

Report on expert workshop on variable demand for biofuels

Variable demand as an avenue to sustainable first generation biofuels and biobased chemicals



IEA Bioenergy

IEA Bioenergy: Task 43: TR2019-02

Variable biofuel demand

Variable demand as an avenue to sustainable first generation biofuels and biobased chemicals

HW (Wolter) Elbersen, Wageningen Food & Biobased Research, The Netherlands

JWA (Hans) Langeveld, Biomass Research, The Netherlands

PMF (Foluke) Quist-Wessel, AgriQuest, The Netherlands

I (Iris) Vural Gursel, Wageningen Food & Biobased Research, The Netherlands

With input from KL (Keith) Kline, Oak Ridge National Laboratory, USA

The authors would like to gratefully acknowledge IEA Bioenergy Task 43 and Wageningen Research KB research programme financed by The Dutch Ministry of Agriculture, Nature and Food Quality for providing funding to make the project possible. We would especially like to thank the participants of the workshop, for sharing their opinions, and helping to move the discussion beyond the identification of problems, and toward solutions.

Copyright © 2018 IEA Bioenergy. All rights Reserved

ISBN, if applicable, [here](#)

Published by IEA Bioenergy

Front cover photo credit: Wolter Elbersen

CONTENTS

1	INTRODUCTION	2
2	VARIABLE BIOFUEL DEMAND	3
3	WORKSHOP PRESENTATIONS	5
3.1	VARIABLE DEMAND AS AN AVENUE TO SUSTAINABLE FIRST GENERATION BIOFUELS	5
3.2	RECONCILING FOOD AND BIOFUEL, THE ROLE OF FLEX-CROPS	7
3.3	SCIENCE FOR FOOD: GLOBAL YIELD GAP ATLAS	10
3.4	PERENNIALS: OIL PALM	12
3.5	AGRICULTURAL POLICY AND GOVERNANCE OF VARIABLE BIOFUEL DEMAND	14
3.6	ILUC AND VARIABLE DEMAND FOR BIOFUELS: FROM MODELLING TO ACTION?	17
3.7	BIOFUEL ECONOMICS	19
3.8	FEEDSTOCK DEMAND AND SUPPLY FOR THE CHEMICAL INDUSTRY	21
3.9	OVERVIEW	22
4	KEY QUESTIONS AND ANSWERS	24
	APPENDIX A: WORKSHOP PROGRAMME	28
	APPENDIX B: LIST OF WORKSHOP PARTICIPANTS	29
	APPENDIX C: LIST OF ABBREVIATIONS	30

1 Introduction

First generation biofuels and biobased chemicals are produced from feedstocks (oils, fats, sugars and starch) that are also used for food and feed. Such feedstocks are produced from maize, sugarcane, rapeseed, oil palm etc. In many countries, public opinion and many experts think this is undesirable due to their negative impacts on food security, indirect land use change (iLUC), and biodiversity.

It has been suggested that a variable demand for biofuels could mitigate these negative effects. A project co-financed by IEA Bioenergy Task 43 (<http://task43.ieabioenergy.com/>) aims to identify, describe and evaluate methods to increase food security, avoid iLUC and decrease the yield gap by means of variable demand for biofuels.

Part of this project is an expert workshop under international researchers and other experts to document expert opinions on the concept of “variable biofuel demand” as an option to address certain issues that have been raised as concerns associated with first generation biofuels and biobased applications (materials and chemicals).

This report presents the results of the one-day “Expert Workshop on “Variable demand as an avenue to sustainable first generation biofuels and biobased chemicals” that was held 3 December 2018 in The Hague. The workshop programme and the list of participants are included in this report in respectively Appendix A and B.

This report is structured as follows. Chapter 2 provides background to the workshop on variable biofuel demand, Chapter 3 provides highlights from the presentations and discussions that took place during each presentation, and Chapter 4 provides the key questions of the workshop and their answers to draw overall conclusions from the workshop.

2 Variable biofuel demand

The competition for feedstocks or for land to produce feedstocks between food, feed, biofuels and other non-food applications (materials and chemicals) remains highly controversial, especially for biofuels that use conventional agricultural crops as feedstocks, sometimes called “first generation biofuels” based on oils, fats, sugars and starch. In the EU, policy is more and more restricting bioenergy production from agricultural crops, but also in other countries including USA, Ukraine, India, the production of fuels made from conventional crop feedstocks is often seen as undesirable.

The main concerns about conventional agricultural feedstocks are the perceived threats to food security and indirect and direct land use change, plus the associated GHG emissions and biodiversity loss. So far, it has been difficult to quantify these impacts, especially for indirect land use change (iLUC). Consensus about iLUC related GHG emissions are not expected any time soon.

Though many studies and public opinion conclude that there is direct competition for feedstocks and therefore, iLUC, a few other voices present alternative views. A number of studies have shown that biofuel demand can also positively interact with agricultural production and, hence, improve the land base, support farmer income and increase investments in agriculture by providing multiple markets that may lead to higher yields. These positive interactions can potentially provide an important driver for crop production and thereby even lead to improvements in food security.

Research on yield gaps worldwide suggests that there is a huge opportunity to increase yield on currently used land. Key issues include (a) how to manage current agricultural landscapes more sustainably, and (b) how to avoid land clearing and other activities, that threaten biodiversity, carbon stocks and other services, especially in high-conservation-value areas.

Varying the demand for biofuels based on conventional agricultural feedstocks according to availability (market price) has been proposed as a method to reduce negative impacts of using first generation feedstocks. The aim of this project is to identify, describe and evaluate methods to increase food security, mitigate negative effects of iLUC, and decrease the yield gap by means of variable demand for biofuels.

The subjects discussed at the workshop include:

- Current examples where biofuel production de facto is varied according to feedstock availability
- The effect of varying the demand for biofuels on food security and competition for food on world or local scales
- The effect on agricultural production and productivity
- Effect on land use change and associated GHG effects
- Effects on first generation feedstocks for chemicals
- Policy options to introduce variable biofuels production depending on feedstock availability
- Research priorities to establish if such policies have positive impacts on food security and GHG emissions

- Research priorities to establish how such policies can be introduced and what the costs would be

Key questions that have been addressed are:

1. What is needed to realize the potential benefits of variable demand?
2. Who needs to be convinced (who is the target audience), and how to convince them?
3. What research is needed and how can this group and their networks help?
4. What recommendation for policy development can be provided?

3 Workshop presentations

3.1 Variable demand as an avenue to sustainable first generation biofuels

Presentation by Dr. Wolter Elbersen

The workshop is on biofuels produced with first generation technologies that need sugar, starch and oils as feedstock. Advantages are: feedstocks are relatively easy to convert; readily available feedstock; GHG balance positive (in the chain) > 50% better than fossil equivalent. Important issues are: variable availability and price; competition with food and indirect land use change risk.

Potential effects of first generation feedstock demand for fuels and chemicals:

Prevent:

1. Higher (food/feed) prices => food/fuel issues, food insecurity for low income people
2. More land is converted into crops = iLUC => land use change, GHG emissions and reduced biodiversity

Aim at:

- 3: Increased production per hectare / intensification

The rationale behind the Variable biofuel demand is to vary the production of 1st generation biofuels (ethanol / biodiesel) according to availability and price of feedstock. Implementation of this concept could lead to: increased food security, increased investment in agriculture, reduced iLUC risk and secure supply for chemical industry.

The idea is not new, there are already examples in Brazil (based on sugar prices) and Colombia; (lowered ethanol mandate in order to prevent higher sugar price) and the USA.

Questions

A VBD approach is offers perspectives. Yes. We need to prove the effect on iLUC and food security with research. We need to reframe the discussion as biofuels can increase food security: show the synergy.

In order to realize a VBD it is required to convince the right people, to define policies to ensure that investors will still invest and to prioritize biochemicals over biofuels.

Discussion

For chemical industry you really depend on biomass while for transportation fuels you can use electricity as alternative. However, for heavy duty, marine and aviation biofuels still biomass is required. Also to reduce climate impact in the short term we still need 1st gen biofuels. And we need it NOW.

An example: for heavy duty it is possible to have an electrified system by having highways with induction line as done in China.

Using 1st generation biofuels will create resistance to shift to electricity

We try to be flexible, but can we be flexible also in time so that this will also make sense after the transition in fuel sector for food and chemical industry.

Commenting on the Colombian example: lowering the mandate seemed to be a solution; but some people will call this "unreliable policy"; the option to act according feedstock availability has to be part of the policy.

Take away message

Priorities:

- Review policy options that reduce biofuel production when prices are high / availability is low
 - What mechanisms to test?
- Can we prove positive effects on food security and iLUC risk?
- How to deal with biobased chemicals?
- How to deal with uncertainty for biofuel industry?
- Certify all agri feedstocks for Food / Feed / Chemicals and Biofuels? (We still need to assure > 50% GHG improvement over fossil)
- What are effects if temporarily switch to more fossil is needed - when biofuel feedstocks are too expensive / scarce
- Still implement policies that prevent deforestation and push higher agri-production by investing in research and technology development
- More focus on multi output factories à Fuel, food/feed and bioplastics

3.2 Reconciling food and biofuel, the role of flex-crops

Presentation by Dr. Keith Kline

There is still much confusion and controversy in the food- fuel discussion. The use of clear and unambiguous terminology could help to solve part of the confusion. Also "Variable biofuel demand" as a name could be confusing. According to the Dr. Kline the term flex crops is a more simple term and easy to grasp; crops that produce both food and fuel.

The reality of a variable biofuel demand is complex as use of energy crops and residues are not always good and food crops are not always bad. We do know how to do it right, we agree on the opportunity but there is difficulty in implementing it. In addition we should reach agreements with NGOs; all should agree that we could manage the environment.

This can be illustrated by examples of sugar cane production in Brazil and corn production in the USA. Brazil is a major player and the "Brazil crop" determines if there is surplus or deficit at a global level. Studies from Brazil show that even a 2% shift in sugar to ethanol can affect prices highly.

Brazil: Global Markets and Brazil Sugarcane Production Case

- Sugar sector suffered overproduction and lacked competitiveness despite government intervention (and subsidies)
- Pro-Alcohol (ethanol program) boosted investment and improved cane breeding, management, processing efficiency, etc.
- Ethanol industry contributed to infrastructure improvements that were critical for socio-economic development (ports, railroads, etc.)
- Sugarcane feedstock represents 2/3 of total final product costs (ethanol or sugar) so improvements in cane genetics and management is key
- Sugar and ethanol in Brazil are partners not competitors for the same feedstock
- The ethanol-sugar mix is already driven by market prices, so policy does not need to change

USA. The USA 2012 drought didn't cause a big problem in food security as would be expected (in the past it would have caused global famine). This is because there was a big cushion from corn that was used for biofuel.

In the USA, the increased returns gave farmers an incentive to invest in their farm (rather than pay it as tax) so productivity increased and they constructed silos, buildings, tractors). When the drought occurred they could supply from the silos.

Questions

What is needed to realize potential benefits of variable demand for biofuels?

1. Overcome public distrust of biofuels (build trust)
2. Focus on investments that improve resource management
3. Engage local communities to conserve remaining HCV areas
4. Monitor and adapt to continually increase carbon stores
5. Explicit integration of bioenergy with food and other systems
6. Develop viable mechanisms to finance these initiatives

* Public distrust is a major issue and includes the following aspects: Food versus fuel; LUC – deforestation; Market distortions, tenure issues; Greed, corruptions, land mismanagement; Lack of performance-based policies with flexibility to support local adaptation and innovative solutions.

We need to overcome public distrust of biofuels. Therefore, we need good data on soil organic carbon; global measurement and monitoring could have a big impact. It is recommended to choose one indicator and report on that indicator, for instance on better land management.

* Lack of markets is an enormous problem for producers (in the South).

* Waste is an issue; we have to reduce waste.

* Food security: mainly the rural areas are affected.

* There is no shortage of land but there is shortage of proper land management and equitable distribution. There is therefore high room for improvement and use of current land and conservation of HCVs (high conservation values). Biofuels can have positive effect on biodiversity. There are climate mitigation potentials with cover crops and with forest management.

Priorities to meet future needs for food, energy, water & nature:

1. Invest to conserve remaining HCV areas
2. Improve management everywhere else
3. Reduce inequalities
4. And creatively finance these initiatives

Discussion

Currently, the outlet of biomass to market chemistry or fuels is not determined by the market; it is distorted by policy. To have the biochemicals we need a level playing field that currently doesn't exist (i.e. with CO2 tax).

Examples in Brazil (switch from sugar to ethanol) and in USA: it is market mechanism. But the

market does not organize climate solutions. It costs money. We do not pay for environmental services. There are not sufficient incentives to improve management.

Price mechanisms differ per country and depend on how the industry is organized.

- In The Netherlands, organization structures such as cooperatives may lead to other kind of decision-making.
- In time of low prices you get restructuring of the industry. F.i. in Brazil the older and less efficient mills closed and did not re-open after crisis, as they could not compete with (modern) flex-mills.

Take away message

How can potential benefits of variable demand be realized?

- Document effects to build trust
- Focus on values of improving land management
- Address deforestation and food security concerns directly

3.3 Science for food: Global Yield Gap Atlas

Presentation by Dr. Patricio Grassini

Increase in crop production can be achieved through increasing crop yield (intensification) and / or increasing the production area (extensification).

Best available data indicate that population increase plus diet changes will increase food demand by 50-70% in the next 35 years (Bruinsma, 2009; Fischer, 2009). This means that global crop yields need to increase 1.2-1.3% annually from NOW until 2050 to meet food demand on existing cropland area. Relative yield gains decreased over time and are not sufficient to meet the growing demand on current land. The crop yield increase is seen to follow a linear trend. Currently it is 1.2% and this is the lower end of the required yield increase until 2050.

Meeting food, feed, fiber and fuel demand without massive expansion of cropland area can only be achieved through intensification of agricultural systems so that every single hectare of existing cropland produces near its potential while minimizing environmental impact and preserving the resource base.

Yield is expressed in tonne product/ ha/year. The yield gap is the difference between the potential yield and the farm yield. The potential yield is determined by: radiation; temperature; [CO₂]; cultivar; rainfall & soil (in rain-fed crops). The farm yield is limited by: poor soil fertility; poor management; insects, weeds and diseases. Reaching 75-85% of yield potential is a reasonable target for farmers with access to inputs, markets, and extension services. Above this threshold, further yield increase becomes not cost-effective and/or environmental sound.

There is slowdown of the decrease in the yield gap. We see already for 15 years a yield plateau in Korea, California, India. We need to acknowledge that there is a limit to yield. To decrease the gap could require a lot of investment and may not be cost efficient to close gap completely. Closing the yield gap can also be hindered by socio-economic concerns.

The Global Yield Gap Atlas (GYGA; www.yieldgap.org) provides data for 62 countries on major food crops, accounting for 70, 84, and 45% of rice, maize, and wheat. It is built with the same methodology applied across crops and regions. From the atlas it is seen that in Eastern Europe there is a yield gap whereas in Western Europe much less. In Africa there is a very large yield gap, offering an intensification potential but it needs to be done sustainably.

When we look at the sugarcane production in Brazil, we see that the area increased but yield didn't. Obviously there was an incentive to use more land instead of increasing productivity per hectare. Cane production in Brazil is now at 62 % of the yield potential for rainfed conditions and could increase to 80% by decreasing the yield gap.

Information on yield gaps can be useful for the following:

- Yield gap analysis can provide estimates of extra crop production potential on existing cropland and with available water resources
- Support to prioritize investment in agricultural research and development and monitor impact
- Foundation for closing yield gaps, estimate nutrient and water requirements, and for studies on climate change, land use, and environmental footprint

Discussion

In Africa we see a lot of potential but the circumstances are moving in the opposite direction. Favourable socio-economic conditions are lacking and there is no infrastructure. It is very important to take these socio-economic aspects into consideration.

There is also data and studies on wind and solar energy potential globally; it would be interesting to combine these studies to obtain an overall "picture" on renewable energy.

Cover crops are also interesting and important for environmental issues but we never see them in policies.

Take away message

Yield gaps & variable biofuel demand: the bright side

1. Meeting food, feed, fiber, and fuel demand without massive land conversion will depend on our ability to increase yields on existing cropland
2. Extra crop demand for biofuels has helped to further highlight the fact that our current rates of yield gains are not sufficient to meet demand.
3. Variable food demand could be an attractive incentive to promote investments in AR&D that explicitly targets crop intensification

Yield gaps & variable biofuel demand: other thoughts

1. Assessments on food security and biofuels need to consider upper yield limits and be based on reasonable yield gain rates
2. Ensure large and stable crop supply and demand is needed for investments on biofuel facilities
3. Local socio-economic and regulatory context may not allow to capture the theoretical benefits.

3.4 Perennials: Oil palm

Presentation by Dr. Maja Slingerland

Areas where oil palm grows are located between 16 °N and 16 °S and are restricted by climatic conditions (temperature, rainfall, light, soil and seasonality). Seasonality has to be taken into consideration specifically for water: the water limited yield is important.

For increasing palm oil production, there is not much possibility to increase the area to grow oil palm sustainably. In addition to the geographical limitations also areas with High biodiversity value are excluded and public opinion is favouring protection of rainforest. Therefore rather look for intensification instead of expansion.

Oil palm is a perennial crop; a plantation/planting is there for 30 years; the dynamics are different from annual crops.

PALMSIM a palm growth simulation model considers many factors, to assess potential and water limited potential yield. It is spatially explicit and the model uses direct ground analysis. The water limited yield is important specifically for Africa and to a lesser extent for Indonesia and Malaysia.

Following reasons have been identified for actual low yields:

- Lack of knowledge on Best Management Practices
- Lack of resources to buy fertiliser, hire labour for pruning or weeding, etc..
- Logistics especially at large scale plantations
- Insufficient organisation to regularly harvest and collect FFB yields at farmers fields à harvest intervals too long
- Lack of certified quality seeds (smallholders)
- Plantations that lack maintenance (smallholders)

Closing yield gap is technically possible and can substantially increase Palm Oil supply but it is not that easy as in Indonesia 40% of palm oil is being produced by smallholders

- Some countries have policies in place: Indonesia: Domestically cooking oil or biodiesel and international market food industry or biodiesel; some flexibility in domestic market depending on world market prices of fossil fuel
- Thailand: government has price policy affecting palm oil production. Often import for cooking oil. Ambition of local production for biodiesel
- Malaysia has own fossil fuel hence biodiesel cannot compete easily in the domestic market
- Ghana has as far as I know no biodiesel policy related to palm oil production but the larger companies producing palm oil in Ghana and Africa in general are the same as those in Indonesia and Malaysia à they will be affected by those domestic markets.

Discussion

Oil palm cultivation: option of monoculture vs intercropping. When intercropping other spacing. Reducing the spacing can cause competition for light so may reduce the palm oil yield but intercropping gives the possibility to add food sources in the same system. Another option that is practised is oil palm with pasture.

In palm oil production the big players are the companies. Indonesian companies for instance own plantations in Ghana. The big players here are not the (national) governments but the (international) companies.

The importance of palm oil production: in Indonesia return on labour of oil palm is 10 % more compared to rice.

Take away message

Palm oil and variable biofuel demand:

- Interesting because there is still scope for increase of production per ha allowing for food and some fuel.
- Governments of producing countries already (try to) use oil palm as flex crop
- Oil palm is a perennial (25-30 year life span) hence reactions to changes in demand in terms of more or less area planted will be very slow compared to annual crops (corn area in USA e.g. can react much faster) so the opportunities to manage supply are very limited.
- Depending on demand and associated price people may decide to manage supply by changing management of existing oil palm crop (to reduce or increase production costs and yields) but even then reactions are slow (yields react 2 years after fertilisation).

In addition:

Palm oil: public opinion strongly opposes further deforestation and loss of biodiversity;

The role of the small holder related to food security: oil palm as cash crop provides income; option of intercropping to provide food crops.

Apart from government policies it is good to realize the importance of the role of companies.

3.5 Agricultural policy and governance of variable biofuel demand

Presentation by Dr. Erik Mathijs

There is a paradox, if we have enough biomass why do we need to increase yield.

Food security is not only about food availability but also about the income. Farmers are trapped; multinational companies look for low cost biomass against farmers' interest.

Buffer systems: In history there used to be a "buffer"; f.i. in the form a pig in the Middle ages. Also in EU we used to have buffer systems (using denatured wheat as feed; and by discarding milk). Since 1992 this is not any more the case; we are getting away from policies.

Some observations: there are competing uses for biomass. Farmers make decisions based on economic incentives. There is a resistance against biofuels. There is a gradual shift from a managed system to market oriented system.

What principal do you use for cascading? Moerman's ladder shows competing uses of biomass.

Five key principles for a sustainable bioeconomy:

- Food first: ensure the primacy of food security
- Sustainable yields: amount harvested < regrowth → agriculture?
- Cascading approach: sequential use of biomass according to 'value added'
- Circularity: reduce/reuse/recycle
- Diversity: systems are diverse, using context-specific practices at different scales, producing a diversity of outputs

In the bioeconomy the challenge is NOT to reduce diversity. There needs to be discussion on protein transition.

There is a bio-physical potential in the long run free meat protein and a socio-economic potential.

Bio-physical potential

- Sustainable intensification: more with less, land sparing, precision farming, GGOs
- Closing global yields gaps
- Ecological intensification: land sharing, agro-ecology
- Shifting diets by reducing (red) meat consumption
- Reducing waste and losses, circular economy
- New protein sources: cultured meat, fungi, algae, insects, plants (quinoa, soy)

Socio-economic potential

- The importance of low staple food prices (food prices: external costs to be included; but this often conflicting with the interest of keeping food prices low to avoid social unrest. There is a very high inelasticity of supply and demand.)
- The issue of scale: micro versus macro (Micro: engage farmers into biofuels: there are both positive and negative (jatropha) examples.)
- The issue of governance and power dynamics

Important questions to consider regarding Variable Biofuel Demand

1. Who will pay the cost of temporary shut down
2. Create vested interest
3. Up scaling usually means favouring large-scale farming
4. Some economic effects may be indirect
5. How to enforce release of virtual feedstock reserve
6. Rebound effect in consumption (giving the wrong incentive)

Governance important issues

- Carry out evidence-based, participatory& deliberative planning process
- Level playing field for more effective participation of less powerful actors
- Ensure wider governance context supports biofuel policy aims (social inclusion& social and environmental risks)
- Carry out evidence-based reforms of governance institutions
- Foster innovation in efforts to benefit the poor
- Foster learning and iterative improvement throughout policy implementation

Final thoughts

- What are the factors influencing the yield gap?
- Who will pay the bill for variability (e.g. temporary shut down costs)
- Land abundance (increase area) versus land scarce context (increase yield); these are different innovation pathways.
- Link to the protein transition
- Scale: from opportunity to unintended consequences: (Scale increase can have unintended consequences, infrastructure in protected area)
- Forbid biofuel crops when prices are high? (Who will manage the switch from food to fuel? Who will coordinate this?)
- Inherent inefficiencies of crop production: photosynthesis, N leakage, ..

Discussion

We need a real phasing out strategy for 1st generation biofuels

CO2 reduction based discussions now in policy

Brazil now has a different structure. Going from energy security towards CO2 based system. So now instead of variable demand they have a system fixed at lowest CO2

Who will pay for variability and what is your steering mechanism?

What is the role of buffer stocks? Advantage: buffering capacity; Disadvantage prices were very low so that farmers could make no income.

With a VBD: Who is taking what out of the revenue; there is a difference between output and revenue.

Take away message

What is/Define the role of biofuels in the broader strategy of a bioeconomy; including (partial) phasing out.

One of the challenges of the bioeconomy is not to reduce diversity.

Choose your "steering criteria", this could be carbon and who pays for the variability.

3.6 iLUC and variable demand for biofuels: From modelling to action?

Presentation by Dr. Uwe Fritsche

A different framing of indirect Land Use Change (iLUC) is needed. Land use change (LUC) is factual; we can relate LUC to causes. It becomes difficult when agricultural products leave the country. ILUC = artefact of (too) narrow system boundaries for all incremental use. It is impossible to monitor iLUC. It is modelled

A dynamic view on iLUC

There are various ways to reduce iLUC:

- Dampening iLUC with REDD+ (adequate finance)
- Better governing LUC in key countries (AR, BR, ID...) => if you improve the LUC from these countries, a large part of the problem is solved.
- Integrating bioenergy into Forest Landscape Restoration, and SDG 15.3 (LDN) – new dialogue started @ GLF (IEA Bio/GBEP/UNCCD/World Bank) => bioenergy can be part of the solution by restoring landscapes. We shouldn't focus only on GHG, we need Forest Landscape Restoration. Bioenergy can be means to improve forest management which will give a positive effect on iLUC
- Strengthening LUC governance in non-bioenergy supply chains (e.g. "deforestation-free" products, see recent Brazil case: Brazilian industry opposed against plans of the government to cut tropical forest to make agricultural development possible; industry is aware of image damage.)

Going for low iLUC feedstock:

- Residues & wastes – unless we do something substantial it won't happen
- Intensification – it is very uncertain what is baseline, how to monitor. No evidence that this will go for biofuels. No consideration of trade-offs (biodiversity, soil, water).
- Unused + degraded land – there is no infrastructure there and probably because of good reason.

A Variable Biofuel Demand – theoretically can work but no agency can regulate it and can it respond quickly. What costs are involved for regenerating these lands?/ who will invest?

There are alternative things that could be done. Look at the whole bioeconomy and ask for sustainability requirements for all biomass; do not restrict this to biofuels.

Variable Biofuel Demand and the issue of governance:

- Biofuels markets have (physical & economic) links with food, feed & fiber markets, and increasingly, those are linked internationally (IEA Bio T40 work)
- There is no agency nor governance perspective to intentionally and consistently "regulate"

markets intertwined across sectors and borders, and with a short response-time

- No implementation of earlier “high-level” proposal* and no issue on G7 or G20 level

Discussion

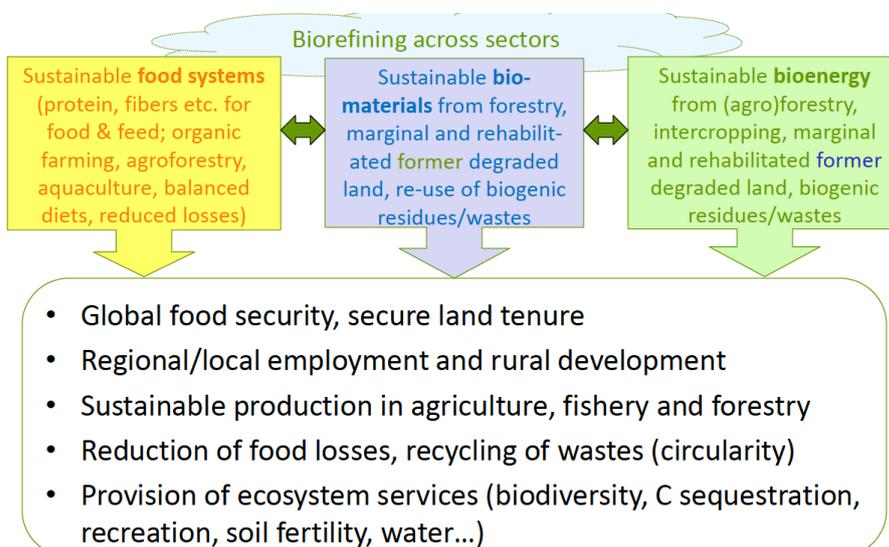
For LUC looking at the (satellite) images and making interpretation is hard; there could be other conditions that have an effect, so difficult to know what to attribute directly to a crop.

There is no perspective that somebody/ organization will regulate the bioenergy market. An attempt was done in 2011 by major international organizations; they reached an agreement but it was not implemented (maybe worthwhile to check why). The WTO reform could offer a window.

Take away message

- Variable biofuel demand could theoretically reduce or even avoid iLUC effects of biofuels
- Its potential to be effectively governed is unknown
- Even if existing, policy “uptake” extremely unlikely, given current dynamics in G7/G20, and overall trade policies –yet, WTO reform may be a “window”
- Alternative pathway suggested: Biofuels as part of the bioeconomy (by-and co-products from land and feedstock conversion), with broad system boundaries to avoid “cherry picking” and burden shifting; sustainability requirements for all biomass
- Reframe iLUC: Currently, iLUC cannot be monitored. But there are various ways how energy crops can make a positive contribution by integration into landscapes.
- Integrate biofuels into a sustainable (iLUC free) bio-economy
- There are no viable options for governance of the implementation of a VBD

Sustainable Bioeconomy: an iLUC-free vision



3.7 Biofuel Economics

Presentation by Dr. Don O'Connor

Over the past 35 years there has been quite an evolution in the biofuel market in the USA.

From 1980 to about 2005 ethanol prices in North America were set by the price of gasoline plus tax incentives. Feedstock prices were set by the overall supply and demand factors of which ethanol had little influence. Nowadays, feedstock prices are still determined by supply and demand but ethanol is a much bigger part of the demand and does have some influence. Ethanol prices now have their own market and respond to supply and demand almost independent of gasoline prices. Currently there is a lot of profit in the supply chain (shared between corn producer and refiner/ blender) but it is concentrated in the hands of the refiner/blender. The corn producer and ethanol producer on average break-even whereas refiners have high profitability

The situation today:

- Refiners can afford to pay a lot more for ethanol and still be profitable, in spite of their hardship claims.
- Ethanol and feedstock producers are operating at breakeven (on average).
- Higher feedstock prices would benefit farmers but would squeeze ethanol producers and probably have no impact on the refiner.
- It is the refiner who is regulated by fuel requirements.

Are markets connected?

- It is not clear to me how changing the requirements on the refiner for blending can be guaranteed to have the desired impact on the ethanol producer or the feedstock producer.
- Current pricing would suggest that there is no upward pressure on feedstock production.
 - The current risk to food security is that prices are too low.

How it worked during the drought:

Credit Carry Forward gave the possibility to draw from the bank and then make up the next year. In 2010 there was over compliance (more ethanol blended). In 2011 during the drought when the ethanol price was high, they could meet the requirement due to over compliance the previous year.

- The US refining industry had built a sizeable credit bank in 2010 and 2011 so that when the feedstock availability in 2012 was reduced, they could draw on the credit bank and maintain RFS compliance.
- An alternative is deficit carry forward but this needs to ensure that it is designed not to encourage lower blending in perpetuity.

A Variable Biofuel Demand, important issues to consider:

- Can a regulatory system respond quick enough to be effective?
- How would it be triggered?
- Do price signals flow through the three markets without distortion?
- Can the yield gap be reduced without profitable prices?
- How can the reduction in cropland in the US and Canada be reconciled with the biofuels expansion over the past several decades?

Discussion

When using averages; the variation between individual farmers is not presented, as some farmers may have high profits whereas others have high losses.

Closing the yield gap in times of low prices. In time of low price farmers look for options to cut on costs; which may lead to increased efficiency and decreasing the yield gap. Innovation takes place on the farm.

Whereas in time of higher prices there might be less focus on efficient farm management and there might be room for inputs such as specific seeds.

The farmer keeps producing even he is not getting his money back, subsidies to make the difference.

Take away message

Have a "buffer system" in your design to make your system cope with fluctuations in feedstock availability. The 2012 USA drought may serve as an example.

Leave regulation to the market.

3.8 Feedstock demand and supply for the Chemical Industry

Presentation by Dr. Michael Carus

Biobased and CO₂ based economy.

Explorative scenarios are developed to match demand and supply by sector. All scenarios have to be sustainable: renewable carbon is key.

High growth in raw material demand is expected in chemicals and textiles (for lifestyle), less in energy and fuel due to solar and wind energy development.

To supply growth according to the projection, then biomass share will increase significantly. It can cover the demand for food, chemical and energy. But biofuels are not totally covered

A future-oriented chemical industry has to deal intensively with renewable carbon. There are only three sources of renewable carbon:

- Renewable carbon from recycling of already existing plastics and other organic chemistry products (mechanical and chemical recycling).
- Renewable carbon gained from all types of biomass.
- Renewable carbon from direct CO₂ utilisation of fossil point sources (while they still exist) as well as from permanently biogenous point sources and direct air capture.

All three sources are essential for a complete transition to renewable carbon, and all of them should be similarly used by the industry, supported by politics and accepted by the population.

Discussion

There is a difference of facts and marketing/what the customer perceives. For consumers these concepts are difficult to understand. When faced with the decision to use corn or wood for plastics they choose corn because they think corn looks like plastic and wood doesn't and they want to protect their forest.

Take away message

When prioritizing according to Nova scenario for global biomass supply and demand: biofuel demand cannot be fully met in 2050; look for alternatives.

If you have a good story, you can sell everything.

3.9 Overview

A reflection by Jan van Esch, Kees Kwant and Paul Sinnige

The government (going for less regulations; less market interference) should only step in and regulate if things go wrong; otherwise don't interfere with the market, step back. The same counts for at EU level.

Intervention may be necessary in specific areas, such as how can farmers can get enough income. Biofuels can offer them an additional outlet and provide solution. Also look for more added-value products.

In general: you need smart interventions.

Some aspects that are worthwhile mentioning and have not yet been touched at in the workshop:

- Can we grow corn with more straw?
- Technology: small scale multi-fed biorefineries in order to be less dependent on 1 crop; in addition what type of technology is needed, do you need a big central or small in different locations
- Who is going to be the middlemen?
- Look at the organization form. Cooperatives are also important, can make the decision without hurting the farmer.

The topic has been looked at from different points of view: what sources do we need as a society. The IEA scenario is a low-carbon scenario.

Not everything can be solved by electricity; we need biomass both for biofuels and for chemicals.

Regarding "supply and demand"; the question is: How can we create a stable environment? It should be a market-oriented approach.

Government defines the rules within the market; we want to bring stability in this formulation.

When you design a VBD system, take the following into account:

- 1 it is a good to have "banking" in it as buffer
- 2 there should be a stimulus to produce more.

The yield gap shows there is room for increase in production. In a bioeconomy – sustainable biomass is used for all applications. Look from GHG perspective what would be the best use, and then look at markets how can this be achieved.

There is debate on REDD

RED for transport: How do we get the right fuels at the right sector and where to put biomass in the system. How do we cater for good, cheap fuels (to replace fossil fuels).

Promoting use of waste & residues. Take into account: availability, logistics and valorisation.

Sometimes the system is also manipulated: rather than collecting used cooking oil they are "playing" with the oil.

Sustainability is important but feedstock needs to be cheap to replace fossil fuel based products.

We would not want to get rid of combustion motors before there is alternative that can be implemented everywhere, solar panel vs crop.

The electricity that we use now is not all renewable.

Aspects to keep in mind:

Crops for energy production as part of the rotation; Stable farmer income has to be realized;

Crop to contribute to C-storage in the field; improve farming systems.

Mansholt: Income of farmers is most important: food for everybody: no war.

4 Key Questions and Answers

1. Do you think the variable biofuel demand approach is offering perspectives?

The group appeared to agree that the variable biofuel demand approach is offering perspectives and theoretically it can work however its implementation faces several challenges.

2. What is needed to realize the potential benefits of variable demand?

To realize the potential benefits of variable demand, the group found it important to convince the right people and build their trust.

For the implementation of the variable biofuel demand approach several questions were raised during the workshop which needs to be handled in order to realize the potential. These questions are:

- Can it respond quickly?
- What would be a viable option for its governance?
- Who will pay for the cost of temporary shutdown?
- How to enable release of virtual feedstock reserves?
- How will it be triggered? Can the price signals flow through the supply chain without distortion?
- What would be the suitable steering mechanism?
- Who will manage the switch from food to fuel?
- How to coordinate this at the high-level?
- How to deal with the uncertainty created for the biofuel producers? How to enable the continuation of investment?

3. Who needs to be convinced (who is the target audience), and how to convince them?

Who?

Policy makers; NGOs; Farmers / Cooperations; Public; Biofuel companies

How?

The group agreed that to communicate the message a simple, clear, good story is needed. For this cartoons or YouTube videos could be very useful. There are good examples discussed during the workshop that could be used in the explanation (Brazil (sugar cane), US (corn), South Africa (wheat), Mozambique (cassava)). If there is a crisis you can't eat the non-food crop. Let people arrive at the same conclusion.

But this should be still backed up by literature and data. We need global measurement and monitoring of i.e. deforestation, soil organic carbon etc. This evidence will also have a big impact in building trust. Furthermore, NGOs agree that intensification (reducing the yield gap) can bring benefits. Proof that biofuels can help with this can also help in the argument.

4. Can variable biofuel demand have a positive effect on food security?

With food crops it is possible to produce both food and fuel, also termed as flexcrops. The group seemed to agree that the variable biofuel demand approach could have a positive effect of food security. Several examples were presented during the workshop as evidence of this effect. An example was provided during the workshop from Brazil's Pro-Alcohol programme where from sugarcane the sugar and ethanol that can be produced are partners and not competitors for the same feedstock. It was shown that this programme led to significant local socio-economic development and ability to react to price changes. Another example was shown for the US, when drought in 2011 occurred, it didn't result in a big problem in food security as would be expected. This is because there was a big cushion from corn that was used for biofuel. However, there was also a point made that food security is not only about food availability but more about the income.

5. Can variable biofuel demand result in additional investment in agricultural productivity with benefits shared across entire chain?

With the expanded markets for their feedstocks, farmers get additional income that they can invest in their farms. An example was provided during the workshop that in the US, the increased returns gave farmers an incentive to invest in their farm (rather than pay it as tax) so productivity increased and they bought silos, buildings and tractors. They could store additional production in silos and this could be directed to food or fuel according to the price incentives.

In case of low food prices, farmers don't invest and this lowers productivity in agriculture. It was especially highlighted that for perennial crops the effect is not seen quickly but only in the following years. Therefore, it is harder to react quickly to price signals since the effect is delayed.

Furthermore, data suggests that there appears no direct link between the profits gained across the supply chain. It was shown that corn producers and ethanol producers on average break-even whereas refiners receive high profits. Farmers keep producing even if they do not get their money back, and subsidies make up the difference.

6. Can variable biofuel demand lead to intensification (increased crop yields)?

It was highlighted during the meeting that there is a problem of shortage of proper land management. Furthermore, data evidence suggests that global crop yields needs to increase 1.2-1.3% annually until 2050 to meet food demand on existing cropland area. Especially in Eastern Europe and Africa there is significant yield gap, offering a lot of potential. The group seemed to agree that with good management practice in place, a variable biofuel demand approach could draw additional investment and R&D for crop intensification. An example was provided during the workshop that Brazil's Pro-Alcohol program boosted investment and improved cane breeding, management and processing efficiency. Sugarcane feedstock represents 2/3 of total final product costs (ethanol or sugar) so improvements in cane genetics and management has significant impact.

7. What research is needed and how can this group and their networks help?

The group thought that partnership of different science based groups and different disciplines working together will be very fruitful. Continuing and improved measurement and documentation of the currently occupied land is needed. The studies of the different groups can be brought together to provide an overall picture.

Several research topics were raised during the workshop:

- Research on synergy, that 1st gen biofuels can increase food security
- Research on showing that 1st gen biofuels can promote investment in agriculture and R&D in intensification (closing the yield gap)
- Research on biorefinery to produce multi-output
- Research on deforestation (when, where, why) and to show if there is a link to biofuels and if it has a negative or positive impact (on iLUC)
- Continuation of building the Yield Gap Atlas (estimate of extra crop production potential on existing cropland and with available water resources, estimate of nutrient and water requirements)
- Research on potential of intercropping
- Research on improving land management, measuring and monitoring soil organic C

8. What recommendation for policy development can be provided?

The group discussed several recommendations for policy development to accommodate the variable biofuel demand approach:

- Include an option to act according to feedstock availability and price. The option to have an emergency break in the policy to prevent potential food crises.
- Have a buffer system in the policy design to make your system cope with fluctuations in feedstock availability.
- Have a banking / credit carry forward system – over compliance when possible and bank it and draw from the bank to maintain compliance when necessary.
- Have performance-based policies with flexibility to support local adaption and innovative solutions incl. better access to inputs, access to credits and markets.
- Address market distortion, create level playing field between biofuels and biochemicals/materials. Can be done through e.g. CO₂ tax, putting tax on fossil C used as input.
- Include viable mechanisms to finance investment in conservation of HCVs, investment in improving land management. Currently not sufficient incentives.
- Provide more incentive to increase productivity per hectare, in order to close the yield gap.

9. What are other relevant issues that need to be researched?

During the workshop also other research topics were brought into discussion that would be important in shaping the future economy. This included a need to have discussion on protein transition. Also production of CO₂ based fuels and chemicals were brought up due to theoretical improved efficiency compared with photosynthesis. Another point that was made is the need to have research on biorefineries, if it would be possible to have flexibility in feedstock and what arrangement would be more suitable (big central or small local decentralized).

Overall Conclusions

We need 1st generation biofuels **now** to reduce climate impact but we need to have a phasing out strategy to achieve the transition to electricity for transportation. But, not everything can be solved by electricity; and also electricity currently is not 100% renewable.

We also need food crops for the chemical sector and you cannot use electricity as an alternative here. Shift to biochemicals will be automatic by market if it makes money. For that a level playing field with biofuels is required since the incentives given currently for biofuels distorts the market. We also need to look from a sustainability perspective for what is the best use of biomass (fuel vs chemical) and then look at how to achieve this in the market. For that we need to consider the whole bioeconomy and bring sustainability requirement for all biomass. We also need to facilitate the development of biochemicals/materials so they become cost competitive with fossil-based counterparts.

To create a stable environment, a market oriented approach should be used. Government defines the rules and not interferes with the market. But may still need regulation to facilitate it, to prevent market distortion. And it also depends on the context; it cannot be "1 size fits all". In developed world market oriented approach can be possible, but in developing countries markets probably cannot organize it and would need government interference.

Meeting food, feed, fiber, and fuel demand without negative iLUC effects will depend on our ability to increase yields on existing cropland. There needs to be improvement in land management. This offers potential for increasing soil organic C content and improving food security (intercropping).

2nd generation biofuels would not help to improve food security, as it would not give the choice to switch to food if necessary. Furthermore, 1st gen biofuels bring more resilience to farmers as they have multiple markets for their agricultural products.

There are good examples of positive effects of biofuels for food security from Brazil (sugar cane), US (corn), South Africa (wheat), Mozambique (cassava) showing the shift from fuel to food according to availability and price of feedstock.

Appendix A: Workshop programme

PROGRAM

Time	Topic	Speaker
8:30 - 9:00	<i>Registration and welcome coffee</i>	
9:00 - 9:15	Opening of the Workshop	Jan van Esch (Ministry of Agriculture) and Kees Kwant (Netherlands Enterprise Agency / IEA Bioenergy Exco Member)
9:15 - 9:30	Introduction of the program + introduction of participants	Hans Langeveld (Moderator)
9:30 - 10:00	Introducing the concept of variable demand, results of an expert survey	Wolter Elbersen (Wageningen University and Research)
10:00 - 10:30	Reconciling food and fuel, concept of flexcrops	Keith Kline (DOE, USA)
10:30 - 11:00	<i>BREAK</i>	
11:00 - 11:30	Yield gap and yield increase options in perennial crops	Maja Slingerland (Wageningen University)
11:30 - 12:00	Yield gap and yield increase options in annual crops	Patricio Grassini (University of Nebraska, USA)
12:00 - 12:30	Agricultural policy and governance of variable biofuels demand	Erik Mathijs (KU Leuven, Belgium)
12:30 - 13:30	<i>LUNCH</i>	
13:30 - 14:00	Variable demand and iLUC	Uwe Fritsche (IINAS, Germany)
14:00 - 14:30	Biofuel economics, variable biofuel demand example from North America	Don O'Connor ((S&T) ² Consultants, Canada)

Time	Topic	Speaker
14:30 - 15:00	Vary feedstock supply for Chemical industries or not?	Michael Carus (Nova institute, Germany)
15:00 - 15:30	Reflection on the presentations by Jan van Esch, Kees Kwant and Paul Sinnige (Netherlands Enterprise Agency)	
15:30 - 16:00	<i>BREAK</i>	
16:00 - 17:00	Break out session on key questions	2 groups
17:00 - 18:00	Reporting per group & Plenary discussion	
18:00 -	<i>Closure of workshop, drinks and dinner</i>	

Appendix B: List of workshop participants

Jan van Esch (Ministry of Agriculture)

Kees Kwant (Netherlands Enterprise Agency / IEA Bioenergy Exco Member)

Paul Sinnige (RVO)

Wolter Elbersen (Wageningen University and Research)

Hans Langeveld (Moderator / Biomass Research)

Keith Kline (DOE, USA)

Maja Slingerland (Wageningen University)

Patricio Grassini (University of Nebraska, USA)

Erik Mathijs (KU Leuven, Belgium)

Uwe Fritsche (IINAS, Germany)

Don O'Connor ((S&T)2 Consultants), Canada)

Michael Carus (Nova institute, Germany)

Iris Vural Gursel (Wageningen University and Research)

Foluke Quist-Wessel (AgriQuest)

Appendix C: List of abbreviations

GHG	Greenhouse gas Emissions
IEA	International Energy Agency
iLUC	indirect land use change
VBD	Variable Biofuel Demand

IEA Bioenergy



Further Information

IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/