

Editorial

Fresh water accounts for 2.6% of the Earth's total water, and two thirds are permanently frozen. There is considerable pressure on the resource from population growth, economic development and climate change. By 2025, water withdrawal and consumption look set to increase by 30% in developing countries and by 10% in industrialized countries. According to the OECD, two thirds of the world's inhabitants are likely to be under moderate to high water stress by 2030.

With this in mind, how can the resource be managed more efficiently to prevent crises and disputes?

Managing water means reconciling complex economic, social and environmental objectives, with an eye on fairness and ethics. CIRAD is working towards this, since water is the key to boosting food production. In fact, agriculture is the largest water consumer, accounting for 70% of withdrawals, and water distribution is seldom optimum. Sometimes there is too much and it is necessary to prevent flooding and control erosion. Often there is not enough and steps have to be taken to prevent drought, irrigate land and produce more using less water.

Managing water more efficiently means calling up advanced scientific and technical resources that given the stakes, CIRAD is working to develop and make available to its partners. The future of water resources concerns us all: let's work together on the issue.

Véronique VISSAC-CHARLES
CIRAD Technology Transfer and
Development Coordinator

The potential of rainfed agriculture in Africa

CIRAD and its European and African partners have just been granted EU funding for an analysis of the keys to the success of agricultural innovation in the arid rural areas of Africa (AIDA project). To mark the launch of the project, CIRAD is organizing an international conference in Ghana, from 22 to 24 January 2007, with FARA—Forum for Agricultural Research in Africa—and the CTA—Technical Centre for Agricultural and Rural Cooperation (Netherlands)—, with a view to promoting agricultural research and development in these zones.

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Challenge programme on "Water and Food"

CIRAD is involved in the challenge programme on "Water and Food", which is encouraging the international community to improve water productivity in farming systems in river basins worldwide. The Echel-Eau project, funded by the French Foreign Ministry, is France's contribution. CIRAD is coordinating the project, in partnership with Agropolis International. It is participating in research, training and promotional operations in the Mekong, Limpopo and Niger Basins.

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Territorial risk management and vulnerability

CIRAD is supporting Agropolis International in coordinating the competitiveness pole on "Territorial Risk Management and Vulnerability" in Languedoc-Roussillon. The pole, which is supported by the Provence-Alpes-Côte d'Azur and Languedoc-Roussillon regional councils, works to foster links between firms, training and research establishments and the local authorities, aimed at managing natural, industrial and urban risks. It has an international vocation, and enables public bodies and firms to implement projects in the two regions involved and in developing countries.

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Diploma in water management with CIRAD

CIRAD is running several diploma courses in water management, in Montpellier: a socio-technical course for graduate-level students with the *Ecole nationale du génie rural, des eaux et des forêts*, and a technical specialist course for future agricultural engineers with the *Ecole nationale supérieure d'agronomie de Montpellier*. It is also involved in a specialist course on social management of water at the *Centre national d'études agronomiques des régions chaudes*, at the interface between the technical, institutional, regulatory and social facets of water management in irrigated farming systems in developing countries.

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Plants of the rice fields of Camargue

CIRAD, in conjunction with the Camargue Regional Natural Park and the *Centre français du riz*, recently published a reference book for rice growers faced with weed control problems: "*Plantes des rizières de Camargue*". The book is a guide to recognizing 178 weed species found in rice fields, and also plants in the surrounding area, reflecting the diversity of the flora in rice-growing systems.

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Science

▶ NEGOTIATING WATER RESOURCE SHARING AGREEMENTS

Galloping urbanization in developing countries has meant increased pressure on water resources and the relevant management infrastructures in periurban areas. The regions of Sao Paulo, in Brazil, and Cochabamba, in Bolivia, are seeing increased competition between many uses: drinking water, irrigation, etc.

CIRAD and its local partners have developed tools to support talks between the various types of users. The approach centres on computerized role-playing. In Brazil, this is helping to bring local communities, the water provider and town councils to the negotiating table. The place for agriculture in periurban catchment areas is under discussion. In Bolivia, agreements have been drawn up for the collective management of irrigation canals in periurban areas.

the approach centres on computerized role-playing

Similar work is under way in South Africa, where negotiating tools are being developed to support water management within catchment areas (AWARE model) or small irrigation schemes (SMILE project). ■

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▶ MANAGING SUGARCANE IRRIGATION IN RÉUNION

Sugarcane is one of the main crops grown in Réunion. Since the 1990s, CIRAD has been developing cane irrigation support tools based on the water balance, ie monitoring changes in soil water reserves using mean parameters for the soil and for crops. The tools are currently being distributed, but are proving to have their limitations in zones with heterogeneous soils and climate.

To improve the support it provides, CIRAD is working with the *Avion Jaune* firm and the *Centre national du machinisme agricole, du génie rural, des eaux et des forêts*, on developing an innovative method for measuring the water status of sugarcane plots. Microlight- and drone-mounted cameras and thermal infrared imaging cameras provide measurements that serve to characterize plot water status. Variability maps are currently being developed in experimental plots, and the method will subsequently be tested in sugarcane plantations, in collaboration with agricultural development services.

an innovative method for measuring the water status of sugarcane plots

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▶ WATER ECONOMICS AND MANAGEMENT IN THE MAGHREB

Water is in short supply in the Maghreb, and is increasingly a bone of contention. To remedy the situation, the countries concerned are drawing up policies aimed at controlling demand for water. They are targeting two aspects that are inextricably linked: reducing the volumes consumed and managing the resource more efficiently.

A group of Algerian, Moroccan, Tunisian and French research organizations has been formed to boost the technical, social, economic, institutional and environmental efficiency of irrigation. CIRAD is contributing to the drive by assigning three researchers to national research organizations. With funding from the French Foreign Ministry and the European Union, it is working on several regional projects to help modernize irrigation networks and manage salinity. Water management training courses for students, engineers, technicians and professional organizations are also being organized. ■

helping modernize irrigation networks and manage salinity

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ISSUE

WATER MANAGEMENT



Muden irrigation scheme in South Africa.
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Market

▶ PREVENTING THE RISKS ASSOCIATED WITH DROUGHT

Following the severe famines in the Sahel in and around 1972, the countries in the region set up the AGRHYMET regional centre in Niamey (Niger), to help fight food insecurity. CIRAD has supported the centre from the outset.

An information system has been developed to alert producers and political decision-makers to the state of the ecosystem in Sahelian zones, whenever appropriate.

the system gives early warnings in the event of cereal and food supply shortfalls

Regular bulletins are widely distributed on the progress of the rainy season and its impact on the flow rates of the main rivers and on the agricultural and pastoral season. The system gives early warnings in the event of cereal and food supply shortfalls and monitors the desertification process.

CIRAD is also involved in training courses organized by AGRHYMET for management staff from West Africa: two professional diploma courses, in concerted management of natural resources and integrated management of water resources, are to be launched shortly. ■

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▶ CONTROLLING EROSION

In Mayotte, soil erosion is gradually causing the lagoon to silt up, which could eventually kill the coral, put an end to the fishing industry and make the island less attractive to tourists.

The territorial authorities in Mayotte asked the *Bureau de recherches géologiques et minières* and CIRAD for help in mapping the risks of erosion in the various districts and ranking the risks depending on the zone. Maps on a scale of 1:25 000 have been produced. Any inhabitant of the island can consult the

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communal atlases. The main factors that account for the current erosion have now been identified: deforestation and urbanization, compounded by soil type and steep slopes. The formation of "badlands"—heavily eroded areas subject to severe gulleying—is caused by land movements. The relative influence of farming and of natural phenomena (wind and rain) has been analysed.

CIRAD is continuing its work in rural areas so as to advise farmers on erosion and determine the origin of the soils that are silting up the lagoon. ■

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▶ PREVENTING FLOODING AND LANDSLIDES

The Algiers region, in Algeria, is particularly at risk of earthquakes, flooding, landslides and pollution. How can urban areas be made less vulnerable, particularly to flooding and landslides?

In 2005 and 2006, CIRAD and a group of Algerian and French research organizations headed by BURGEAP carried out a vulnerability diagnosis of 48 districts in the Algiers *wilaya*. Seven pilot zones with specific problems were identified. Technical and organizational measures and new regulations were proposed, and the

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methodological guide to
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cost of the various alternatives was determined to provide decision-makers with a management tool to assist them in making the *wilaya* as a whole less vulnerable.

A technical and methodological guide to implementing illustrative operations is available: checking the foundations of buildings, reinforcing constructions, gabionage to stabilize embankments, protecting riverbanks with fascines, treating rainwater, etc. ■

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▶ MANAGING LARGE IRRIGATION SCHEMES: THE OFFICE DU NIGER

In Mali, the Office du Niger manages an area of 82 000 hectares irrigated with gravity-flow systems. To improve management and coordination with users, CIRAD has been helping the Office introduce an automated information system that encompasses water distribution, water supply network maintenance, plot allocation and licence fees. These data are memorized and processed to provide solutions in terms of operational management, decision support and planning. To date, the basic computer equipment has been installed. The 35 000 irrigation licence holders are now billed automatically, and have been since the 2004-2005 season. The water supply network maintenance module will be operational shortly, to be followed in early 2007 by the consumption monitoring and water supply network management support module. Plot delimitation is under way and a comprehensive geographic information system will enable analyses that take account of the spatial dimension of irrigation scheme management. ■

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▶ DEVELOPING UPPER CATCHMENT AREAS

Since 2002, CIRAD and its Indonesian partners have been conducting pilot operations aimed at intensifying small-scale farming in the rainfed parts of upper catchment areas. At the pilot sites, collective management of water resources has been improved and sustainable cropping systems, which make better use of water, are being developed by means of a research-action approach. Agrotechnical innovations aimed at securing agricultural production and improving income levels are being built hand in hand with farmers. Work is also under way to determine what organizational

surface water collection, crop
watering, soil protection and
introduction of improved varieties

measures and partnerships with the local authorities are required in order to establish hydro-agricultural projects.

The innovations in question concern surface water collection (small dams, reservoirs, etc), crop watering (micro-irrigation), soil protection (mulching, legume crops) and the introduction of improved varieties (rice and maize). They have been tested successfully at the Playen pilot site in the Wonosari region. The operational approach is currently being extended to other zones in the region. ■

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▶ MECHANICAL HARVESTING OF IRRIGATED RICE CROPS

Camargue (France) has 18 000 hectares of rice, which are harvested while still flooded. The combine harvesters used, which are increasingly heavy, have caterpillar tracks on the front and narrow tyres on the rear that leave deep ruts. As the rice fields need to be flat if they are to be irrigated, this means extensive, costly soil preparation every spring.

In 1999, the *Centre français du riz* contacted CIRAD to see about reducing the cost of mechanization in the case of irrigated rice crops. Soil resistance was measured, and combine harvesters were fitted with wide, low ground pressure tyres that could withstand heavy loads while only being inflated to 0.45 bar to reduce rutting. The trials showed that fuel consumption during harvesting and soil preparation costs could both be reduced. The results were publicized throughout Camargue, and 20% of the area under rice is now harvested using machinery fitted with low ground pressure tyres. ■

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Danone AQUA

Danone AQUA, an Indonesian subsidiary of the Danone group, taps several drinking water sources on the island of Java. CIRAD and Danone AQUA have been working together since 2005 on sharing the water resource between the various users.

INTERVIEW with Yann Brault, Sustainable Development and Social Responsibility Manager at Danone AQUA.

What does Danone AQUA do?

The market for bottled water and for 19-litre drums of water in Indonesia is huge. Danone AQUA taps 11 water sources in the country and has 13 bottling plants. We sell 5 billion litres of water a year! The flavoured water sector is also expanding.

How did you get to know CIRAD?

I had already heard of CIRAD and knew its Regional Director, Jean-Guy Bertault. Then in 2004, Danone AQUA was faced with a complex problem: how to share water resources with farmers in Klaten. CIRAD had set up pilot water management operations in the region, which gave us access to concrete results and real experience of the water resource in general.

How do you reconcile commercial tapping of groundwater and integrated management of water resources?

The first step is precise hydrogeological monitoring of the resource so as not to overexploit it. However, to ensure sustainability, it is important that local communities subscribe to a shared vision of development. We take a participatory approach so as to involve the various water users in the resource management decision-making process: they decide together what is to be done.

How do you preserve water quality at your sources?

Danone AQUA taps mountain groundwater sources. From the outset, the boreholes are designed to facilitate maintenance. Our



Danone AQUA at a glance

- Nationality: Indonesian
- Status: limited company
- Founded: 1970
- Staff: 10 732
- Production: 5 billion litres of water a year
- Field: bottled water production

bottling plants have ISO 14000 certification. Our water is thus top quality. To preserve that quality, Danone AQUA is embarking upon resource protection programmes: replanting recharge areas, rational agriculture, and waste management, particularly at sites where the water is tapped. It is also vital to take account of local economic aspects if environmental operations are to be sustainable.

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

With other programmes under way, we have now begun to build a positive relationship with the water users in Klaten. We have established a dialogue with irrigators, government representatives and most of the players involved in water management. Although it will be a long haul, Danone AQUA can prove its commitment to promoting better resource management in Indonesia.

Do you have any plans for new projects with CIRAD?

Above all, we want to extend our experience in Klaten and establish a methodology that can be reused under the new Indonesian Water Management Act. In future, CIRAD's expertise could be of use in rehabilitating degraded soils: its methods for rehabilitating catchment areas using no-till systems on permanent mulch cover have already proved themselves in West Java.

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Indonesia



CIRAD has been conducting research in Indonesia for more than thirty years. It began with the main tree crop commodity chains—oil palm, coconut and rubber—and subsequently extended its operations to forestry, agroforestry, agronomy and socioeconomics. In partnership with the Ministries of Agriculture and Forestry, the private sector, NGOs, international agricultural research centres and the United Nations, CIRAD is now working to alleviate poverty, improve food security and manage biodiversity, while continuing its traditional activities.

CIRAD IN INDONESIA

has eleven researchers and a Regional Director. It has the support of numerous specialists who intervene through short missions. Each year, it provides training for local partners (seminars, on-the-job training, etc) and receives Indonesian students for scientific training in France. Its main fields of operation include:

- genetics and crop protection, in particular for oil palm;
- natural resource management;
- sustainable cropping systems;
- support of family agriculture, particularly for water management;
- public policy economics.

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SPECIFIC EXPERIENCE OF WATER MANAGEMENT

CIRAD researchers are involved in developing agroclimatic and hydrological diagnosis techniques and in characterizing demand from local communities on the one hand and water resources on the other. They take a participative approach to building hydroagricultural projects, involving all the stakeholders concerned.

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