The Challenge of Accounting for Land Use Change in the Assessment of Bioenergy Production

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Direct and Indirect Land Use Change

The expansion of biomass production for energy uses is seen as one of the strategies to replace fossil energy sources by non-fossil renewable sources. Many countries are promoting the conversion of existing agricultural land and the conversion of land previously not used for crop production for the production of feedstock for biofuels and other bioenergy.

The contribution of bioenergy to the saving of greenhouse gas emissions has recently become criticized because – according to previous practice – the inclusion of the carbon balance of land use change has not been included in the greenhouse (GHG) balances of bioenergy production. The previous greenhouse gas balances were computed by netting out the gross GHG savings of a particular bioenergy product such as a specific biofuel with the fossil based GHG inputs needed to produce the bioenergy. This approach has ignored the fact that in the process of production not only the flow of GHGs in the production process need to be accounted for but also the change in the stock of carbon that is contained in the biomass above ground and in the soils and roots below ground.

The change in the stock of carbon is of particular importance if land comes into use for bioenergy production that has not been used before or has been subject to other uses such as forestry or as pasture. The direct land use change can release carbon from the land if, e.g., forest area is converted to the production of energy crops. The carbon stored in the wood and leaves of the trees and the carbon in roots and soils would need to be added to the fossil GHG inputs as the production of energy crops mobilizes carbon that would not have been released into the atmosphere without the activity.

Some argue that the GHG balance including the change in carbon stocks of a particular area still does not account for the complete GHG balance of a particular bioenergy production activity. Instead, also the so called "indirect land use change" (ILUC) should be included in a complete GHG balance. This claim rests on the idea that the conversion of an area that has been used for food production will lead to an increase in the food production on another land area. It is then argued that the change in the carbon stock due to land use change on this indirectly affected land now in use for food production should be added to the GHG balance of the bioenergy production.

There are several issues that make it difficult to find a convincing argument in favour of such an approach.

1. It is not at all clear whether indeed such a substitution of food production will take place. It is entirely possible that the demand for food may fall in the region in which the expansion takes place. It may also be met by deliveries from other regions or countries. This can be due to a comparative advantage in bioenergy versus food production of a country relative to other countries as it may be the case with sugar cane a crop best suited for bioenergy use.
2. Even if a substitution would takes place it is not clear which area actually is the one that has been converted in response to the land use change for bioenergy production. Suppose land used for cattle production is sold by the farmer and is then used by the new owner for bioenergy production. How would the indirect land use change assessed if the seller of the land retires or if he uses the funds to start raising cattle in another country? Would the bioenergy production by charged with a carbon load from ILUC?
3. Even if the area could be identified there often is no legal basis for charging the producer of the bioenergy with the losses of carbon stocks due to newly established food production somewhere else.

Why the attempt to assess the carbon impact of indirect land use change runs into conceptual difficulties can be attributed to several factors. The most important ones are the following:

On a global scale it is most likely true that an expansion of bioenergy production will either indirectly or directly lead to land use change. This is simply necessary in order to meet the increased demand for biomass. It could be argued that the additional biomass for bioenergy uses is grown on so called degraded land. Degraded land is land that has been in agricultural use but has been abandoned due to overuse or to changes in the climatic, institutional, or economic conditions. Studies that try to compute the global potential for bioenergy production often refer to the degraded land areas that could be brought back into productive use. Such assessments indeed provide a figure – albeit currently still with a high margin of uncertainty – for the overall bioenergy potential. They conclude that a sizeable share of renewable energy could come from bioenergy. However, they ignore that such potentials must be realized in a commercial setting where such activities actually need to turn out as a profitable activity. In fact, if bioenergy production is a profitable activity then it is not clear why it should take place on degraded land and not on the more productive, i.e. fertile, land.

If the production incentives are in favour of bioenergy relative to food production the expansion of these activities is likely to take place on fertile land and not on marginal land. In this case there is a good chance that globally a negative GHG balance will be the result of an expansion of bioenergy production. This could only be avoided if the expansion of bioenergy production is properly managed with respect to the overall GHG balance of biomass production activities. In practice, this would require a complete world wide GHG balancing of agricultural production activities. Since food production is currently not subject to any GHG accounting only a global management approach would be a possible way to assess the carbon balance. Yet, this is essentially not feasible due to a lack of reliable data, and more importantly, it is extremely unlikely to be implemented.

This global effect of bioenergy activities can not be translated to a single farm or even a region. The adjustment processes and the replacement of areas devoted to food production as well as the expansion of cultivated land areas is governed by complex global processes. Global demand and supply conditions as well as the regional support policies in the agricultural sector determine simultaneously the land use decisions. As a consequence, the ILUC of bioenergy production does not take place within the local community nor on a national level but is spread throughout the globe. The expansion of food production may take place far a way from the location where the food production has been replaced by bioenergy production. Therefore, a local carbon balance can not be computed nor can the accounting of carbon losses to bioenergy activities implemented on the basis of a causal relationship since the substitution effects take place beyond the local borders.

Without a causal relationship between bioenergy expansion and the ILUC the amount of GHGs that would need to be allocated to a particular bioenergy plantation can not be computed. The only option that is proposed consists of the application of an average carbon loss in a region to all bioenergy activities. Apart from the fact that this may be in conflict with basic legal principles it does not provide incentives to the implementation of carbon saving technologies. A carbon load that is artificially added to all bioenergy activities will simply result in a shift of the net carbon balance but not in a change of the competitive advantage of a producer that can produce with a better net carbon balance. If such a correction is made on a country wide basis it runs the risk of being seen as a trade barrier instead of an incentive instrument for promoting those biofuel activities with the highest GHG savings.

Solutions to the Assessment of Direct and Indirect Land Use Change

Direct land use change can be introduced directly through a stock taking of land use practices over a certain number of years before present. This history can be used to establish an estimate of the development of the carbon stock of a particular area over time. So far, such information is not available on a regular basis nor is it done for a sufficiently fine resolution that can identify farm level activities. The current ISCC project is working on the development of such information for those areas in which farms will become subject to a GHG certification.

The land use change documentation will provide the information for the computation of carbon flows associated with the production of feedstock for biofuels. If there has been a change in land use prior to the feedstock production and this change has released large amounts of carbon, these emissions need to be allocated to the current land use practices. If no land use change has taken place over a reasonable amount of time the carbon stock assessment is only proof for not needing to include the change in carbon stocks in the GHG balance.

If, for example, the conversion of land for biofuel feedstock production releases a certain amount E tons of carbon per ha, this would be a debt to the subsequent biofuel production which has to be balanced over time with carbon savings. Suppose the biofuel production on this land saves e tons of carbon. Then the biofuel activity could claim carbon savings only after E/e years. In fact, this resembles somewhat the regulation for farmers who switch to bio-products as they can use the label after a number of years over which the farm has sufficiently removed the “non-bio” aspects in its land use chain.

There are other options that could be used to account for the direct land use change. A crude system would determine whether the land use change has released an amount of carbon beyond a certain threshold per ha and would then remove this activity completely from receiving any carbon credits.

A more market oriented approach would be the following: An operator could be given the option to compensate the debt incurred through land use change by buying the equivalent amount of carbon certificates from a carbon market. Once he has served this debt he could operate on the basis of the current carbon flow balance and get accounted for the GHG savings from the standard GHG balance.

Such an approach of compensation payments would also solve potentially more complex cases where over time several changes in the land use practices take place. Suppose there is first a change from forest to food production and then to biofuel feedstocks. In the case where the debt is allocated to the next activity the loss in carbon would not be attributed to bioenergy because there was food production – to which carbon balances are currently not applied - before the area is used for biofuel feedstock. In this case the new bioenergy activity would need to compensate for the loss in carbon if the conversion from forest has taken place before a reference year that would have to be determined. This would avoid the need assess the whole chain of land use changes which would be very difficult to control. In fact, as long as only biofuel activities are subject to carbon balances a chain of land use changes will essentially prohibit an entirely correct attribution of carbon stock changes on the biofuel activity but the compensation system would at least approximate it.

Indirect land use change can not be controlled efficiently for biofuel activities alone. Efficiency is here understood as the quality of an accounting system to ascribe the causal effects of the chain of land use changes to the biofuel activity. As argued above, this is in principle impossible and can only in a few cases established with some accuracy. This problem could only by overcome if all agricultural activities are brought into the GHG accounting system.

In this case every land use change becomes by definition a direct land use change. And this land use change may increase or decrease the stock of carbon on the area under consideration; hence the land use change would incur a carbon debt in the case of a loss and a carbon gain in the case of an accumulation of carbon through the new land use practice.

This means the problem of indirect land use change is in fact only a problem of an incomplete carbon accounting of land use practices where only biofuel activities are subject to such an accounting but not food production or other bioenergy uses. If, in contrast, all land use practices from forestry, to animal grazing, and to food, fodder and bioenergy production were subject to a carbon accounting system the burden of land use change would always be imposed on the activity that has replaced the previous type of land use. All considerations about accounting for indirect land use change would be meaningless.

The solution to the accounting for indirect land use change (ILUC) can therefore not be an ad hoc attribution of land use changes that are taking place all over the world due to the expansion of bioenergy production. ILUC can only be efficiently taken care of if all land use activities will in the next years become subject to a GHG accounting. This may not be the last step as the inputs going into agricultural activities would also need to carry a GHG balance. But this would require a complete carbon and GHG balance of all economic activities, an approach that would be desirable for an efficient choice of land use that takes into account the climate change aspects of agricultural activities.