An increasing number of non-governmental organizations are criticizing current oil palm development systems, accusing them of being responsible for the degradation of natural resources and causing environmental problems. In 2003, that led to the founding of the roundtable for sustainable palm oil production, bringing together the different stakeholders in the supply chain, in which CIRAD is a participant. 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.

Assessment of plantation sustainability

Implementation of these criteria means establishing a normative and transparent evaluation system established 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.

With that in mind, CIRAD’s strategy, along with its partners, is to develop a set of agri-environmental indicators. The approach adopted is based on the INDIGO® method developed by INRA in Colmar for temperate crops. It involves a matrix 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.
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 or a specific expertise. 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 remains possible to improve. Any score under 7 indicates an excessive ecological risk requiring a specific action plan.

\[ \text{IN: an indicator for nitrogen} \]

IN, the first indicator developed, is intended to assess the efficiency of nitrogen management in plantations, especially of nitrogen fertilizer elements, 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 \( \text{IN}_{\text{NH}_3} \), \( \text{IN}_{\text{NO}_3} \), \( \text{IN}_{\text{NO}_2} \) 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. IN 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 according to the areas.

\[ \text{IPhy: an indicator for pesticides} \]

Pesticide use is a major concern of consumers. IPhy 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, drift 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 one of the environmental compartments—surface water, groundwater, air—and the fourth on the risk associated with the rate applied.

For a broader partnership

The calibration of IN and IPhy will be improved. There are plans for them to be validated via an international network of partners attracted by such an approach. Their use could be easily generalized by taking into account parameters that are simple to acquire in plantations, such as soil texture, topography, rainfall frequency, the type of nitrogen fertilizer and application rates, etc.

**Partners...**

- INRA (Institut national de la recherche agronomique), Colmar centre, France
- INRA (Institut national de la recherche agronomique), Montpellier centre, France
- PT Smart, Indonesia