- **Humus balancing:** With the formation of humus, carbon is stored in the soil. With the decomposition of humus, CO_2- und N_2O-emissions are released. Integrating a biogas plant into a farm concept can lead to changes in fertilization practice, crop rotation and the management of crop residues. Furthermore the intensity of farm management may rise. These issues affect the humus balance. A current project at the Institute for plant production and plant breeding at the LfL analyses the level of the release or fixation of carbon to/from the humus layer for different biogas crop rotations: Optimierte Pflanzenbausysteme für nachhaltige und klimafreundliche Biogasfruchtfolgen
  Depending on the crop rotation up to 3 t $CO_{2\text{-equivalent}}$ $(ha\ a)^{-1}$ can be released or fixed.
- **Direct land use change (LUC):** lead to long-term emissions from the decomposition of soil organic matter. The most important LUC in German agriculture is the utilization of drained peat soils and the ploughing of permanent grassland. The ploughing of permanent grassland is according to IPCC (2000) coupled with emissions of around 2.133 t CO_2 $(ha\ a)^{-1}$ over 50 years. Moreover another 0.486 t $CO_{2\text{- equivalent}}$ $(ha\ a)^{-1}$ are emitted over ten years from nitrogen mineralisation in terms of N_2O-emissions.
- **Indirect land use change (iLUC):** describes the displacement of cultivation area. In the case of biogas production, a displacement of local cultivation area for the production of foodstuff for the benefit of energy crops is generally possible. The displaced agricultural goods can be produced in other parts of the world at the expanse of newly developed land (cleared rain forests or ploughing of permanent grassland). The provoked effects by the change of cultivation of a single area can't be causally proven but only simulated with global land use and market models under high uncertainties. Political factors, changed cropping conditions and technical progress in the agricultural sector complicate the analysis. Fritsche et al. (2010) state an exemplary range for the iLUC factor for 2010: 3.4 t CO_2 $(ha\ a)^{-1}$, if 25 % of bioenergy crops lead to indirect land use change; 6.8 t CO_2 $(ha\ a)^{-1}$ for the share of 50%; up to a maximum of 10.2 t CO_2 $(ha\ a)^{-1}$ if 100% of bioenergy crops lead to indirect land use change.