German Environment Agency

30. June 2022

Funding climate-friendly soil management – key issues

Carbon leakage

1 Background

Definition: Carbon leakage can be illustrated by the 'waterbed' metaphor: It occurs when an activity reduces emissions or increases sequestration within the project's boundaries, but as a result emissions increase outside the project boundary, thus reducing the net mitigation effect. The IPCC defines **carbon leakage** as a phenomenon "whereby the reduction in emissions (relative to a baseline) in a jurisdiction / sector associated with the implementation of mitigation policy is offset to some degree by an increase outside the jurisdiction / sector through induced changes in consumption, production, prices, land use and / or trade across the jurisdictions / sectors".[1][2]

Importance: Carbon leakage decreases the net mitigation impact of carbon actions, as mitigation within the project boundary is offset by increased emissions outside the project boundary. It is particularly relevant to avoid carbon leakage in the context of transfer-based mechanisms[3] to make sure that the use of such mechanisms does not lead to higher total emissions than if no transfer had taken place. However, also for other funding mechanisms, carbon leakage undermines environmental integrity.

Relevance: Leakage is principally relevant for various types of mitigation activities including soil carbon mitigation projects that aim to reduce or avoid emissions as well as activities that aim to sequester additional carbon. The specific risks depend on whether the activity affects the way the land is used and whether the activity decreases the supply of products or services compared to the land use prior to the implementation of the activity.

2 Key issues

Different types of leakage (Böttcher et al. 2022; Schwarze et al. 2002):

- *Direct or primary leakage* occurs if the implementation of an activity directly causes a shift in the supply of products or services from one area to another. Direct leakage often occurs at a local and national scale. If the supply of a product or service is displaced by an activity, resulting in primary leakage, the design of the activity is likely to be flawed.

[1] Climate Change 2014: Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Glossary, available at https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-i.pdf.

[2] As a particular case, carbon leakage is often referred to in the context of the shift of emissions-intensive activities to jurisdictions with weaker regulation as a result of pricing CO_2 emissions through a climate policy instrument such as an emissions trading scheme. It can also refer to the leakage of stored CO_2 in technical carbon sinks. Here we focus on leakage that occurs as a result of implementing mitigation activities in a broader sense.

[3] Transfer-based mechanism: A results-based payment (i.e. payment depends on mitigation result achieved), where the ownership rights of the mitigation are transferred from the seller to the buyer.

- *Indirect or secondary leakage* refers to a situation where the implementation of an activity in one area indirectly creates incentives for changes in activities in other areas. The reduction in the supply of products or services in one area leads to a *shift in markets*. Conservation activities avoiding the expansion of commercial agricultural production are more likely to lead to secondary leakage. It is most likely to occur on a national or international scale.
- *Ecological leakage* occurs if the implementation of an activity in one area affects natural processes in surrounding ecosystems outside an activity's boundary which in turn causes emissions, e.g. if organic soils in an area are rewetted and this affects the hydrological properties of ecosystems in other areas resulting in tree dieback.

System/project boundary: System boundary refers to the scope of a mitigation activity and thus defines the removals and emissions that are included in the quantification of net mitigation effects. The boundary can include or exclude particular gases, carbon pools, or geographic areas. While broader system boundaries leave less space for leakage, narrower ones involve greater leakage risks (McDonald et al. 2021). Possible carbon leakage risks are usually accounted for in the quantification methodology.

Types of activities causing leakage: Leakage is not linked to specific activity types (with the exception of ecological leakage caused by wetland activities). Any activity changing the level of supply of products or services from affected areas can result in leakage. The way the land has been used prior to the activity, the properties of products and services from affected areas and the characteristics of related markets as well as the design of the activity and underlying drivers are important factors influencing the risk of leakage (Böttcher et al. 2022). The risk of leakage is lower if an activity is implemented in abandoned areas (UBA 2019).

Environmental integrity: Carbon leakage generally undermines the environmental integrity of a mitigation activity. If it is not avoided or accounted for, leakage leads to overestimating the mitigation impact on the atmosphere. Leakage can also be positive (also referred to as spill-over), if the implementation of a mitigation activity induces additional removals/emission reductions that are not accounted for (e.g. by inducing neighbouring farmers to implement removal activities) (McDonald et al. 2021).

Challenges of identifying leakage: As it is difficult to identify impacts outside of an activity's boundaries which are not monitored, it is challenging to identify leakage (McDonald et al. 2021).

3 Examples

Low-input grasslands / set-aside areas: By taking arable land out of production and out of crop rotation for a certain time, carbon sequestration on this area can be increased. However, the cultivation of crops or grazing of animals might be displaced to other areas as a result (with a resulting decrease in mitigation on those sites), providing an example of direct leakage. Landscape approaches that extend sequestration activities to larger areas can help to address direct leakage risks (Jacobs et al. 2020). When assessing leakage risks, all impacts on emissions or sequestration need to be considered, including potential increased numbers of ruminants and related emissions resulting from the expansion of grasslands used as pasture, for example. Stringent planning of measures to increase soil carbon stocks through ex-ante impact assessments can help to address such risks (Thamo and Pannell 2016). Indirect leakage could occur if the displacement of crops or grazing of animals would induce deforestation elsewhere. In such instances, leakage emissions may even exceed the increases in soil carbon achieved on the project areas.

External organic inputs: Import of organic inputs such as manure, compost, biochar from elsewhere may lead to carbon accumulation in the targeted site but lead to a carbon loss at the place of origin. Whole-farm approaches can help to account for all emissions and removals or carbon losses at a farm by measuring a farm's overall GHG emissions occurring within the boundary of the farm. Mixed farms which produce their own manure can ensure more closed nutrient and carbon cycles.

Rewetting of peatlands: In the context of rewetting peatlands, there is a risk of ecological leakage. This would occur if raising the water table within the project boundary resulted in water table levels dropping and increased emissions on hydrologically connected fields. To avoid such forms of leakage, the project design needs to account for possible leakage, e.g. by establishing a project boundary wide enough to capture expected water level changes that are linked to project activities (UBA 2019).

4 Relevance for the EU

Existing EU voluntary carbon mechanisms have different ways of avoiding and addressing leakage. These include assuming that no leakage occurs, qualitative approaches for reducing leakage, or estimating the extent of leakage and discounting it when quantifying net mitigation (McDonald et al. 2021).

Indirect land use change (ILUC) can be considered as a specific form of leakage. ILUC can occur when pasture or agricultural land previously used for the production of food or feedstock is diverted to the production of biofuels. As a result, the previous agricultural activities may shift to forests, wetlands and peatlands that are cleared or dried and thus lead to additional emissions that negate emission savings from the use of biofuels instead of fossil fuels. To address this risk, the revised Renewable Energy Directive (RED II)[4] includes three mechanisms:

1. The EU has set a quota for advanced biofuels made from feedstocks listed in Annex IX of the RED II, e.g. biowaste, crop residues and wood from forests except saw logs and veneer logs. ILUC effects are supposed to be low for these feedstocks.
2. The EU limits the contribution of biofuels made from food or feed crops to renewable energy targets of its Member States in RED II, as these fuels imply a risk of causing ILUC.
3. Feedstocks that qualify as high ILUC-risk feedstock for which a significant expansion into land with high-carbon stock is observed, shall decline to zero until 2030. Until now, palm oil has been identified as high ILUC-risk feedstock.[5] However, the Directive exempts certain biofuels, bioliquids and biomass fuels from these limits if they are certified to present a low ILUC risk according to the Delegated Regulation 2019/807[6], including palm oil produced e.g. by small holders or on degraded land.

The proposal for adapting the RED II as part of the Fit for 55 package published in July 2021 sets limits on the use of high ILUC-risk feedstocks, regardless of whether they are produced within the EU or are imported.[7] However, until the adoption of revised legislation, no rules on the import or use of high ILUC-risk fuels, e.g. on the basis of palm oil, exist.[8] The risk of additional

[4] See Directive (EU) 2018/2001, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC.

[5] See report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the status of production expansion of relevant food and feed crops worldwide, COM(2019) 142 final, available at https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52019DC0142.

[6] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.133.01.0001.01.ENG.

[7] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0557.

[8] The current RED II only limits the amount of such fuels that can be counted when calculating the share of renewables used in transport, see https://ec.europa.eu/commission/presscorner/detail/en/memo_19_1656.

emissions caused by indirect land use change effects as a result of the production of biofuel therefore currently persists.

5 Addressing challenges

To minimise leakage risks to the extent possible, the following hierarchy describes possible approaches to be taken (see Böttcher et al. 2022):

1. **Identify** possible leakage risks related to land-use activities, including not only emission leakage but also ecological leakage and potential spillover effects where relevant;
2. **Exclude activities** with material risks of global leakage (the risk varies for different types of activities, therefore it is not possible to exclude a certain type of climate-friendly soil management because of high leakage risks but the risks need to be evaluated in the specific context of a project);
3. **Mitigate** leakage risks to the extent possible through the careful design of activities, e.g. through the implementation on abandoned land, or the introduction of buffer zones;
4. **Quantify** leakage appropriately using case-specific quantification methods; if default factors are applied, they need to be differentiated as much as possible (e.g. by type of activity/products affected);
5. **Include** leakage transparently in determining total net emission reductions or removals.

There is, however, a lack of methods to address international leakage (Henders and Ostwald 2012), so that the risk cannot be ruled out completely.

6 Relevant literature

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Imprint

Publisher

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Completion: June 2022