



VIP

VALORISATION
& INNOVATION
en PARTENARIAT

No 15 • May 2009

Editorial

Certain types of mining, industrial or agricultural operations have severely damaged the environment. Landscapes, soils, vegetation and even human health can suffer as a result.

In an international context which sets great store by preserving nature and biodiversity, restoring the environment is now a necessity. CIRAD's research work means that it is now possible to respond effectively to the expectations of both private firms and the public sector in terms of practical solutions.

Using bacterial or fungal strains suited to soils with high heavy metal contents is a rational, sustainable way of reconstituting the endemic flora of mining sites. Crop tolerance of cadmium can be measured to identify those suitable for use on phosphate mine refuse. If soils are too severely polluted for food crops, energy crops can be an alternative way of using the land. Lastly, knowing the ecology of plants and the processes by which endemic species are produced serves to guide ecological restoration operations aimed at restoring degraded forests.

If you are interested in the rehabilitation of degraded sites and the restoration of soils and vegetation, please get in touch with our teams with a view to working with them on the projects covered in this special issue.

Jean-Michel SARRAILH
Dynamics of Natural Forest,
CIRAD

Adapting to climate change

The impact of climate change on forests risks making millions of people poorer, destroying biodiversity and exacerbating greenhouse gas emissions. With the collaboration of CIRAD, the international forest research organization CIFOR recently published a report entitled "Facing an uncertain future: how forests and people can adapt to climate change". The report calls for the introduction of adaptation measures to reduce the vulnerability of forests and the people who depend on them.

For further information: <http://climat.cirad.fr>
Contact: bruno.locatelli@cirad.fr

Remedying soil pollution in the West Indies

An international workshop to look into possible ways of depolluting soils polluted by Chlordecone is being organized in the West Indies, in collaboration with CIRAD, the whole range of local scientific partners, and the local authorities. Biodegradation of pollutant molecules and ways of remedying soil pollution will be analysed in the aim of coming up with a strategy for depolluting soils contaminated by organochlorine compounds. The workshop is scheduled for early 2010.

Contact: magalie.jannoyer@cirad.fr

Research and development on nickel and the environment

In New Caledonia, the national technological research centre for "nickel and the environment" pools resources and equipment to conduct research and technological development programmes aimed at improving mining resource use, to ensure sustainable development. In March 2009, it launched an initial invitation to tender on the following topics: nickel and technology, nickel and the environment, and nickel and society. This could be an opportunity for CIRAD to make use of its experience of ecosystem dynamics and mining soil restoration techniques.

Contact: alain.bergeret@cirad.fr

Small-scale diamond mining

In the Central African Republic, small-scale diamond mining is often only a means of subsistence for miners. Moreover, it leads to significant water pollution and forest destruction. Under a project to improve such operations, CIRAD made concrete proposals in April 2009 for rehabilitating former mining sites: planting sapele, fish farming, growing plantain bananas, etc.

Contact: jean-michel.sarrailh@cirad.fr

Food technology centre

CIRAD's Qualisud Joint Research Unit recently received students from the *Institut des régions chaudes* at Montpellier Supagro, studying the food industry in hot regions, at its technology centre. They developed new foods aimed at promoting tropical agro-resources: baby food containing cereals and plantain banana, maize, millet and sorghum pasta, pasteurized prickly pear juice, etc. The operation provided them with training in the whole development chain, from product formulation to simulated production in a developing country.

Contacts: nawel.achir@supagro.inra.fr; gerard.loiseau@cirad.fr

Science

► SAFEGUARDING ECOSYSTEMS IN NEW CALEDONIA

The “ultramafic” soils of New Caledonia, primarily comprising iron, are naturally very rich in heavy metals: nickel, chrome, cobalt, and manganese. These factors, along with the archipelago’s isolation for the past 30 million years, have resulted in an extremely rich endemic fauna, associated with soil microorganisms enabling it to tolerate these toxic metals. The ecosystems

an ideal model for the study of how plants and associated microorganisms adapt to soil constraints

that develop on such soils are an ideal model for the study of how plants and associated microorganisms adapt to soil constraints.

CIRAD is working with the *Institut agronomique néo-calédonien* and the University of New Caledonia to characterize the region’s plant, bacterial and mycorrhizal biodiversity and its functioning on endemic plants suited to soils with high heavy metal contents and to non-metalliferous soils. Under the study, nickel-hypertolerant strains of the ectomycorrhizal fungus *Pisolithus albus* have been characterized. The genes involved in the nickel tolerance of those strains are currently being characterized. ■

SCIENTIFIC CONTACTS: yves.prin@cirad.fr; marc.ducousso@cirad.fr
COMMERCIAL CONTACT: alain.bergeret@cirad.fr

► RESTORING FOREST LANDSCAPES IN MADAGASCAR

The remaining forests in East Africa are shrinking ever more rapidly. The deforestation caused by slash-and-burn farming and the various types of manmade pressure on these humid ecosystems have resulted in significant erosion. With a view to offering local decision-makers new sustainable management strategies to restore forests, CIRAD and its European and Madagascan partners are studying the degraded forest ecosystems of Madagascar. The degree of degradation is being assessed in terms of the loss of specific and genetic diversity, while the changes in plant communities in fallow areas are serving to analyse the different stages in the regeneration of forest areas. Farmers’ knowledge of how species follow one another and of non-wood forest products is also being used. These various types of information help to steer forest landscape restoration towards either forests or agroforests. Similar studies are under way in Kenya and Uganda. ■

offering local decision-makers new sustainable management strategies to restore forests

SCIENTIFIC CONTACT: jean-marc.bouvet@cirad.fr
COMMERCIAL CONTACT: alain.chauchard@cirad.fr

► GROWING SUGARCANE TO PRODUCE FUEL IN GUADELOUPE

The banana plantations of Guadeloupe and Martinique have been polluted by an organochloride insecticide, Chlordecone. Although the insecticide is no longer used, the molecule is still found in the soils of the plots in which it was applied. Growing food on these soils carries a variable risk of contamination that has to be taken into account when choosing crops.

CIRAD and the research consultancy IRIS-Ingénierie are working with the *Office pour le développement de l’économie agricole des départements d’outre-mer* to analyse the possibility of using these soils to grow non-food biomass for fuel production. They are due to launch trials of sugarcane with a view to studying what becomes of the pollutant molecule within the fuel production chain and analysing the economic feasibility of generating electricity from specially-grown plants. ■

studying what becomes of the pollutant molecule within the fuel production chain

SCIENTIFIC CONTACTS: denis.pouzet@cirad.fr; caroline.lejars@cirad.fr
COMMERCIAL CONTACT: cindy.van_hyfte@cirad.fr



© M. Ducousso, CIRAD

Medium-altitude mining area, Koniambo mountains, New Caledonia.

Market

► REHABILITATING MINING SITES IN NEW CALEDONIA

Large-scale open-cast nickel mining in New Caledonia has destroyed the local vegetation and degraded the natural environment. In recent years, mining companies have been implementing replanting programmes. To help reconstitute the local landscape, CIRAD and the *Institut agronomique néo-calédonien* are conducting research aimed at gradually restoring mining areas by planting endemic species. In effect, it is vital to plant local species on mining land, as they are the only ones capable of living on these soils with their high heavy metal contents. Working with mining companies and forestry services has enabled the collection and conservation of seeds and mastery of the techniques required to propagate and plant such species at a reasonable cost. Several sites have been rehabilitated (Thio mines, etc). ■

mastery of the techniques required to propagate and plant such species at a reasonable cost

SCIENTIFIC CONTACTS: jean-michel.sarrailh@cirad.fr; laurent.maggia@cirad.fr
COMMERCIAL CONTACT: francois.laporte@cirad.fr

► CONTROLLING INVASIVE SPECIES IN RÉUNION

The forests of Réunion still contain a remarkable degree of biodiversity. However, some introduced species such as the giant bramble have become invasive and are threatening those forests. Following on from their work to control these invasive species, the *Office national des forêts* and the departmental council are working on

Technology

► RESTORING THE DRY FORESTS OF NEW CALEDONIA

The dry forests of New Caledonia are of significant biological interest, but have been broken up and degraded and are under threat from fire and invasive species. In 1997, the Worldwide Fund for Nature, WWF, launched a programme to conserve and restore New Caledonia's dry forests.

ways have been found of controlling invasive exotic plants

With the financial support of the State and the local authorities, CIRAD is working to restore the dry forests, under the aegis of the *Institut agronomique néo-calédonien*. Through its work, ways have been found of controlling invasive exotic plants, and the

impact of introducing deer species has been assessed. Seeds have been harvested from around a hundred indigenous species and plants have been produced to set up experimental plantings at highly degraded sites. Vegetation clusters are now serving to trigger the recolonization of such areas by indigenous species. ■

SCIENTIFIC CONTACT: jacques.tassin@cirad.fr

COMMERCIAL CONTACT: francois.laporte@cirad.fr



ecological restoration operations, with the support of CIRAD, which is providing staff training.

To select the species best suited to replanting the areas cleared of invasive species, CIRAD has worked to

choosing the plants best suited to high altitude, specific rainfall conditions, and the size of the cleared area concerned

characterize endemic and indigenous woody species. Groups of species have

been distinguished based on the types of fruits and seeds and their germination and

dissemination processes. These characters are of use in choosing the plants best suited to high altitude, specific rainfall conditions, and the size of the cleared area concerned, to ensure natural recolonization. The La Roche écrite natural reserve has been restored in this way. ■

SCIENTIFIC CONTACTS: jean-michel.sarrailh@cirad.fr;

jean-noel.riviere@cirad.fr

COMMERCIAL CONTACT: francois.laporte@cirad.fr

► RESTORING SOILS IN COTTON-GROWING ZONES

The cotton-growing savannah soils of sub-Saharan Africa have been degraded by long periods of continuous cultivation and inappropriate management of cropping systems. Soil organic matter contents play a central role in determining the extent of soil fertility degradation.

To restore the fertility of these soils, CIRAD and its research partners in West and central Africa have conducted long-term trials aimed at maintaining soil organic matter content. Providing crops with mineral and organic fertilizers and returning crop residues to the soil serves to restore soil fertility in the initial stages of degradation.

long-term trials aimed at maintaining soil organic matter content

It is now necessary to apply calcium and magnesium ameliorators and practise endemic grass-based fallow to rehabilitate more severely degraded soils (acidification, aluminium toxicity). However, fertilizer applications are currently insufficient, due to their high cost. ■

SCIENTIFIC CONTACT: michel.cretenet@cirad.fr

COMMERCIAL CONTACT: cindy.van_hyfte@cirad.fr

► AGRICULTURAL USE OF FORMER PHOSPHATE LAKES IN SENEGAL

Producing commercial phosphate from ore means discharging large quantities of schlamm (a mixture of fine clay and phosphate particles and toxic compounds such as cadmium and fluoride). In Senegal, farmers grow fruit trees and market garden crops on this schlamm, to make the most of its high water retention capacity and phosphate content.

a quick test for screening cadmium uptake by root systems

To determine the amount of toxic cadmium absorbed by plants grown on such soils, CIRAD has developed a quick test for screening cadmium uptake by root systems. Cadmium contents vary depending on the crop: they are negligible for courgettes and mangoes and maximum for aubergine. For other species such as tomatoes and cabbage, it is the variety that determines absorption. These results can be used to guide crop choices. ■

SCIENTIFIC CONTACT: denis.montange@cirad.fr

COMMERCIAL CONTACT: philippe.ourcival@cirad.fr

► REHABILITATING MINING SITES IN THE CÉVENNES

Zinc was mined in the Saint Laurent le Minier region (Gard, France) for a long time. The former industrial sites are now degraded, since the soils, with their high heavy metal contents, are toxic to many plants. To stabilize these soils with suitable vegetation and rehabilitate these sites, the CNRS (Centre of Evolutionary and Functional Ecology)

the new symbiotic bacterium isolated is highly resistant to zinc and cadmium

and INRA (Laboratory of Tropical and Mediterranean Symbioses) are studying combinations of local metal-tolerant plants. The legume *Anthyllis vulneraria*

in particular is of major interest, since it can use atmospheric nitrogen through symbiosis with a soil bacterium; its growth is considerably improved and it serves to regenerate soil fertility. The new symbiotic bacterium isolated is highly resistant to zinc and cadmium and fully adapted to the sterile mining soils of the Cévennes. These results offer prospects for the rational and sustainable replanting of mining sites. ■

SCIENTIFIC CONTACTS: jose.escarre@cefe.cnrs.fr; cleyet@supagro.inra.fr

COMMERCIAL CONTACT: cleyet@supagro.inra.fr

EGIS Route

EGIS Route, a subsidiary of the EGIS group, is a world leader in the field of infrastructure and transport system engineering. CIRAD and EGIS Route have been working together since 2004 to replant the verges of the new Tamarins road in western Réunion, and to restrict the road's impact on the local landscape.



Interview with Mr Thierry Schantz (Environmental Engineer working for EGIS Route on the Tamarins road project)

What does EGIS Route do?

EGIS Route works on road projects, from planning to project management. The firm has acquired significant experience over the past 40 years of roads and motorways in France and overseas. In Réunion, EGIS Route won the invitation to tender issued by the regional council, for the construction of a medium-altitude road to reduce traffic congestion on the existing coast road.

How did you come to work with CIRAD?

Right from the design stage, the Tamarins road's impact on the landscape was taken into account. Our landscape gardener met Jean-Michel Sarrailh and Jean-Noël Riviere, forest specialists at CIRAD, and was able to appreciate their knowledge of indigenous forest species. We saw the need for their support in the project, and CIRAD and the *Office national des forêts* were signed up as partners.

How do you set out to reconcile building roads with protecting the environment?

At EGIS, our road and structure specialists work with our environmental engineer to ensure that projects have as little impact

EGIS Route at a glance

Head office: France
Status: Limited company
Staff: 500
Turnover: 85 million euros in 2007
Field: transport systems

as possible. The Tamarins road fits into the landscape: it follows contour lines, the roadside vegetation respects the original natural environment, and the embankments were designed so as not to cover protected plant varieties, and grassed over to prevent erosion. There are drainage ponds to recover polluted rainfall all the way along the road, to prevent pollution of the lagoon, and so on.

Have you been working with local nurseries?

CIRAD and the landscape gardener chose to use some fifteen indigenous plant species (olivewood, *Cossinia pinnata*, pleomele, etc) to avoid introducing exotic species that could have proved invasive. We then signed production contracts with local nurseries for young forest plants. As these species are not widely cultivated, CIRAD trained the nursery staff in mass production techniques, boosting their skills. We are now signing planting contracts.

What are the most significant results of your collaboration with CIRAD?

The road is to be opened in June 2009. Despite the technical difficulties, 500 000 plants have been reared and planted along the roadside. Within a few years, we will be able to appreciate the road's "invisibility", once the young plants on the embankments have grown! Over and above this project, we have launched production of indigenous plant species that could be used for other future projects.

Do you have any plans to work with CIRAD again in future?

Not for the moment, but we are keen to repeat the experience.

Contacts: thierry.schantz@egis.fr;
jean-michel.sarrailh@cirad.fr

For further information:
<http://www.egis-route.fr>

French Guiana

CIRAD has been working in French Guiana for more than 35 years, and hopes, along with its research and development partners, to constitute a centre of excellence in the knowledge and management of the region's natural resources. Its research operations include tropical forest ecosystem functioning, through the Joint Research Unit on the Ecology of the Forests of French Guiana (ECOFOG), cocoa and rubber genetic diversity and disease resistance, and promotion of its coffee and oil palm collections.



CIRAD in French Guiana

has a staff of 45, including eight researchers. Each year, it receives PhD and other students on the Kourou agricultural research campus and in its research laboratories.

It favours active cooperation with a view to raising the profile of French Guiana, the only European region in South America.

Its researchers provide training in tropical forests, in partnership with the higher education sector.

Main operating fields

- Ecology and dynamics of how the Amazonian forest functions, genetic diversity;
- Estimating carbon stocks in the forests of French Guiana;
- Wood anatomy and durability;
- Research on local species to ensure sustainable tropical forest management;
- Cocoa diversity in French Guiana and use in disease control; maintenance of an international clone collection;
- Enrichment and analysis of an international coffee collection;
- Study of rubber tree resistance to *Microcyclus ulei*;
- Territorial development and biodiversity conservation.

Specific experience of soil rehabilitation

In Brazilian Amazonia, degraded land as a result of deforestation now accounts for 25% of cleared areas. CIRAD researchers are studying how such areas can be integrated into a territorial development process that would encourage colonists to settle within agrarian reform schemes.

Contact: richard.pasquis@cirad.fr

For further information:
<http://www.cirad.fr/guyane>

To receive CIRAD-VIP free of charge by e-mail,
please register at vip-cirad@cirad.fr