

# The intensity of land use doubled in the 20th century

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The growth of green plants – which can be measured in terms of "net primary production", or NPP for short – provides the energetic foundation for all life on earth. The share of NPP appropriated by humans (HANPP) through agriculture and forestry, bioenergy production, and vegetation fires doubled over the course of the past century. Researchers at the Institute of Social Ecology at the AAU have shown that while land is used more efficiently, simultaneously, the intensity of land use has increased continuously. In a study published in *PNAS (Proceedings of the National Academy of Sciences)*, researchers warn that an increased expansion of bioenergy use would drastically raise HANPP to over 40%.

The growing [global population](#) and its increasing hunger for resources gives cause for concern for various reasons, in particular with regard to the sustainability of the current and future use of natural resources. The so-called HANPP indicator is a measurement for the intensity with which humans use land and biomass. HANPP stands for "Human Appropriation of Net Primary Production" and provides information about the impact of human activity upon the biosphere. HANPP reveals the percentage of the annual plant-based biomass production that is co-opted by humans through land use activities such as agriculture and forestry, bioenergy production, construction of buildings and infrastructures, soil degradation, or human induced vegetation fires – and thus not available to other [ecosystem processes](#).

A study recently published in *PNAS* quantifies for the first time long

term trends in HANPP during global industrialization covering the period from 1910 to 2005. The authors, including Fridolin Krausmann, Karl-Heinz Erb, Simone Gingrich, Helmut Haberl, Veronika Gaube, Christian Lauk and Christoph Plutzer from the Institute of Social Ecology, and Tim Searchinger from Princeton University arrived at a surprising result: While global population increased fourfold over the past century, and economic output increased 17-fold, HANPP "only" doubled. "This shows us that land use became more and more efficient across the globe: The production of food and other products has increased at a much faster rate than HANPP. Nevertheless, HANPP has climbed from 13 to 25 per cent during the past century", Fridolin Krausmann, lead author of the article, explains.

While global consumption has increased dramatically, the amount of biomass harvested and used per capita has dropped significantly. Krausmann elaborates: "One of the reasons for this is that – seen from a global perspective – bioenergy has increasingly been replaced by fossil energy. Furthermore, efficiency of conversion processes from biomass to products such as food or fibre has grown." However, as the authors of the study point out, there are major drawbacks: The impressive increase in efficiency gains in crop and livestock yields have been achieved at considerable ecological costs. "In order to increase yields and output, we use large amounts of fossil fuels and water, we turned to large-scale industrial animal production systems and put high environmental pressure on land, soils and biodiversity", Krausmann points out.

The authors assume that, given a continuation of the past trends, global average HANPP is likely to increase moderately to values up to 29 per cent by 2050. However, if bioenergy is to be expanded by as much as some IPCC scenarios suggest, the value could climb as high as 44 per cent, clearly exceeding the growth rate observed over the past decades and putting high pressure on ecosystems. The researchers thus call for caution: "Caveats are warranted concerning bioenergy strategies. The

utilization of vast land areas for the production of bioenergy can have a strong negative impact on food safety, forest resources, and biodiversity. Unrealistic expectations regarding bioenergy can result in failing to achieve the target of reducing greenhouse gases. Above all, we have to focus on sustainable intensification and we have to be careful to prevent any potential negative consequences of forms land use intensification that further increase the pressure on ecosystems."

**More information:** Krausmann, F. et al. Global human appropriation of net primary production doubled in the 20th century. *PNAS*, Early Edition (EE), week of June 3, 2013.

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