

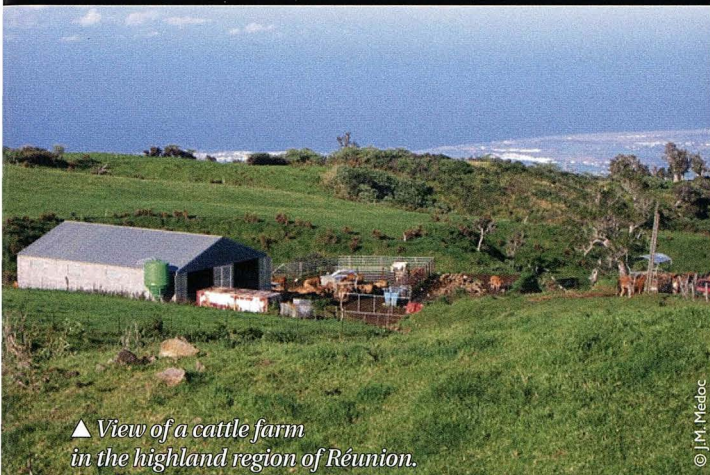
les dossiers
d'AGROPOLIS
INTERNATIONAL

Expertise of the scientific community



Agronomy
Crops and cropping systems

Integrated modelling of cropping practices and biomass flows in agricultural production systems



▲ View of a cattle farm in the highland region of Réunion.

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The 'Mafate' approach was developed for modelling and analysing mass flows on farm and territory scales, and designed to represent farmers' practices and test management strategies. It involves four steps: (i) acquisition of knowledge on practices, (ii) their conceptual representation (action models, typologies), (iii) construction of simulation models, (iv) use of these models to evaluate the functioning of targeted production systems. Several models have been developed with the same representation and goals, i.e. to simulate mass transfers between production units represented by stocks, linked by flows, which in turn are controlled by actions:

- 'Magma' was designed to simulate effluent management on livestock farms in Réunion. It was also adapted to represent family farms in Vietnam which include pig rearing, crop growing, fish farming ponds and biodigesters to process manure.
- 'Biomass', which was developed in partnership with the

Université de La Réunion, simulates effluent transfers between farms with surpluses and farms with shortages within territories. It was parameterized in the territory of Petit-Grand Tampon in Réunion.

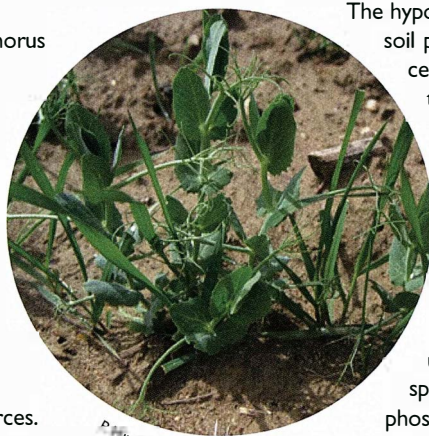
- 'Approzut' has been used to study pig slurry supplies to processing units in Réunion (Grand Ilet, Saint-Joseph).
- 'Comet' is used to assess logistical and environmental plans, and a collective pig slurry spreading plan involving several dozens of livestock farms and land lenders in southeastern Ille-et-Vilaine department (France).
- 'Gamede' (developed by J. Vayssières during his PhD research at CIRAD's UPR Livestock Systems and Animal Product Management), simulates overall nitrogen flows on cattle-dairy farms in Réunion.

Ongoing research is focused especially on environmental assessment of simulated production systems and representation of farmers' activities.

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Sharing major nutrient resources and uptake facilitation in intercropped cereal-legume systems: a case study on phosphorus

In light of the importance of ecological intensification in agrosystems, the phosphorus issue is especially worrisome because of the finite nature of natural phosphate resources, which is the main source of phosphate fertilizers. The shortage of these fertilizers will be a major problem within a few decades, so solutions are urgently needed. Among the promising innovations, UMR Eco&Sols has launched an extensive research programme on the benefits of intercropping, as compared to monocropping, in making more effective use of soil nutrient resources. Many previous studies have revealed that cereal-legume intercropping increases productivity, while also enhancing the quality of cereal production (protein contents) and nitrogen use, especially atmospheric nitrogen through more efficient symbiotic fixation. This is one factor behind the success of such cropping systems in developing countries and China, where intercropping systems are used on an area of around 25 million ha.



Philippe Hingsinger © INRA

The hypothesis put forward is that, in addition to nitrogen, soil phosphorus could be better used by intercropping cereals and legumes than by separately monocropping these species. Studies carried out by UMR Eco&Sols have shown that legumes (various tested grain legumes) and cereals (durum wheat) tap different soil phosphorus pools (organic/inorganic). Both species make more effective use of soil resources via this functional complementarity. Studies—especially long-term phosphate fertilization trials (40 years in 2009) carried out at INRA in Toulouse (France)—have also revealed nutrient uptake facilitation processes between intercropped species, i.e. the legume seems to be able to increase phosphorus availability in the associated durum wheat rhizosphere. Research is currently aimed at gaining insight into the underlying processes in order to come up with the best crop associations, especially under minimal phosphate fertilizer application conditions.

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▲ Intercropped pea-durum wheat in a phosphate fertilization trial at INRA Toulouse-Auzeville (France).