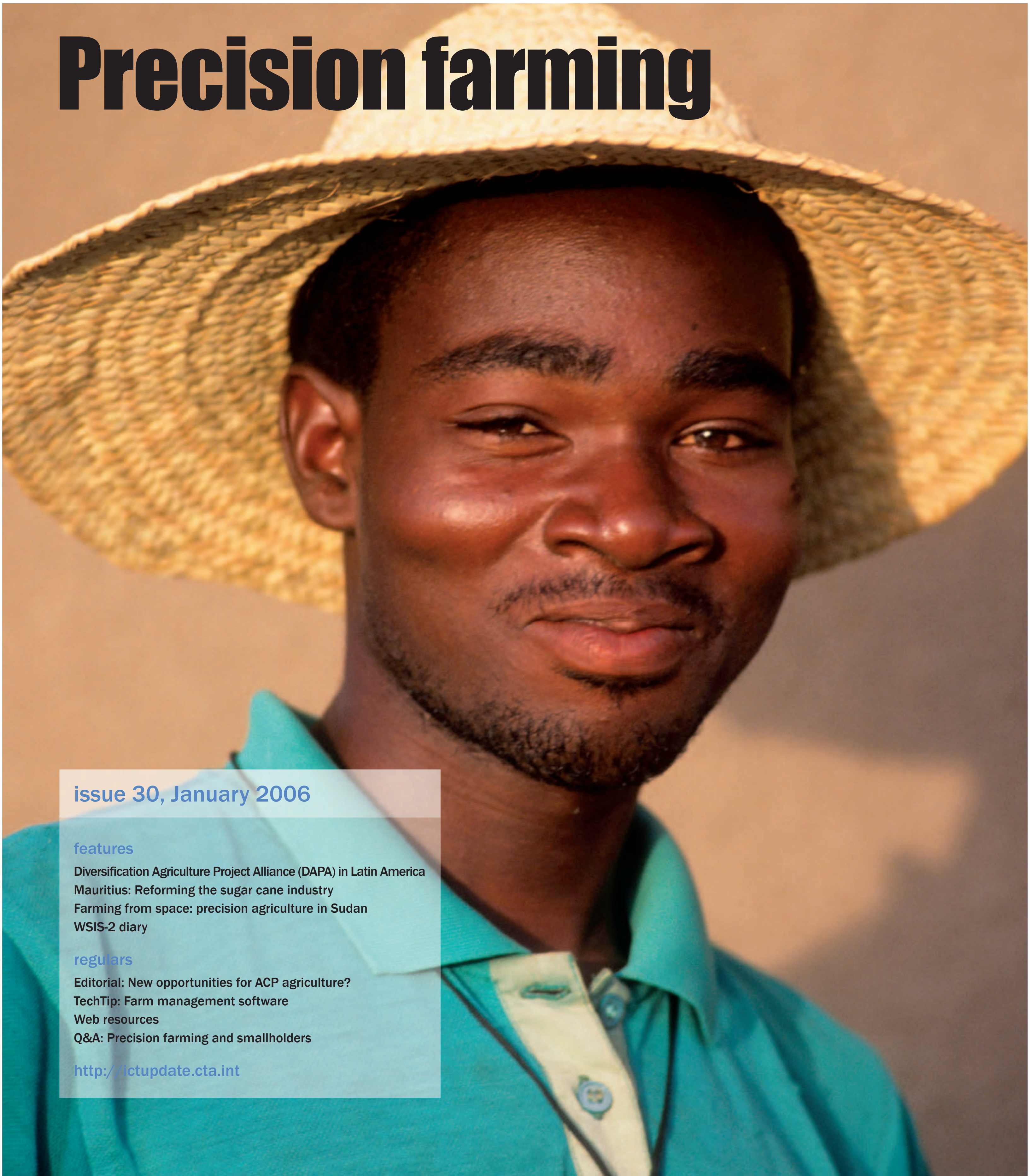
ICT Update
a current awareness bulletin for ACP agriculture

CTA

Precision farming



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editorial

Precision farming: new opportunities for ACP agriculture?

This issue of *ICT Update* focuses on precision farming, an advanced e-agriculture application that ICT experts are calling a true agricultural revolution. Still in its infancy, precision farming represents a high-tech approach to managing soils and crops and ensuring the most efficient use of resources – but it is already the subject of intense debate. Some express doubts that it can be applied to small-scale agriculture, and others seriously question its value to farmers in developing countries.

In preparing this issue of *ICT Update*, we looked for examples of farmers who are using precision agriculture in ACP countries, as well as in Europe, North America and Australia. We found very few, indicating that the barriers to adoption are very high. Farmers have to invest heavily in equipment, support infrastructures are weak, and the training to become an efficient precision farmer requires much time and energy. But, ten years ago, could farmers use mobile phones without difficulty almost everywhere? Were they using the Internet to examine trends in market prices, to buy farm inputs or to check long-term weather forecasts? How many farmers were driving their tractors using hands-free steering equipment?

It is unlikely that the rate of agro-technical innovation will slow down. Innovations will continue to trickle into the sector from the medical, defence, aerospace and computer industries. As the technologies developed within these industries become less expensive and more widely available, bright agricultural minds will observe, research and adapt them. Eventually they will help to improve farm efficiency, develop new techniques and enhance supply chain management throughout the world.

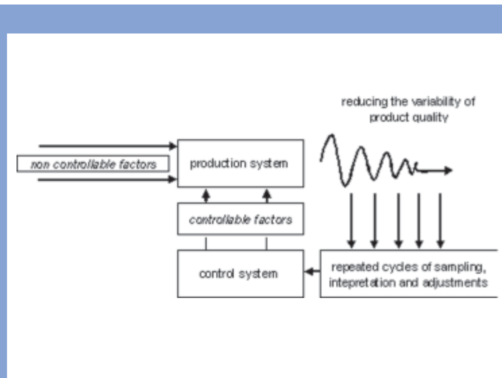
Precision farming has become possible due to the convergence of three groups of modern technologies: information and (wireless) communication technologies, monitoring and measuring technologies (including remote sensing and GIS, yield monitoring and GPS), and automated process control technology. Once adapted to farm conditions, these technologies will provide a completely new level of accuracy in measuring plant growth, in monitoring on-farm growing conditions and in operating farm equipment. Automated processes will replace routine, labour-intensive agricultural work. Irrigation on a sugar cane estate, for example, will involve linking sprinkler systems to plant sensors, soil sensors and nearby weather stations. The technology will ensure that exactly the right amount of water reaches the growing plants as and when needed.

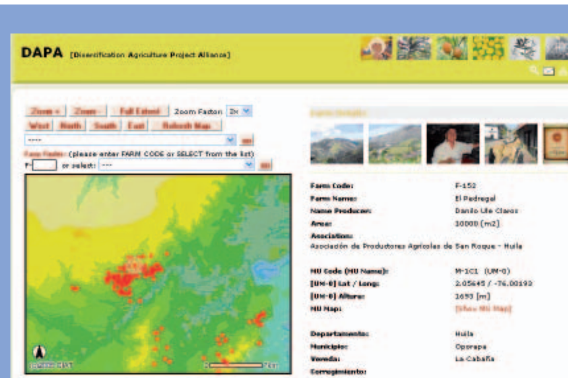
Many agricultural experts have argued that the use and maintenance of these technologies are beyond the capacity of small-scale farmers. It is suggested that they do not have the right educational backgrounds to understand and operate the equipment, and that farms are too small and cropping practices too heterogeneous for them to be used effectively. Nevertheless, over the past three years, *ICT Update* has reported many exciting examples of small-scale farmers, nomadic herders and fishermen who have experimented with new technologies, sometimes in projects supported by outside funding and expertise, but often on their own account. Farmers have adopted *en masse* the mobile phone, which has proven invaluable in enabling them to access market information and deal with the everyday problems that threaten their crops and livestock. At the same time, agricultural scientists are increasingly becoming interested in working with farmers and rural communities to explore the potential of technologies such as remote sensing, GIS and GPS for monitoring crop yields and quality, and automated process control technology.

This issue of *ICT Update* highlights three precision farming projects. CIAT's Thomas Oberthür explains how the DAPA project has brought together farmers, scientists, food processors and retailers in Colombia to improve the quality of crops such as coffee. The farmers can now identify the precise environmental conditions required to grow high-quality crops that meet specific consumer preferences, and thus fetch high prices. From Mauritius, L.J.C. Autrey and his colleagues report how the introduction of precision farming into the sugar cane industry is cutting production costs, and is thus helping to make the sector more competitive. Jon Howcroft, of Golder Associates Africa plc, describes the Agadi farm project in eastern Sudan, where GPS- and GIS-based technology is being used to guide applications of seed, fertilizers and other chemicals.

To complete this issue, Oumy Ndiaye, who represented CTA at the recent World Summit on the Information Society (WSIS-2) in Tunis in November 2005, reflects on her experiences. Finally, in the Q&A section, Dr Jetse Stoorvogel of Wageningen University and Research Centre, the Netherlands, takes the precision farming debate a step further, and argues that many small-scale farmers in developing countries are already using the principles of precision farming without the benefit of high-tech equipment. ■

Left: The concept of process control
Centre: Screenshot showing one of DAPA's information management tools
Right: The mobile processing unit used to obtain coffee samples under standardized post-harvest conditions.





Diversification Agriculture Project Alliance (DAPA) in Latin America

Thomas Oberthür explains how farmers, scientists, food processors and retailers are working together to improve the quality of agricultural products

Small-scale coffee growers in the mountains of southern Colombia are capable farmers. They dream of better ways of growing their coffee and profiting from the increasing demand for specialty products. They are continually searching for new farm management techniques and are prepared to try out any innovation that seems viable. Yet, because coffee prices locally are low, their incomes continue to fall and no one seems able to help them secure niche markets with high returns.

The Diversification Agriculture Project Alliance (DAPA) is a public–private research partnership, led by CIAT. In DAPA, small-scale producers of high-value crops, such as specialty coffees and medicinal plants, are collaborating with scientists, food processors and retailers. Together they aim to develop sophisticated ways of managing the agricultural product supply chain, and to develop products with exclusive qualities that will be capable of fetching premium market prices.

DAPA aims at identifying the precise environmental conditions farmers need to grow quality crops that meet specific consumer preferences. DAPA faces two major challenges, however. First, farmers are largely unaware of the unique qualities that can be added to their products by the customized management of the environmental conditions under which they grow their crops. Second, they have insufficient knowledge about consumer preferences.

DAPA is addressing these problems using a three-step approach. First, the causal relationships between the quality of selected agricultural products and environmental factors are demonstrated. Second, using a process control approach, the most important factors that determine product quality are identified. Third, information and tools are provided to help generate and analyze information about agronomic conditions and product processing methods so that supply chain participants can benefit from the causal relationships between environmental factors and product qualities.

In the case of specialty coffee production, DAPA started by collecting on-farm samples using a purpose-built mobile processing unit. Five kilograms of coffee cherries were harvested at ideal maturity. They were then wet-processed, dried in a gas oven and stored in a controlled environment. DAPA's industry partners (such as Intelligentsia Coffees Chicago, VIRMAX Inc. Bogota, and Coffee Star Belrin) cup the samples and test their specific qualities. In addition, corresponding control samples are collected and processed and cupped using the growers' traditional methods. With these pairs of samples, CIAT scientists are able to identify precisely the impact of environmental factors on quality, and conduct farm quality gap analyses of potential quality against the actual quality achieved.

In the second step, DAPA and the farmers identify the most important production factors that determine the quality of their produce. DAPA has adopted the process control approach used in the industry to ensure minimum variability in product quality. This approach is based on the premise that the variability in product quality is due to just a few factors. The challenge is to identify and manage these factors in a way that suits consumer preferences.

For example, the taste of a specialty coffee depends on the site's exposure to the sun. Berries from fields with different exposures are then harvested, processed and cupped separately. The cupping results are analyzed and in the next growing cycle, the selection of fields is tightened so that the only berries harvested are those with taste characteristics that meet market preferences. Repeated cycles of sampling, interpretation and evaluation eventually lead to the selection of fields with the type of exposure that produces coffee with the degree of quality variation acceptable to particular markets.

As the third step, DAPA has developed a web-based information management tool that can be used by all supply chain participants to search for detailed product information. For example, the screenshot on page 2 (*centre*) shows the locations of farms of members of the Huila coffee growers' association who are participating in the DAPA initiative. Information about the environmental and production conditions on their farms can be called up and analyzed by all partners in the supply chain. Users can search for specific qualities, information about successful production practices, and engage in dialogue with other participants in the chain.

The DAPA approach can only succeed if all participants in the supply chain are involved. Farmers and scientists contribute information about the production characteristics of crops, and processors and retailers share information on product quality and market preferences. For example, a local producer association provides coffee samples from a large number of farms that have been geo-referenced and environmentally characterized by CIAT staff. Specialty coffee roasters and exporters analyze the quality of the samples. CIAT scientists then correlate product information with on-farm environmental and production conditions. The results of these analyses are then made available online through DAPA's information system.

By the end of the three-year DAPA project in 2007, it is hoped that the approach will have been refined to the point where farmers themselves can use it to produce the high-quality coffees preferred by consumers, and which fetch the highest prices. ■

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feature

Mauritius: Reforming the sugar cane industry

L.J.C. Autrey, S. Ramasamy and K.F. Ng Kee Kwong describe the achievements in the process of introducing precision farming technologies in Mauritius, and the challenges ahead

Sugar cane is vital to the economy of Mauritius. In 2004 it accounted for 19% of the value of exports and 5% of the country's GDP. About 90% of the arable land, and 45% of the total area of the island is devoted to growing sugar cane. It also provides direct employment for 60,000 workers and small planters.

The island's sugar industry urgently needs to strengthen its competitive position. The ACP–EU Sugar Protocol and the proposed 39% reduction in the price of sugar has accelerated the process of reform. The Mauritius Sugar Industry Research Institute (MSIRI) is now giving priority to precision farming research with an emphasis on intensified mechanization. Cutting production costs by mechanizing all operations is seen as offering opportunities for optimizing the use of resources and for increasing the viability of this vital industry.

Introducing precision farming

Farm planning is an indispensable first step in introducing mechanization. However, in Mauritius most soils are very rocky and have developed on uneven topography, which complicates the development and adoption of appropriate tools and technologies. The very nature of the soil results in a spatial variability that hopefully can be addressed by precision farming.

In Mauritius, precision farming in the sugar cane sector is still at the experimental stage. Since 2001, the MSIRI has been evaluating the applicability and effectiveness of precision agriculture for the local industry. The research work has centred on testing an Australian prototype of a yield mapping system, the acquisition of spatial data on yields and soil, and assessing the significance and causes of yield variations on two sugar estates, Médine and Beau Champ. The aim of the research is to facilitate the development of a totally mechanized industry – from soil preparation to harvest – on 55,000 of the 65,000 ha under sugar cane production. Steps have been taken to introduce special land use planning measures, including increased field sizes, which are in fact the beginning of the total mechanization of sugar cultivation in Mauritius.

Yield variability mapping

One of the most challenging aspects of precision farming is the production of maps showing yield variability. So far, the most successful method has been to use a yield monitor system, which consists of a yield sensor and display unit, and a GPS unit mounted on a chopper harvester. In Mauritius, an accuracy of 97% of bin-weighed cane has been obtained.

The cane yield maps produced so far have shown that yield variability is significant. It can vary from 30 to 200 tonnes per hectare within a field, with distinctive patterns of low and high yields closely related to cane harvested in green or burned conditions.

One immediate practical outcome of yield monitoring has been the improved management of cane loading operations, including measures to avoid overloading and over-spilling, improved transport scheduling of trucks and bins, and the verification of contractual work in terms of harvested area and tonnage.

Remote sensing, GIS and GPS

The resolution of satellite images has improved considerably. As images are now available in the range of 1–5 m, remote sensing is increasingly being used in studies of sugar cane precision farming. GIS and GPS have already become standard tools for building spatial databases and for geo-referencing fields and other spatial features.

In particular, 2.5 m resolution QuickBird satellite images of Mauritius have been used to identify spatial variability and corrrelations with other factors. In a natural colour composite image of the western part of Mauritius, for example, the spatial variability in cane canopy and the correlation with soil conditions can be seen very clearly. Patches of poor cane growth and low yields were associated with waterlogged areas (as indicated by soil conductivity surveys), and high-yield areas, indicated by dense canopy and high biomass, were also clearly visible on the image.

Outlook

Over the past two decades significant progress has been made in applying precision farming techniques to crops such as maize, soy bean and wheat. In sugar cane, progress has been slow even in countries known to be at the forefront of precision farming research, such as Australia, South Africa, Brazil and Mauritius. Yield sensors combined with mapping software for sugar cane are still not available as a commercial package. The first yield sensor – developed in 1996 for sugar cane in Australia – is still in prototype form.

Low world sugar prices, combined with other factors, have affected the availability of human and financial resources for research into sugar cane production using precision farming approaches and technology. Progress is also hampered by the fact that cultivation practices must be mechanized, and operators have to be well trained in the use of high-technology equipment.

Despite these drawbacks, the outlook for precision farming remains firmly positive. For example, the continuing research on yield sensor systems means that they could soon be commercially available for use by farmers. On-the-go soil sensors are also being developed to facilitate the measurement of important plant and soil properties that directly affect crop yields. High-resolution satellite images are also becoming more accessible for mapping and thus contributing to our understanding of spatial variability. ■

L.J.C. Autrey, S. Ramasamy and **K.F. Ng Kee Kwong** are working at the Mauritius Sugar Industry Research Institute, Mauritius. For further information, visit www.lsuagcenter.com/archive and www.usyd.edu.au/agric/acpa/articles.

Farming from space: precision agriculture in Sudan

Jon Howcroft looks at how GPS and GIS technology are helping to boost farm productivity in eastern Sudan

Golder Associates Africa has introduced the first auto-steer tractor on the continent, to Agadi farm, an 80,000 ha rain-fed farm in Blue Nile state in eastern Sudan. The tractor is fitted with a GPS satellite guidance system that takes control of tractor steering and can maintain a preset course accurate to within 10 cm. The auto-steer unit has already helped reduce the average planting time on the Agadi farm by 60% compared with the previous two seasons.

During the past four seasons, Golder has been working with ASBNACO, a Sudan-based company that manages the Agadi farm, and the Arab Authority for Agricultural Investment and Development (AAAID), which has provided finance for testing the auto-steer unit as well as technical support.

The Agadi project

The Agadi project is coordinated by the Precision Farming Unit (PFU), whose aim is to introduce site-specific farming, using GPS and GIS-based technology, for the commercial mechanized farming sector in Sudan.

The PFU has set up a GPS farm survey section that produces accurate base maps for use in GIS systems. It has also undertaken spatial yield monitoring using GPS field monitors installed in combine harvesters. These monitors record yield variations within each field and produce yield maps for each section of land harvested. Yield maps are produced annually so that farmers can identify areas of high and low productivity on their farms. The yield maps can also be processed and used to guide applications of fertilizer, seed and agro-chemicals.

Moreover, the unit has successfully introduced 'controlled traffic farming' (CTF) using GPS-based self-steering tractors. CTF restricts the movements of tractors to deliberately chosen 'lanes' within the field so that operations occur sequentially in the same wheel tracks, thus reducing soil compaction and erosion and improving efficiency by eliminating overlaps when sowing seed and applying chemical sprays.

The unit is currently developing a

GIS-based farming information and management system. Future plans include the introduction of infrared photography and variable rate application (VRA) technology, both of which will have environmental and efficiency benefits. Infrared photography will be used to identify weed infestations, and areas suffering from water stress or crop pest outbreaks. In the latter case, chemical applications can be specifically targeted, thus reducing the wastage incurred with conventional blanket spraying. Using VRA, fertilizers, chemicals and seed are applied at rates derived from the previous seasons' production figures and chemical analyses of the soil. For example, a variable-rate monitor installed on a tractor can use fertilizer maps to increase or reduce fertilizer dosages. This helps to even out yield variations, reduce fertilizer wastage and prevent unnecessary groundwater contamination.

Boosting productivity

Other techniques such as conservation and zero tillage have also been introduced to boost productivity. Zero tillage, with seed sown directly into the ground without ploughing, harrowing or chemical weed control, has proved to be an ideal way of managing Agadi's soil and weed problems. The farm's soils have a high clay content – they are slippery and almost unworkable when wet, but become hard and cracked when they dry out. As a result, they require special management skills to obtain profitable yields. By using a sophisticated zero tillage method for planting seed and for distributing fertilizers, soil disturbance has been kept to a minimum, tractor power requirements and fuel consumption have been cut significantly, and weed pressure has also been reduced as fewer weed seeds are buried or exposed. For three seasons, zero tillage has resulted in crop yields significantly higher than those achieved locally using conventional techniques. Golder has now started a farmer support project to introduce these new methods to other farmers in the region.

Challenges

The innovative precision agriculture technology introduced at Agadi farm has generally helped to make farming practices more efficient. Planting times have been reduced by 60%, the area of plant cover has improved by 3.5%, and the cost of spraying herbicides has been cut substantially. However, precision farming in Agadi still faces a number of challenges. Special care is needed, for example, to ensure the reliable operation and maintenance of highly specialized equipment in the harsh conditions of this remote region. Greater efforts are also required to provide training for local technicians in the use of GPS equipment and the operation of GIS software. Attention is also being given to assessing the way precision farming systems can be effectively integrated into current practices, or even replace them.

Plans have been made to expand this project significantly. However, precision farming must become more widely accepted before its potential can be fully exploited in other large-scale projects in the area, such as the Gezira irrigation scheme (800,000 ha) and the Kenana sugar estates (170,000 ha).

For now, precision farming will continue to play a vital role in establishing an integrated management information system for Agadi farm, particularly if sufficient funding becomes available for such high-tech farming applications. ■

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Impressions of WSIS-2 in Tunis

Oumy Ndiaye, head of CTA's Communication Channels and Services Department, attended the second World Summit on the Information Society (WSIS-2) held in Tunis, 16–18 November 2005. Here she gives some impressions of the meeting.

You attended the WSIS-2 gathering in Tunis in November last year. What were your main impressions?
There was an enormous number of people! It seemed that everyone was there, including many of CTA's partners. The Summit was divided into two parts. First, there was the official programme, where government representatives negotiated the details of the so-called Tunis Commitment and the Tunis Agenda for the Information Society. Then there was the more informal programme, where representatives of civil society groups, NGOs, research organizations and donor agencies were able to network. For me, the informal programme was particularly useful and exciting.

Why was the informal programme more useful to you?
World summits are of course organized so that the governments of UN Member States can discuss and reach agreement on issues of global importance. In this case the discussions focused on the emergence of the Information Society and the need to find ways to bridge the digital divide. Equally important for me, however, was to be able to meet with many of CTA's partners and to facilitate interactions among them. To be honest, I spent most of my time in Tunis networking with partners and other organizations involved in ICT4D programmes, both to learn from their experiences and to discuss future grassroots initiatives.

What was for you the most exciting event at WSIS-2?
For me personally, that was the launch of the '$100 laptop' by Nicholas Negroponte of the Massachusetts Institute of Technology (MIT). The laptop has been designed specifically as a learning tool for children in developing countries. It includes all the features of a modern laptop, as well as wireless broadband. Even more important, it can be 'wound up', and so can be used in areas where electricity supplies are unreliable.

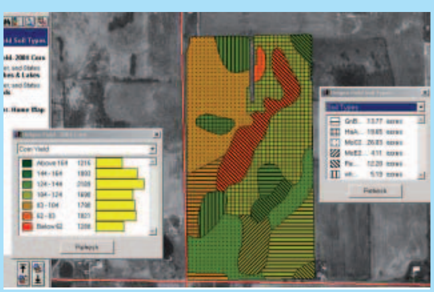
The reactions to the $100 laptop were generally rather sceptical. It is too expensive for children, there are insufficient software applications in local languages, and there are no repair facilities in rural areas. How would you respond to these criticisms?
I admit that I am getting a bit tired of the critical reactions to the mere mention of high-tech solutions. The $100 laptop is exactly what we need in Africa. This is a real breakthrough. Of course, there may be problems that need to be solved. The laptop has been designed for use in schools, and that may take some time to achieve. But in the meantime I'm sure that people will find other uses for it. Just look at what happened with the mobile phone – no one could have predicted that it would be so popular in Africa. In Senegal, CTA's partner Manobi developed a very popular agricultural market information service for farmers and local traders that uses the mobile phone as its main service channel. When the mobile phone was introduced, who had thought of that?

Returning to the subject of agricultural development in ACP countries, was anything achieved at WSIS-2?
The FAO ensured that promoting the use of ICTs to improve agricultural production in developing countries was included as one of the policy objectives in the Tunis Agenda. It also successfully lobbied to make sure that e-agriculture was one of the ICT applications listed in the 'action lines' to be undertaken by the development community.

What do you mean by 'e-agriculture'?
The FAO recently widened its definition of e-agriculture to include not just Internet-based solutions to make agricultural information more easily accessible. E-agriculture now includes the use of satellite technology, global positioning system (GPS) equipment, advanced computers and electronic monitoring systems in applications such as precision farming, in order to improve the volume and the quality of agricultural production.

But isn't that what ICT Update has been demonstrating for some years?
Yes, I have noticed that too. The FAO has many trained professionals who don't need the advice of ICT Update. But who knows?

TechTip: Farm management software helps farmers produce more



Precision farming is intended to improve productivity while making more efficient use of fertilizers, pesticides and water, and minimizing the impacts on the environment. Farm management software can thus help farmers make informed decisions about the use of resources and plan for the future.

Farm Works, a US-based company, has developed a variety of software packages such as Farm Trac and Farm Site. Farm Trac is a GPS-integrated field record-keeping package written for MS Windows that allows farmers to keep notes on field history and chemical usage, calculate direct costs incurred at the field level and plan future farming operations. Farm Site adds GPS compatibility to Farm Trac and provides state-of-the-art positioning and a limitless number of layers, including soil types and soil tests, details of previous activities and the outline of future plans. These two packages are complemented by field software. Using a pocket PC or a laptop, Trac Mate can be used for on-site field record keeping, while Site Mate – in combination with a GPS receiver – can be used for site-specific mapping, scouting, soil sampling and variable rate control. With Site Mate it is possible to create maps of field boundaries, weed areas, tile lines, spray paths and soil sample locations, and the data can be used in most GIS programmes.

For more information about these and other Farm Works software packages, visit www.farmworks.com

Web resources

This section lists key resources in the field of precision farming.
Additional information is available from the web magazine at http://ictupdate.cta.int

Sustainable Agriculture and Precision Farming in Developing Countries
H.-W. Griepentrog and B.S. Blackmore, Deutsche Tropentag, 2004
Sustainable agriculture in the context of development is defined by production efficiency, ecosystem sensitivity, appropriate technologies, environmental maintenance and the capacity to meet basic needs and the demands of cultural diversity. The Green Revolution significantly increased production in developing countries but had negative ecological effects. It is suggested that precision farming can combine the need for increased productivity with environmental conservation, although how it is applied depends heavily on local conditions. Precision farming is both a management approach and a technology. It can be applied in low- and high-tech environments. Implementation approaches vary considerably, but in developing countries, care should be taken to ensure that it complements rather than replaces local farm practices.
www.tropentag.de/2004/proceedings/node153.html

Future directions of precision agriculture
A. McBratney *et al*., *Precision Agriculture,* 2005
Precision agriculture is advancing, but not as fast as predicted. The development of decision-support systems for precision farming remains a major stumbling block to adoption. The authors discuss other critical research issues, including the lack of recognition for temporal variation, the absence of a whole-farm focus, crop quality assessment methods, product tracking and environmental auditing. They then introduce a generic research programme and a typology of countries, and discuss their potential for precision agriculture.
www.springerlink.com/cyk4x155czgigmynrxl4wg55)/app/home–/contribution.asp?referrer=parent–&backto=issue,2,7;journal,5,26;linkingpublicationresults,1:103317,1

Precision Agriculture '05
J.V. Stafford (Ed), Proc. 5th European Conference on Precision Agriculture, Uppsala, Sweden, June 2005
The papers presented at the conference reflect the wide range of disciplines involved in precision agriculture including technology, crop science, soil science, agronomy, information technology, decision support, remote sensing and others.
www.wageningenacademic.com/Bookshop/index.htm

Precision Farming: Challenges and Future Directions
A.Dobermann *et al*., in *New Directions for a Diverse* Planet, Proc. 4th International Crop Science Congress, 2004
Much research has been conducted on developing strategies for site-specific crop management in different agricultural systems but with mixed results. Applications in which the focus has been on variable rate technology for managing spatial variation at the sub-field level have often failed to deliver significant and consistent improvements in terms of crop yields, profitability, input use efficiency and environmental impact. More robust, dynamic, and integrated forms of site-specific management are currently being developed. They require better techniques for characterizing and understanding crop growth determinants at the spatial and temporal levels most relevant for decision making. This level of understanding delivers the highest return in the case of high-value crops where precise management can improve both quantity and quality.
www.cropscience.org.au/icsc2004/pdf/217_dobermanna.pdf

Precision farming in agriculture: a production technique for the next millennium
Z. bin Mohamad *et al.,* Strategic, Environment and Natural Resources Research Center, MARDI, Serdang, Selangor, Malaysia
This paper provides an overview of precision farming and the critical questions that need to be addressed before adopting it as a production tool. The elements of precision farming are discussed under the headings: information, technology, and management. Information refers to the establishment of databases such as soil-related properties and the crop characteristics that impact on production. Technology deals with such tools as GPS, GIS and computers that can be used to generate useful information. Management information and the availability of technology enhance the overall cost effectiveness of the precision farming approach in crop production.
www.econ.upm.edu.my/~peta/zamzam/zamzam.html

Cranfield Centre for Precision Farming, UK
Precision farming is a fast-developing and exciting new approach to crop management. It involves the management of within-field variations and helping farmers to grow crops more efficiently at competitive prices while minimizing waste and environmental damage. Set up in 1996, the Centre aims to provide a forum for farmers, the supply industry and research organizations on a wide range of issues and activities related to precision farming. The Centre provides expertise and training in key areas, promotes links with the commercial agricultural sector at service and farmer levels, and disseminates information on developments in precision farming technology and practice.
www.silsoe.cranfield.ac.uk/cpf/centre_welcome.htm

AGIS for Windows: a simple mapping and GIS shareware package
AGIS for Windows is a mapping and simple GIS package specifically designed for easy use. It is distributed as shareware via the World Wide Web. Mapping is vector-based, producing high-resolution results at any scale, and publication quality displays can be cut and pasted into popular packages such as MS Word. Distances can be measured on-screen, cursor positions are constantly updated, and almost everything in a map display is configurable. Animation, web serving and linking AGIS to other applications such as databases are supported via a scripting language. Help as well as support and tutorials are also available online.
www.agismap.com

Geographic Information Systems in Sustainable Development
This website is maintained by FAO's Department of Sustainable Development and contains amongst other things relevant information, datasets and basic materials on GIS and its agricultural applications.
www.fao.org/sd/eidirect/gis/EIgis000.htm

Precision Livestock Farming
S. Cox (Ed.), Wageningen, 2003
Precision Livestock presents the latest scientific results from worldwide research, field studies and practical application. The book contains peer-reviewed papers that were presented at the 1st European Conference on Precision Livestock Farming. The papers focus on physiological identification and monitoring of animals, on farm and in transit, and on the operation of automatic milking systems. Major objectives are secure methods of animal identification for traceability; animal welfare and hygiene. The economic and health effects of implementing precision livestock husbandry are featured in many of them.
www.wageningenacademic.com/books/ecplf.html

Q&A: Precision farming and smallholders

Dr Jetse Stoorvogel claims that many small farmers in developing countries are already using the principles of precision farming, without the benefit of high-tech equipment.

Dr Stoorvogel, precision farming technologies are quite dazzling for the average development practitioner or policy maker. Could you briefly explain the basic principles of precision farming?

Fields are not homogeneous. We can observe variations in, for example, soil conditions, crop performance and weed development. New technologies now allow us to map and interpret these variations, as well as to carry out crop management at a much higher resolution than we have been used to. In Western countries, this is done through high-tech approaches. The overall results of precision farming are more efficient farm management, fewer inputs, reduced leaching and, therefore, less damage to the environment.

Does precision farming need to be high-tech?

Not at all! Low-tech approaches are just as interesting as high-tech ones. For example, a Kenyan farmer who has to decide where, when and how to apply the limited amount of manure he has on his farm is very much aware of the variability of the soil in his fields and, in most cases, will not spread the manure equally throughout the farm.
In Costa Rica we have worked intensively to develop a system for banana management that is currently operational on several farms.

Despite constraints limiting the use of high-tech approaches, such as the farmers' low level of schooling and the lack of machinery in the plantations, we have been able to develop methods of yield mapping which, in combination with soil surveying, have allowed for site-specific management.

What are the obstacles to the adoption of precision farming techniques in developing countries?

The blueprint for high-tech precision agriculture does not fit in the local context of developing countries. As in the case of Costa Rica, important obstacles include the low levels of literacy among farmers and the lack of equipment. In addition, land tenure systems in developing countries are mostly based on smallholdings, and this affects the extent to which precision farming technology can be applied.

If we were to introduce certain precision farming applications in small farms in Africa, it would be almost impossible to train the large numbers of barely literate farmers that would be involved. We also need to be realistic about the type of farms we can target, and these are farms that cover at least 100 ha. Another constraint is that no crop growth simulation model for tropical fruit crops has yet been developed. In Costa Rica, we did develop a specific system for banana plantations.

How can smallholders benefit from precision farming?

Increased efficiency in management systems is a key aspect of precision farming, especially in smallholder systems where funds to buy large amounts of external inputs are often in short supply. The approach carries many clear messages, including do not waste fertilizers on soils that are constrained by other factors.

Smallholders should also try to determine the type of system required and manage it as specifically as possible. It is worth stressing the fact that smallholders often do not need equipment. They know the variability of their soil very well, they observe crop variability, and they can manage their fields on a site-specific basis even if they rely on manual labour and do not make major investments.

Is precision agriculture likely to make small farmers more dependent on off-farm knowledge and expertise as well as on expensive technology?

As I mentioned earlier, small farmers do not need high-tech equipment. For example, it is not necessary for them to use remote sensing to detect yield differences.

In my view, there are many smallholders that already use the basic concepts of precision agriculture. However, they still face questions such as what constitutes an optimal management system for a specific site given local agro-ecological conditions. And they certainly face financial constraints. ■

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