# Agri-environmental impacts of the oil palm

## **Indicators** for sustainable production


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An increasing number of non-governmental organizations are blaming current oil palm development systems, accusing them of being responsible for the degradation of natural resources and causing environmental problems. In 2003, this led to the founding of a roundtable for sustainable palm oil production, bringing together the different stakeholders in the supply chain, and CIRAD. The initiative is based on defining principles and criteria for sustainable production and on using a good practices guide. If the initiative is to be effective, it needs to be accompanied by precise qualitative and quantitative indicators.


Mature oil palm plantation. © A. Labeyrie

### Assessing plantation sustainability

Implementing these criteria means establishing a normative and transparent evaluation system based on a sound scientific footing, with a view to measuring, assessing and analysing how agricultural practices affect the environment, providing information on the status of each situation and monitoring the progress achieved.

To that end, CIRAD is developing with its partners a set of agri-environmental indicators, known as IPALM. The approach adopted is based on the INDIGO® method developed by INRA in Colmar for temperate crops. It involves a system that cross references agricultural practices with components in the agro-ecosystem that might be affected, such as surface water or groundwater quality, air quality, soil fertility, or even biodiversity

### Contacts

Jean-Pierre Caliman
CIRAD
Performance of tree crop-based systems research unit
c/o P.T. SMART
P.O. Box 1348
28000 Pekanbaru, Riau
Indonesia

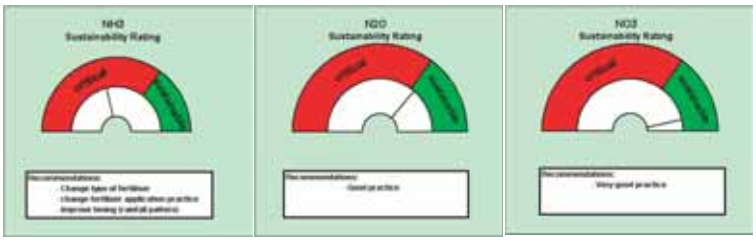
**jean-pierre.caliman@cirad.fr**

Aude Verwilghen
CIRAD
Performance of tree crop-based systems research unit
Avenue Agropolis
34398 Montpellier Cedex 5
France

**aude.verwilghen@cirad.fr**

## Assessment, decision-support and communication tools

These agri-environmental indicators are a tool for assessing pollution risks, but also for estimating the effectiveness of the fertilizers applied. Farmers who adopt these tools are thereby demonstrating their involvement in environmental conservation.
A scoring system has been developed based on scientific knowledge and a field assessment. It is on a scale of 0 to 10. The optimum "risk-free" situation for the environment is awarded a score of 10. A score of 7 to 10 lies in the "acceptable" zone, but still remains improvable. Any score under 7 indicates an excessive ecological risk requiring a specific action plan.



Results of nitrogen indicator ($I_N$) calculation, and recommendations.

## $I_N$: an indicator for nitrogen

$I_N$, the first indicator developed, assesses the efficiency of nitrogen management in oil palm plantations, especially applications of nitrogen fertilizers, which are usually both a key production factor, a major cost, and a major environmental risk. It can be used to estimate nitrogen losses in the form of ammonia by volatilization, nitrates by leaching and nitrogen protoxide by gas emission. It is therefore organized in three modules $I_{NH_3}$, $I_{NO_3}$, $I_{N_2O}$, relative to those compartments. Depending on whether the aim is to analyse environmental impact, or establish a diagnosis with a view to making practices more efficient, just one of these sub-indicators might be considered, or all three. $I_N$ is based on a complete nitrogen flow balance in relation to oil palm requirements and has to be updated each year for each plot. It can be applied to a plantation by using a mean of the plot values weighted by the areas.

## $I_{Phy}$: an indicator for pesticides

Pesticide use is of major concern to consumers. $I_{Phy}$ is a qualitative risk indicator based on decision trees. Fuzzy logic is used to aggregate the different factors identified as determinants in the process being considered, such as leaching, run-off and volatilization of pesticides. It also takes into account some properties of the molecules, their risks for human and animal health, and what happens to them in the environment (half-life, soil infiltration, etc.). The indicator comprises four modules, three on the risks associated with phytosanitary practices for the environmental compartments—surface water, groundwater, air—and the fourth on the risk associated with the rate applied.

## For a broader partnership

In addition to these two indicators, Iom, an indicator for organic matter and Icov, an indicator for soil cover, have also been developed. These four indicators are to be validated via a network of partners familiarized with this type of approach. Development of a software package to calculate the indicators on oil palm, IPALM, will facilitate its adoption by users. Future developments will focus on assessing how practices impact on biodiversity and water quality.

Nitrogen flow study: soil solution sampling system for $NO_3$ leaching analysis.
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Study of nitrogen flow balances (here the root system). © J.P. Caliman

### Partners

- University of Nancy, France
- INRA, Institut national de la recherche agronomique, Environment and Agronomy Centre, Nancy-Colmar, France
- PT Smart Tbk, Indonesia



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