In Germany, some biodiesel refiners have cut their output by 50%, though there are fears this could lead to an 80% fall by the end of 2007.

The American fuel, known as B99, is a blend of 99% soya biodiesel and 1% mineral diesel. It is being sold at about $860 (£420) per tonne, far cheaper than the $1,114 price of raw rapeseed oil before it has been refined to create biodiesel. Refining typically costs $125 a tonne.

Elliott Mannis, chief executive of D1 Oils, said: "This is a nascent industry that is being fundamentally damaged. Bluntly, there is a danger that if this goes on unchecked it could be destroyed."

Clare Wenner, at the UK's Renewable Energy Association, said: "The UK government has raised this with the commission. This issue needs to be resolved or companies could go out of business."

However, all these effects derive from the subsidies, both US and EU, provided to the biofuel producers.

In 2006 EU governments spent at least 3.7 billion euros (5.2 billion dollars) on subsidising biofuel production. And such support is likely to grow in the coming years because the Union has set a strategy of raising the quantity of road fuel generated from biofuels from its present level of 2 percent to 10 percent by 2010.

No subsidies would be needed if biofuel were economically competitive with the gasoline they displace.

Oil prices have soared 40 percent this year but the palm oil has jumped by two-thirds. So now palm oil costs an astonishing US$735 a tonne compared to crude a bargain at about US$593 a tonne.[17] Furthermore, the energy from a tonne of palm oil is less than that from a tonne of crude. Biomass feedstocks have to be processed to obtain alcohol or ethanol for use as biofuel and crude has to be refined to obtain gasoline.

Ethanol is being used throughout the U.S. as an additive of 10% blended with gasoline. The result has been increased fuel costs for US drivers. In the two months following introduction of this additive at the start of May 2006, demand for ethanol caused its price to rise about 65% to around $4.50 a gallon in U.S. spot markets, according to the Oil Price Information Service. This is much more expensive than gasoline which costs about $2.90 a gallon at the pump so the direct effect is to raise the price at the pump to $3.06 (a price rise of 16%) without taking into consideration costs of transporting and blending the ethanol. The Wall Street Journal commented, 19 June 2006, "Analysts say this has set up a lesson straight out of the Economics 101 textbook: If you add an ingredient to a product that is pricier than the product itself, in effect, you're driving up the price of the product".

The existence of the large subsidies for biofuels is – of itself – direct evidence that the use of biofuels is raising fuel prices.

2.5 Failure to provide significant reduction to greenhouse gas emissions

In its most recent report on biofuels[7], the Paris-based OECD says the use of fuels such as ethanol made from corn, palm oil and other sources using crops as raw material amounts to "a cure that is worse than the disease they seek to heal."

The OECD is hardly a shill for the oil industry, but its report flatly rejects the displacement of crude oil products by biofuels as a valid method to reduce greenhouse gas (GHG) emissions from transport. It says, "When acidification, fertilizer use, biodiversity loss and toxicity of agricultural pesticides are taken into account, the overall impact of ethanol and biodiesel can very easily exceed those of petrol and mineral diesel."

As stated, earlier, the OECDreport says governments "should cease to create new mandates for biofuels and investigate ways to phase them out", avoiding technologies that compete for land use with fuel production. But it notes that this would not be easy because politicians have a vested interest in backing increased biofuel use.

Another recent analysis reached the same conclusion and its authors are also blunt on the matter when interviewed. Paul Crutzen, was awarded the Nobel prize for his work on the ozone layer. He and his colleagues calculated that growing some of the most commonly used biofuel crops releases around twice the amount of the potent GHG nitrous oxide (N_2O, also known as 'laughing gas') than previously thought – wiping out any benefits from not using fossil fuels by probably contributing to global warming.

For rapeseed biodiesel, which accounts for about 80 per cent of the biofuel production in Europe, the relative warming due to nitrous oxide emissions is estimated at 1 to 1.7 times larger than the relative cooling effect due to saved fossil CO_2 emissions. For corn bioethanol, dominant in the US, the figure is 0.9 to 1.5. Only cane sugar bioethanol – with a relative warming of 0.5 to 0.9 – looks like a better alternative to conventional fuels.

The paper by Crutzen et al. is still subject to open review in the journal Atmospheric Chemistry and Physics, and – being the lead author – Crutzen declined to comment until that process is completed. But the paper suggests that microbes convert much more of the nitrogen in fertilizer to nitrous oxide than previously thought – 3 to 5 per cent, which is twice the widely accepted figure of 2 per cent used by the International Panel on Climate Change (IPCC) to calculate the impact of fertilizers on climate change.

As a result of these observations, Crutzen *et al*. conclude that "on a globally averaged basis the use of agricultural crops for energy production can readily be detrimental for climate due to the accompanying N_2O emissions." In addition, they note that "increased emissions of N_2O will also lead to enhanced NO_X concentrations and ozone loss in the stratosphere." Taken together, they thus conclude that the relatively large emission of N_2O associated with biofuel production "exacerbates the already huge challenge of getting global warming under control."

Keith Smith, a co-author on the paper and atmospheric scientist from the University of Edinburgh, said "The significance of it is that the supposed benefits of biofuels are even more disputable than had been thought. What we are saying is that growing many biofuels is probably of no benefit and in fact is actually making the climate issue worse." He added, ***"One wants rational decisions rather than simply jumping on the bandwagon because superficially something appears to reduce emissions."***

The climate issue is global. But local environmental damage is also being caused. The parts of the US coast and Hungary illustrate the varied nature of these effects.

Invetors Business Daily reports that agricultural runoff fertilizes oxygen-consuming algae to create an oxygen-poor dead zone— a condition called hypoxia. The subsidies for biofuel have encouraged maximization of production by excessive use of fertilizers. It takes 4,000 gallons of fresh water per acre per day to replace evaporation in a cornfield. Each acre requires about 130 pounds of nitrogen and 55 pounds of phosphorous. These nutrients used to grow corn and other bio-fuels in the Midwest watershed of the Mississippi River have induced an hypoxic region the Gulf of Mexico that has an area of 7,900-square-mile; i.e. it is about the size of Connecticut and Delaware together.[18]

Hungary provides a very different example of unintended harmful environmental effects from the demand for biofuels. Drought slashed Hungary's maize crop by half this year but dry weather would have less impact on crops if farmers had left the plants' stalks and straw on the fields as protection from the sun and evaporation. Instead, they sold it as biomass. [19]

"There is plenty of biomass out there to burn and lots of fallow land to grow energy crops," Szent Istvan University professor Marta Birkas told a farming conference. "I caution everyone not to sell straw and stalks to power plants," she said. "The soil needs it as a protection from drought."

Of course, Istvan is right and farmers know it. But farmers know that droughts do not occur every year, and poor farmers in poor countries will rarely resist the temptation to maximise profits each year.

In summation, biofuels have been touted as an aid to solving the environmental problem of 'global warming'. Bur recent studies show that the use of biofuels adds to the problem and encourages other environmental damage, too.

3. Conclusions

My paper published in August 2006 [1] predicted several problems from the adoption of biofuels as a displacement for crude oil products used as transport fuels. This paper has considered the development to date of each of the problems predicted. These predictions were:

- damage to energy security,
- reduction to biodiversity,
- induction of excessively high food prices, and
- induction of excessively high fuel prices, while
- failure to provide significant reduction to greenhouse gas emissions.

The evidence in this paper shows that each of the predicted problems is occurring and, therefore, the use of biofuels as a displacement for transport fuels should be reconsidered. It is noted that a completely independent study from the OECD makes the same recommendation for the same reason.

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Richard S Courtney is a Member of the European Science and Environment Forum (ESEF) and acts as a technical advisor to several UK MPs and mostly-UK MEPs. He is Chairman of the Southern Region of a Trade Union (BACM-TEAM) affiliated to the UK's Trades Union Congress. He was the Vice-President of BACM-TEAM from 1995 until May 2000, and he was also a Member of the Executive of the Federation of European Energy Industry Executives throughout that time. Having been the contributing Technical Editor of *CoalTrans International,* he is now on the Editorial Board of *Energy & Environment.* His present work mostly consists of providing commissioned advice to national governments, although he has recently conducted research studies of energy interactions at sea surface.

Richard is a respected authority on energy issues, especially clean coal technology. He has been the Senior Materials Scientist of the UK's Coal Research Establishment, has served as a Technical Advisor to the European Coal and Steel Community (ECSC), possesses several patents, and has published papers in many journals including *Nature, Microscopy* and *Filtration.* He is the author of the chapter on coal in *Kempes Engineers Yearbook.*

His scientific achievements have obtained much recognition. The British Association for the Advancement of Science appointed him as a Member of the Association of British Science Writers in recognition of his "clear presentation of scientific information to politicians". The UK's Royal Society for Arts and Commerce appointed him as a Life Fellow in recognition of his "services to British industry". PZZK (the management association of Poland's mining industry) gave him an award in recognition of his "services to Europe's industry". He has broadcast on radio and TV around the world in response to requests from several media companies, notably the BBC, and he lectures around Europe.

His knowledge of energy and environment issues is widely respected. He has been called as an expert witness by the UK Parliament's House of Commons Select Committee on Energy and also House of Lords Select Committee on the Environment. UNESCO commissioned a paper from him on Coal Liquefaction. An Expert Peer Reviewer for the UN Intergovernmental Panel on Climate Change (IPCC), in November 1997 he chaired the Plenary Session of the Climate Conference in Bonn at the joint request of the European Academy of Science, the Science and Environment Project (USA), and the Europaische Akedemie fur Umweltfragen e.v. (Germany). In June 2000 he was one of 15 scientists invited from around the world to give a briefing on climate change at the US Congress in Washington DC, and he then chaired one of the three briefing sessions.

Richard is also an Accredited Methodist Preacher. He is a founding Member of the Christ and the Cosmos Initiative that explores the interactions of religious and scientific ideas. The Initiative started in the UK but became active in 28 countries.

Richard avoids confusion about him in his scientific and religious activities by rarely citing his academic achievements, but his material science qualifications include a DipPhil (Cambridge), a BA (Open) and a Diploma (Bath). He may be contacted at:

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