From the President’s Desk

John V Stafford, ISPA President

Since last November, the President has had his ‘ECPA editorial’ cap on! It’s been really good to see the response to the call for abstracts and then papers from the organisers of 9ECPA to be held in Lleida, Spain. From over 300 abstracts submitted, full papers were requested from 200, 150 were received and - after the scientific assessment/editorial processes - over 100 were accepted for oral presentation at the conference. And now the organisers are concerned that too many wish to attend! I am sure that all will be accommodated! It is very encouraging to see the level of interest in precision agriculture.

A little earlier (June 25-28) and on the other side of the world, the Asian conference (5ACPA) will be taking place. There are more details later in this Newsletter.

We have seen in recent years, reports emanating from several sources including the UK, USA and EU on the challenges facing agriculture now and in the coming decades. Challenges include food security, environmental protection, water availability and resistance to agrochemicals. Precision agriculture can and is playing a major part in providing solutions to these challenges. Continuing research – as reported in our conferences and our Society journal, Precision Agriculture – is essential in this process.

Invitation to the 5th Asian Conference on Precision Agriculture

Sun-Ok Chung, Chairperson of 5th ACPA

June 25-28, 2013
Jeju Island, Republic of Korea

On behalf of the organizing committee of the conference and the Korean Society of Precision Agriculture, it is our great pleasure to invite you to the 5th Asian Conference on Precision Agriculture (ACPA), scheduled in Jeju Island, Republic of Korea, during the period of June 25-28, 2013.

The conference will include a plenary session, a panel discussion session, concurrent oral and poster technical presentation sessions, and a technical tour. In the plenary session, representatives from several Asian countries will present recent topics in each country. Dr. Kenneth Sudduth (USDA-ARS), an invited speaker, will give a presentation on soil and plant sensing technologies. In the panel discussion session, invited world-leading scientists will give presentations on recent research and development activities will be presented and discussed. In a technical tour, conference participants can visit the "Citrus Research Institute" and related facilities, unique sites of citrus production in Korea. We will do our best for a successful conference. As an added incentive to attend, Jeju Island is a world-famous sightseeing place. Jeju Island, formed by volcanic activity, has many places to visit, and has recently been named a World Heritage Natural Site.

Please visit www.precisionag.or.kr for detailed information. We look forward to meeting you at the 5th ACPA in Korea, 2013.

Welcome to the May 2013 issue of the ISPA Report, the official newsletter of the International Society of Precision Agriculture. Inside you will find updates on the 2013 Asian and European Conferences on Precision Agriculture. These promise to be excellent events that hopefully many of you can attend. Also in this issue are several country reports and an article on a Chinese program designed to advance IT use in agriculture. We hope you enjoy this issue, and as always if you have suggestions of items to include in future issues, please let me know.

Ken Sudduth
ISPA Newsletter Editor

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**Events**

**25-28 June 2013**
*5th Asian Conference on Precision Agriculture*
Jeju Island, Republic of Korea  
www.precisionag.or.kr

**7-11 July 2013**
*9th European Conference on Precision Agriculture*
Lleida, Catalonia, Spain  
http://www.ecpa2013.udl.cat/

**16-18 July 2013**
*InfoAg 2013*
Springfield, Illinois, USA  
http://www.infoag.org/

**19 July 2013**
*4th Workshop on Data Mining in Agriculture (DMA ‘2013)*
New York City, USA  
http://dma-workshop.de/

**21-24 July 2013**
*ASABE Annual International Meeting*
Kansas City, Missouri, USA  
www.asabe.org

**28-29 August 2013**
*IFAC Agricontrol 2013*
Espoo, Finland  
http://agricontrol2013.automaatioseura.com

**10-12 September 2013**
*6th European Conference on Precision Livestock Farming*
Leuven, Belgium  
www.ecplf2013.eu

**19-22 September 2013**
*6th International Conference on Information and Communication Technologies in Agriculture, Food and Environment*
Corfu Island, Greece  
http://2013.haicta.gr/

**3-6 November 2013**
*ASA-CSSA-SSSA Annual Meetings*
Tampa, Florida, USA  
www.acsmeetings.org

**8-9 November 2013**
*Land Technik AgEng 2013*
Hannover, Germany  
www.vdi.de/landtechnik-ageng

**20-23 July 2014**
*12th ICRA*
Sacramento, California, USA  
www.ispag.org/icpa/

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**9th European Conference on Precision Agriculture begins July 7**

*Alex Escolà on behalf of The Organizing Committee*

It’s less than two months to the 9th European Conference on Precision Agriculture! We are doing our best to have everything ready to welcome you on July 7th.

These last weeks we have been working hard together with John Stafford, the Editor, to finish the Proceedings. We are really enthusiastic about the final figures; this time, the Proceedings are compiling 100 papers and we are expecting about 90 posters!! Moreover, to date we have more than 230 registrations, so that we are expecting more than 300 attendees in July!! We are now distributing the technical sessions and the oral communications within the program. Be aware of the program web page updates in the following days!

We are designing a program to enable spontaneous meetings as well as to promote social relationships during the conference. To this purpose, we are working on offering you special Evening Events to attend after the technical sessions. The Evening Events will consist of short and relaxing low-cost experiences not related to Precision Agriculture but with amusement (visit to a local brewery, Catalan/Spanish cooking workshop, sports, cultural exchange,…) They will also be open to the accompanying persons. In short, you will receive a detailed offer and we will ask you about your choice. The 9ECPA is also offering a Partner program. There will be guided tours within the town and its surroundings for accompanying persons every day.
Country Report – Botswana  
Monga Mzuku, Botswana College of Agriculture

Although Botswana has experienced a significant decrease in the contribution of agriculture to Gross Domestic Product (GDP), the great majority of the people live in rural areas and depend on agricultural activities for their livelihoods. The area under crops varies from year to year, as the country is prone to drought on a regular basis; even in good years the crop area is only around 0.5 to 1% of the land area. There is also a disparity between areas planted and areas harvested in most years, since the harvest depends on the rainfall during the growing season. There is very little commercial crop production, and most crops are produced for subsistence, or for sale locally. Crop farm sizes are highly variable, ranging from about 0.5 – 20 ha (subsistence farmers) to about 2,000-5,000 ha (commercial farmers). In 2002, the government initiated the National Agricultural Master Plan for Arable Agriculture and Dairy Development (NAMPAADD). Its primary objective is to develop agriculture’s competitiveness and reduce the country’s reliance on imports of agricultural products that can be viably produced locally. This is to be achieved through programmes that enable traditional/subsistence farmers to up-grade their operations to a commercial level, and at the same time assist commercial farmers to improve their level of management and technological application.

Issues Relevant to PA Adoption

Small-scale farmers. The majority of subsistence farmers would not be expected to readily adopt PA for various reasons. These farmers do not perceive agriculture as a business, and therefore they are not concerned with maximizing profits through efficient use of inputs. Production costs are quite insignificant since these farmers depend on government assistance – for example they are given free seed and fertilizer, and the government hires tractors for them to use in ploughing. In addition, the farm owners are not full-time farmers because they are employed elsewhere, and to them farming is not the only means of making a living. Farm sizes are relatively small, and although there could be in-field variability, it may not make economic sense to collect data and invest in expensive equipment to manage this variability.

Commercial farmers. These full-time farmers own large fields and spend a lot of money on inputs, and therefore, they would be expected to readily embrace technologies such as precision farming. They own tractors and combine harvesters that can be fitted with PA equipment (e.g. GPS units and yield monitors).

During my discussion with their advisors in the field it is clear that although they have been slow in adopting PA, there are signs that once they understand its benefits they would probably welcome and adopt the technology. Operations of two different commercial farmers are discussed below to illustrate this point.

One farmer in the northern part of Botswana practices what is referred to as precision planting. His tractors are fitted with GPS units so that every year he plants seeds and applies fertilizer in the same rows as the previous year. The benefit of this technique is that not all nutrients will be absorbed by plants in a given year, and so any excess nutrients remain in the soil bank and will be available to the plants in the current year. Even if the nutrients are leached down the soil profile, they will be brought to the surface through nutrient bio-circulation.

The other farmer who works with NAMPAADD personnel in the southern part of Botswana also has GPS units fitted on his tractors. After harvest, the farmer uses a disc plough to kill the stover, and he follows up this operation with a ripper at the start of the rainy season to prepare for planting. Ripping, during which he uses the GPS to guide the tractor, is done so that seeds will be planted only along the strips that have been ripped. The seed planter is then modified so that inter-row spacing is the same width as the space between the ripped strips. Other farmers appear to have been encouraged by this development, and have also been enquiring about the possibility of fitting GPS units on their tractors. Through personal communication with an agricultural advisor in the area, I learnt that NAMPAADD advocates for adoption of PA since it can help to reduce production costs. The challenge is that although the response by farmers is promising, PA adoption is yet to be realized.

PA Research

I am working with a colleague at Botswana College of Agriculture on a study to determine the level of awareness about PA in Botswana. Because there has been no previous study regarding PA in Botswana this initial investigation will determine if the farming community is aware of the technology and its benefits. This knowledge will help us to work with other stakeholders to fill the knowledge gaps that we can deduce from this study. The study was in the form of a questionnaire whereby respondents in various parts of the country were selected at random. The responses are currently being analyzed and a future publication will share our results with the rest of the PA community.
Sweden is the third largest country by area in the European Union, elongated from 69°N (north of the Arctic Circle) down to 55°N in the south. Most of the country is sparsely populated and dominated by forests. In the southern third of the country, however, about 20% is arable land (2.6 million hectares in total). Forage and field crops such as wheat, barley and oats cover most of the farm land, but oilseed rape, potato and sugar beets are also important crops. The agricultural sector constitutes only 2% of the Swedish gross domestic product. The agriculture industry is highly mechanized and the prevalent trend is that farmers are becoming fewer, but the farms are becoming considerably larger.

Since the mid 1990s, various aspects of precision agriculture (PA) have become more and more common, even though not many farmers have entirely adopted the “precision thinking” in all parts of their production. Back then, a countrywide DGPS service was initiated which suddenly made it possible and affordable to track yield monitors and tractors accurately enough to make the technique of PA an interesting choice to put into practice. Yield mapping revealed considerable within-field variation, but yield maps did not become as widely used in the practice of PA by farmers as was expected.

N-sensors are used in about 20% of the wheat acreage, primarily for on-the-go scanning and optimal application of supplementary N, but it is also used in other crops and for protein prognoses. Photo © Yara.

At present, the most common PA activity is grid soil mapping. Satellite positioning of sample locations and interpolated maps of nutrients and pH has been the standard for many years. Based on soil maps, variable-rate application of lime was the first commercial PA service that was available to farmers. Later, toward the end of the 1990s, the Yara N-sensor used for on-the-go scanning and variable-rate nitrogen fertilization was introduced as a service by contractors; however, today, many farmers have their own equipment. The handheld version of the N-sensor has been used in most Swedish field trials for the last 10 years. Experiences from these measurements have been used in the development of new applications for the tractor sensor. For example, in collaboration between Yara, the farmers’ cooperative Lantmänn, and the Swedish University of Agricultural Sciences (SLU), a malting barley module was created for optimizing the N rate in order to reach a target protein level. Another such example is the development of a new N-sensor-based approach for variable-rate N fertilization of winter oilseed rape in the Scandinavian climate.

For the past few years, RTK-GPS can be used, more or less, everywhere in Sweden through national or local networks of reference stations. This infrastructure, with accuracies down to a few centimeters, has attracted many farmers to invest in auto-steering and guidance equipment. This precision has led to an improved working environment for the driver and the capability to decrease the overlap between tracks, thereby saving both fuel and inputs. Although still not commonly adopted, there is a large interest in controlled-traffic farming.

Research on precision agriculture is mainly carried out at SLU (www.slu.se) and at the Swedish Institute of Environmental and Agricultural Engineering (JTI, www.jti.se). The ECPA conference in 2005 was organized by JTI and SLU. Current research projects include studies on the application of remote and proximal soil sensors for efficient soil mapping in 2D and 3D, development of the use of crop sensors for quality assessment, data fusion of sensors and crop models, a systems approach to assess the economical and environmental benefits of PA and sensor development for seedbed and soil structure analysis. Newly available national datasets on, for example, topography (a LIDAR based national DEM with 2x2 m spatial resolution) have a great potential for use in PA, for example, in digital soil mapping and improved modeling of nutrient leaching at a detailed level.

Sweden has implemented rather strict environmental regulations concerning the use of chemicals and fertilizers. In an effort to compete with cheaper imported products, the focus of the Swedish agricultural production is primarily on high quality and traceability. Various certification systems are in place which may give farmers a somewhat higher price on their produce, both in conventional and organic agriculture. Ecological production methods are currently being applied in 15-20% of the arable land. PA is mostly applied in conventional farming, but efforts are being made to introduce easily applied PA procedures in organic farming, for...
example, variable-rate application of manure and sensor-based control of manure quality.

One program for improving the management of fertilizers at the farm level is Focus-on-Nutrients (www.greppa.nu), which is the single largest undertaking in Sweden to reduce losses of nutrients to air and water from livestock and crop production. The program also focuses on the safe use of crop protection products. The farmer is in focus, and therefore, the core of the project is education and individual on-farm advisory visits. Advice is organized in advisory modules including a module on precision agriculture. The modules are provided by different local advisors and participation in the program is voluntary and without costs for the farmer.

Through the R&D platform of Precision Agriculture Sweden (POS), research and educational organizations, commercial companies interested in PA services, governmental bodies and farmers regularly meet and initiate projects and seminars on PA. The web-based “School of Precision” (www.precisionsskolan.se) is an example of such an initiative.

Demonstration of PA techniques, trial plots with different crops, exhibits by companies and experts, practical demonstrations of machinery and informative seminars are held at the yearly fair, Borgeby Faltdagar (www.borgebyfaltdagar.se) arranged by the Swedish Rural Economy and Agricultural Societies (HIR Malmöhus; hs-m.hush.se). This event attracts visitors from around the world and is a good place to become acquainted with Swedish agriculture.

Visualization of a detailed three-layered 3D model of soil texture covering about 400 ha developed by soil sensor fusion and data modeling. Image © Piikki, Söderström, Wetterlind & Stenberg, SLU.

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**About ISPA**

The mission of ISPA is to advance the science and practice of precision agriculture globally, primarily by facilitating information exchange among precision agriculture scientists, students and practitioners.

The officers of ISPA, listed below, welcome your input as we continue to enhance your Society.

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National Pilot Program of Information Technology for Agriculture in Hubei Province, China

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Background

In late 2012, Hubei was officially designated as one of the seven Chinese provinces to conduct the Chinese National Pilot Program of Information Technology for Agriculture. A provincial Program Steering Committee was formed with the Governor as chair heading 30 provincial government agencies with significant interests in the area of information technology applied to agriculture. Along with this organization structure, resources (in the form of financing, marketing support, etc.) were contributed to the initiative from both the central and the provincial governments.

Province of Hubei

Hubei is located in the middle of China with a total area of 185,900 km², making it 1.94% of the total area of China, and the 16th largest province in the nation. Of this total area, 56% is mountainous, 24% is hilly, and 20% is in prairies/waters. Of the 60 million total population, 43 million live in rural areas. As of 2005, the total arable land was approximately 3.3 million ha where paddy fields account for 1.8 million ha and dry fields 1.5 million ha. Per capita arable land is 0.056 ha. The province is geographically located in the north-south transition zone, with a subtropical monsoon climate, sufficient sunlight and abundant rainfall. The annual average temperature is 15-17°C, the annual average sunshine is 1,200-2,200 hours, the annual frost-free period is 230-300 days, and the average annual rainfall is 750-1600 mm.

A wide variety of crops are grown in Hubei Province, including rice, wheat, corn, potatoes, beans (soybeans, peas, broad beans, green beans), cotton, rapeseed, sesame, peanuts, kenaf, jute, ramie, tobacco, tea, mulberry, citrus, orange, apple, peach, pear, ginkgo, and mushrooms. Being a major contributor of grain, cotton, oil and pigs, in a “normal” year (without major natural disasters), the province can comfortably produce 24 million tons of grain, 500,000 tons of cotton, 1.75 million tons of oil, and 25 million pigs.

In 2012, the total power of agricultural machinery amounted to 40 million kW which accounts for 60% of the plowing, planting, and harvesting done in the region. By 2015, the total horse power requirement is expected to increase to over 45 million kW, increasing the mechanization coverage rate to 65%. This estimate assumes the mechanized plowing of 4 million ha, seeding of 0.5 million ha, planting of 0.45 million ha and harvesting of 2.7 million ha.

Information and communication technology (ICT) in agriculture

Over the past decade, there has been a significant investment in ICT infrastructure in the region including web-based technologies and training of staff dedicated to agriculture. The coverage rate, among 30,000 villages of the province, for cable TV, fixed phone lines and wireless communications has reached 100% in the region, with broadband accounting for 84%. Over 20,000 IT stations have been set up scattered across the province, each equipped with computers and projectors, for the purposes of personnel training. Hundreds of agriculture-related web portals have been deployed where some of them are general purpose and others tailored to specific needs. Over 4,000 agriculture experts have been retained and 22,000 information technologists hired.

Challenges for widespread application of information technology in agriculture include:

• Information systems built by multiple government agencies with no or little coordination resulting in redundancy and/ or conflicts of information and waste of investment.
• Multiple information systems built in the absence of any standards that pose technical challenges for integration;
• Marketing effort of applying information technology in agriculture is ill managed in the rural areas, and the business model is yet to be understood.

…continued on page 7
Guiding principles and goals

Success of the national pilot program depends on incorporating proven technologies, better utilizing existing resources and innovating new sustainable business models applicable to agriculture. Precision agriculture (PA) is one component of this program, premised on an information technology infrastructure utilizing satellite imaging and geospatial tools to provide a holistic farm management solution with the goal of optimizing crop yields while preserving resources.

By 2015, a structure for effectively delivering information technology for agriculture in Hubei will be installed. A provincial Agricultural Service Delivery Platform (Ag-SDP) will be operational with all heterogeneous systems of multiple different agencies pertinent to agriculture fully integrated. Modern technologies and smart equipment (WSN, RFID, etc.) will be widely used in production. The "digital" gap between metropolitan and rural areas will shrink considerably.

The project goals include:

- Relying on the existing communication infrastructure, integrate heterogeneous information systems operated by different government agencies (organization, science and technology, agriculture, education, weather forecast, TV broadcast, commerce, universities, etc.), build a comprehensive Ag-SDP, with an unified Graphic User Interface (GUI) and a Common Information Model (CIM). Furthermore, the Ag-SDP adheres to an open, flexible and robust architecture allowing for a rapid provisioning of new services. Responsibilities of administration and operation of the integrated system will be shared in concert between centralized and distributed levels.
- Leveraging the influence of the provincial governor and the high profile Program Steering Committee, make sure all agencies involved are fully cooperative with adequate resources put in place and necessary system interfaces made available for integration.
- Showcase benefits of the state-of-the-art technologies such as M2M, RFID, WSN, GIS and Cloud Computing applied to PA, taking into consideration Hubei’s specific natural conditions, crops, poultry, livestock, etc.
- A combination of government subsidies and market driven innovation will result in sustainable business models.

Conclusion

Hubei is a major agricultural province in China, with the agricultural industry representing roughly 12% of the provincial GDP. Harvesting enough yields with relatively limited arable lands calls for increased productivity. Use of ICT based PA is still in its infancy in the province. Therefore, there’s a great market opportunity when these emerging technologies are adapted to Hubei’s environment. We are keen to partner with companies, academic institutions experienced in PA to catch up the wave of agricultural modernization taking place in China.

Architecture of Agricultural Service Delivery Platform

[Diagram showing the Unified User Interface (SSO-Enabled) connected to various systems and processes, including Cloud, GIS, WSN, Ag Expert System, Soil Management, 3rd Party Packages, Data Integration, and Process Integration.]
In Malaysia, interest in Precision Agriculture (PA) began about fifteen years ago when the late Prof Dr Pierre C. Robert, widely acclaimed as the Father of Precision Agriculture, delivered a guest lecture on the principles of PA and its potential applications on tropical cropping systems at Universiti Putra Malaysia. Since then, PA has gradually progressed from a sophisticated idea into a logical strategy of managing crops and soils. Much PA research has been done, particularly on commodity and food crops. Two of the widely researched crops are oil palm and rice. Malaysia is currently the world’s second largest producer and largest exporter of palm oil, contributing 44% of the global export market. The oil palm land bank currently stands at 5.8 million hectares. Rice, on the other hand, is Malaysia’s staple food and covers a cultivated land area of almost 0.6 million hectares. At present, Malaysia’s self sufficiency in rice is at 72% and is projected to increase to 90% by 2020. While oil palm and rice are excellent candidates for PA by virtue of being a high value crop and a strategic crop, respectively, several other crops have emerged as potential candidates for PA implementation. These potential candidates include pineapple, vegetables and orchard crops.

Initial work on PA focused on basic applications such as deployment of GPS to mark farm boundaries and crop clusters and points (for tree crops). This followed with spatial variability characterization of crop yields, soil nutrient contents and uptake, and soil chemical and physical properties. Ten years ago, remote sensing investigations kicked in with an aim to detect aboveground crop stress. A considerable amount of work was done to understand the spectral response of target crops across different growth stages.

Gradually, spatial variability maps and satellite imagery were fed into a GIS to compute management zones. Other available data sets, i.e. rainfall and soil/topography maps were digitized and used as GIS layers to strengthen the delineation of management zones. Over the past three years, crop sensors (optical and proximal) have been explored as a tool for detection of crop stress caused by pest and disease.

Some practical PA-based solutions that have been demonstrated in oil palm include: i) Non destructive estimation of palm oil content and oil quality using imaging and GIS protocols, ii) Delineation of nutrient management zones based on topographic attributes, iii) Mapping of crop productivity clusters using Quickbird imagery, iv) Stand density assessment using Google Earth, and v) Spectral discrimination of Orange Spotting disease severity.

In rice, some of the PA-based solutions include: i) Customized GIS for site-specific nutrient management, ii) Decision support system for fertilizer recommendation, and iii) Removal of spatial variability effects in fertilizer trials. In pineapple (grown on peat), management zones were delineated based on variability of crop yields, soil fertility, and nutrient uptake.

PA research and development involves several government agencies and private companies, among which Universiti Putra Malaysia (UPM) and the Malaysian Agricultural Research and Development Institute (MARDI) are the front runners. In UPM, much of the research initiatives on PA are carried out by the following departments: Agriculture Technology, Land Management and Biological & Agricultural Engineering. Recently, UPM established a center of excellence called Geo-spatial Information Science Research Center to synergize research efforts in PA. Over the past fifteen years, UPM has produced more than twenty post graduate (MS and PhD) dissertations that are directly related to PA.

PA has become an engaging topic in meetings organized by academia and professional societies. For example, the Agriculture Congress – a scientific event organized triennially by the Faculty of Agriculture, UPM, typically dedicates a whole technical session on PA. Famous names in PA such as Prof Dr David J Mulla (University of Minnesota, USA) and Prof Dr Raj Khosla (Colorado State University, USA) have delivered plenary talks at the Agriculture Congress. The Malaysian Society of Soil Science and the International Society of Southeast Asian Agricultural Sciences (Malaysian Chapter) have also organized workshops, seminars and public lectures on topics directly concerned with PA.

PA, which started out as a field strategy to increase crop productivity, is now progressing as an enabler of crop and environmental quality, sustainable agriculture and food security. There is a growing interest in employing the concept of PA and its tools for land use-cover change management, carbon foot printing, food safety and traceability, life cycle analysis and environmental/ecological monitoring.