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WCCA · AFITA 2016

World Congress on Computers in Agriculture (WCCA)
Asia Federation for Information Technology in Agriculture (AFITA)

CONGRESS PROGRAMME & ABSTRACT BOOK

ICT for Future Agriculture

June 21(Tue.)**-24**(Fri.), **2016**

Sunchon National University, Suncheon, Korea

Hosted by | Korea Rural Community Corporation | SUNCHON NATIONAL UNIVERSITY

Organized by | Korean Society of Food and Agricultural Information Science | WCCA·AFITA 2016 Organizing Committee | AFITA | ACITRC AGRIFOOD CONVERGENCE ICT RESEARCH CENTER 농식품ICT융합연구센터

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GREETING

"The GIT tries to make a deep impression on all of the clients sincerely on the basis of our best technology."

The Geospatial Information Technology Co., Ltd. was established in 1996 and has become a leading company of the GIS field in fact as well as in name, since with the creative thinking and continuous investment in R & D the GIT has led to open up a new market and led the changing geospatial paradigm by developing new technology and applying the technology to actual field.
The Geospatial Information Technology Co., Ltd. deals with high-tech geospatial service technologies such as digital aerial photographs, LiDAR, satellite images and GPS and the treatment, renewal, integration, application and service solution of client-oriented special geospatial information. Thus, the GIT can support reasonable decision-making and efficient business actions of various kinds of clients, such as BPR / ISP, SI, MIS, Fusion Technology, IoT development.
Also, the recently developed 2EYES(Analytical 3D CCTV SDK), established on various experiences such as UIS, Transportation-GIS, Traffic Safety Smart System(T3S), provides a compelling replacement for the existing intelligent CCTV with 2D video images in the market today.
The GIT will continually develope new technology and provide a differentiated client satisfaction. The GIT will endeavor to be a customer-centered company that human beings and technology will simultaneously grow together.

CEO Kyungyul Park

BUSINESS

GIS DB
Digital Map Production
Construct Space Image DB
Construct Underground Facility DB
Construct Forest Spatial Information
Build Smart pammaep

SI / R&D
Traffic Management system construction(T-GIS)
Land information system development
Comprehensive Real Estate Management System Development
KAIA Land Space and Information Systems Business Conduct

Solution Provider
GeoDT 5.0
Smart Marker
2EYES(Analytical 3D CCTV)
Esri Partner Network(EPN)

T3S
Wireless Smart Lamp
Local Controller
Web-Monitoring System

2EYES
DepthMap
Measure
Boundary Detection

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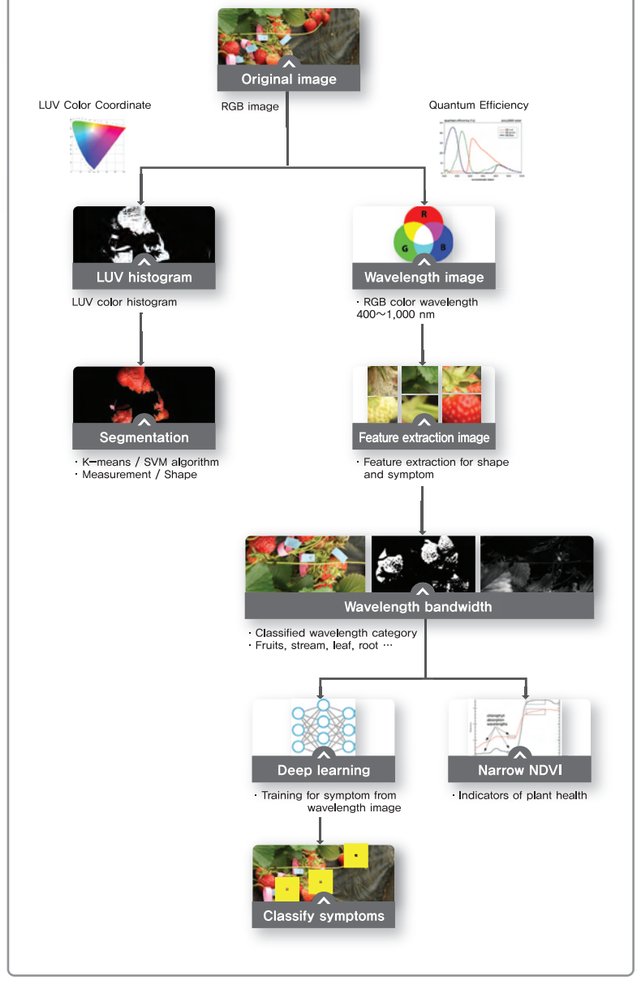
PlantCare

"In greenhouse and field studies PlantCare solution with a visible and near infrared images an quantify damages in number, size and area, including classification of colors."



Harvest forecasting

- Using plant morpheme features, estimate plant's growth, quality, harvest time and yields.
- Calculate pixel value (red, green, blue) to Luv (luminance, u-v color, CIE1976) and make Luv histogram.
- Shape extraction using K-means and SVM algorithm
- Measuring plant size using triangulation.

Early diagnosis of plant

- Using plant color image, calculates and analyzes optical wavelength spectrum.
- Using Narrow NDVI, measures plant physiological stress.
- Using WEKA (deep learning software tool, open source), classifies and diagnose plant physiological stress.

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WCCA · AFITA 2016

C O N T E N T S

WCCA·AFITA 2016
World Congress on Computers in Agriculture (WCCA)
Asia Federation for Information Technology in Agriculture (AFITA)

Welcome Message

On behalf of the Organizing Committee, it is a great pleasure and honor to welcome all of you to the WCCA·AFITA 2016 which will take place at the Sunchon National University from June 21st to 24th, 2016. This congress is co-hosted by Korea Rural Community Corporation and Sunchon National University.

WCCA·AFITA 2016, with the theme of "ICT for Future Agriculture", aims to promote a wide range of ICT researches and developments for agriculture. The scientific program will provide an opportunity for all participants to exchange the latest information and ideas, and encourage to debate on the many issues in ICT convergence research, with high standard instructional invited lectures and wide array of topics of presentation, forum and exhibition.

In addition to the outstanding scientific program, we hope that you will find time to explore Suncheon City and the surrounding areas. We are sure you will enjoy perfect blend of scenic beauty and rich biodiversity in Suncheon, a must-visit eco-city for nature lovers. A visit to the city's natural attractions will make WCCA·AFITA 2016 participants' journey all the more special.

We look forward to welcoming you to Suncheon, where you will find both constructive discussions at the WCCA·AFITA 2016 and warm Korean hospitality.

Best Regards,

Co-Chair of WCCA·AFITA 2016
President of
Korea Rural Community Corporation

Co-Chair of WCCA·AFITA 2016
President of
Sunchon National University

Organizing Committee

Co-Chair of WCCA • AFITA 2016

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※ MAFRA: Ministry of Agriculture, Food and Rural Affairs
※ RDA: Rural Development Administration
※ KRC: Korea Rural Community Corporation
※ SNU: Seoul National University
※ SCNU: Sunchon National University

Program at a Glance

Date	JUNE 21 (TUE.)			JUNE 22 (WED.)			JUNE 23 (THUR.)	
Time/Room	Wooseok Hall (1F)	Main Conference Room (2F)	Meeting Room (2F)	Wooseok Hall (1F)	Main Conference Room (2F)	Lobby (2F)	Wooseok Hall (1F)	Main Conference Room (2F)
08:30~09:00	**Registration** 08:30-18:00, Lobby (1F) / **Exhibition** 09:00-18:00,			Lobby & Exhibition Hall (1F) / **Poster Session** 09:00-18:00, Lobby (2F)				
09:00~09:30							**Plenary Speech Ⅱ** 09:00-09:30, Wooseok Hall (1F) **Prof. Young Chan Choe (Seoul National University, Korea)**	
09:30~10:00				**OS 5** Internet of Things for Agriculture	**OS 6** Precision Agriculture and Robotics		**OS 10** Computer Adoption and Extension for Farmers	**OS 11** Big Data Analysis for Agriculture
10:00~10:30	**Opening Ceremony** 10:00-11:00, Wooseok Hall (1F)							
10:30~11:00				**Coffee Break**			**Coffee Break**	
11:00~11:30	**Keynote Speech** 11:00-11:50, Wooseok Hall (1F) **Prof. Fedro Zazueta (University of Florida, USA)**			**OS 7** IT for Post-Harvest and Food Marketing	**OS 8** IT Convergence for Livestock Farms		**OS 12** Decision Support Systems for Farmers Ⅱ	**OS 13** IT Convergence for Horticulture Farms
11:30~12:00								
12:00~13:00	**Lunch Break** 12:00-13:00, Cafeteria (3F)			**Lunch Break** **AFITA Board Meeting**	12:00-13:30, Cafeteria (3F) 12:00-13:30, Meeting Room II (3F)		**Lunch Break** 12:00-13:00, Cafeteria (3F) **INFITA Board Meeting** 12:00-13:00, Meeting Room II (3F)	
13:00~13:30	**Plenary Speech Ⅰ** 13:00-13:30, Wooseok Hall (1F) **Dr. Iver Thysen (Innovation Fund Denmark, Denmark)**						**Invited Speech Ⅲ** 13:00-13:30, Wooseok Hall (1F) **Prof. Junyu Wang (Fudan University, China)**	
13:30~14:00	**Invited Speech Ⅰ** 13:30-14:00, Wooseok Hall (1F) **Prof. Noboru Noguchi (Hokkaido University, Japan)**			**Invited Speech Ⅱ**	13:30-14:00, Wooseok Hall (1F) **Prof. P.Krishna Reddy (IIIT, India)**		**General Assembly of AFITA / INFITA**	**Coffee Break**
14:00~14:30	**OS 1** e-Business in Agriculture	**SEMINAR** Current State and Issues on ICT Convergence in Agricultural Industry	**OS 2** Modeling and Simulation for Agricultural Production	**OS 9** GIS for Agriculture and Natural Science	**SPECIAL SESSION** Progress Report on InterAct Project, Interdisciplinary Agricultural Information and Communication Technology, Ministry of Agriculture, JAPAN		**Closing Ceremony** 14:00-14:30, Wooseok Hall (1F)	
14:30~15:00								
15:00~15:30	**Case Study 1** Korea Rural Community Corporation		**Case Study 2** Goodmorning Information Technology Co., Ltd.	**Case Study 3** Seedream				
15:30~16:00	**Coffee Break**			**Coffee Break**				
16:00~16:30	**OS 3** Decision Support Systems for Farmers Ⅰ	**SEMINAR** Current State and Issues on ICT Convergence in Agricultural Industry	**OS 4** IT for Water Management	**FORUM** Developing Countries' ICT Forum	**SPECIAL SESSION** Progress Report on InterAct Project, Interdisciplinary Agricultural Information and Communication Technology, Ministry of Agriculture, JAPAN	**Poster Presentation**		
16:30~17:00								
17:00~17:30	**Break**							
17:30~18:00	**Welcome Reception** Lobby (1F), 70 Year Memorial Hall							
18:00~18:30				**Break**				
18:30~20:30					**Gala Dinner** Beommin Hall (1F), International Cultural Convention Hall		OS: Oral Session	

DAY 1 - JUNE 21 (TUE), 2016

SESSION CODE & TIME		CONTENTS	Room
08:30~		Registration	Lobby (1F)
10:00~11:00		**OPENING CEREMONY**	Wooseok Hall (1F)
11:00~12:00		**KEYNOTE SPEECH** **- ICT in Agriculture: Technology Convergence as a Driver of Innovation** ► Prof. Fedro Zazueta (University of Florida, USA)	Wooseok Hall (1F)
12:00~13:00		Lunch Break	Cafeteria (3F)
13:00~13:30		**PLENARY SPEECH** I **- Research and Innovation in ICT and Robotics for Agriculture in Europe** ► Dr. Iver Thysen (Innovation Fund Denmark, Denmark)	Wooseok Hall (1F)
13:30~14:00		**INVITED SPEECH** I **- Agricultural Robotics** ► Prof. Noboru Noguchi (Hokkaido University, Japan)	Wooseok Hall (1F)
14:00~14:45		**ORAL SESSION 1 - e-Business in Agriculture** (Chair: Prof. Amots Hetzroni, Agricultural Research Organization)	Wooseok Hall (1F)
OS 1-1	14:00~14:15	The Effects of Information Security Policy on Information Systems Assimilation within Agricultural Corporation ★ ► Chunghan Kang (Presenter), Junghoon Moon, Cheul Rhee	
OS 1-2	14:15~14:30	The Diffusion of ICT Innovations in Small Hungarian Farms ► Mihály CSÓTÓ (Presenter)	
OS 1-3	14:30~14:45	The Activity and Web Service of Bioinformatics Center for Agricultural Genomics in Korea ► Chang-Kug Kim (Presenter), Yongbeen Cho, Keunseop Shim	
14:45~15:30		**Case Study 1 - Korea Rural Community Corporation**	Wooseok Hall (1F)
14:00~14:45		**ORAL SESSION 2 - Modeling and Simulation for Agricultural Production** (Chair: Prof. János Tamás, University of Debrecen)	Meeting Room (2F)
OS 2-1	14:00~14:15	Digital Knowledge Ecosystem to Reduce Uncertainty and Coordination Failure in Agricultural Markets - Study of "Govi Nena" Mobile-Based Information System ★ ► Lalinda Sugathadasa (Presenter), Athula Ginige, Gihan Wikramanayake, JeevaniGoonetillake, Lasanthi De Silva, Anusha I. Walisadeera	
OS 2-2	14:15~14:30	CFD-based Analysis of Temperature Distribution and Coefficient Uniformity on Floating Hydroponically Grown of Shallots ► Agus Ghautsun Niam, Herry Suhardiyanto, Kudang B Seminar (Presenter), Akhiruddin Maddu	
OS 2-3	14:30~14:45	A Multiobjective Genetic Algorithm for Land Use Planning for Sustainable Biodiesel Agroindustry ★ ► Firdaus (Presenter), Yandra Arkeman, Agus Buono	

SESSION CODE & TIME		CONTENTS	Room
14:45~15:30		**Case Study 2 - Goodmorning Information Technology Co., Ltd.**	Meeting Room (2F)
14:00~15:30		**SEMINAR** **- Current State and Issues on ICT Convergence in Agricultural Industry** (Chair: Prof. Hangjung Zo, KAIST)	Main Conference Room (2F)
SEMINAR 1	14:00~14:20	Current State of Agricultural (Association) Corporation Informatization and ICT Convergence in Korea ► Prof. Cheul Rhee (Ajou Univ.)	
SEMINAR 2	14:20~14:40	Case Study on Agricultural Product Screening Systems ► Prof. Jongtae Lee (Seoul Women's Univ.)	
SEMINAR 3	14:40~15:00	Predicting Supply and Demand of Agricultural Products Using Big Data Analysis ► Prof. Dong Hwan Kim (NEWMA), Do Hoon Ahn (WooRim Info Tech)	
SEMINAR 4	15:00~15:30	Construction of the Intelligent Agro-food Integrated Information System Based on Cloud ► Kangoh Lee (Deputy manager of Korea Agency of Education Promotion and Information Service in Food, Agriculture, Forestry and Fisheries)	
15:30~16:00		Coffee Break	Lobby (1F)
16:00~17:00		**ORAL SESSION 3 - Decision Support Systems for Farmers** I (Chair: Prof. SURESH Kumar Mudda, Acharya N.G.Ranga Agricultural Univ.)	Wooseok Hall (1F)
OS 3-1	16:00~16:15	Impact of IT Investment Portfolio in Agricultural Corporations ► Dongmin Lee (Presenter), Chunghan Kang, Junghoon Moon, Cheul Rhee	
OS 3-2	16:15~16:30	Information and Communication Management System (ICMS) in India – Connecting the Resource Poor Farmers to Knowledge and Institutions ★ ► Suresh K Mudda (Presenter), Ravikumar N K, Chitti B Giddi	
OS 3-3	16:30~16:45	Pearl Model for Detecting Contaminated Shellfish Growing Areas and Aquarius Model for Adjusting Closure Rules of Contaminated Bays ► Conte, F.S., Ahmadi, A. (Presenter)	
16:00~17:00		**ORAL SESSION 4 - IT for Water Management** (Chair: Dr. Baeg Lee, Korea Rural Community Corporation)	Meeting Room (2F)
OS 4-1	16:00~16:15	Performance of Drip Irrigation System in Banana Cultuivation – Data Envelopment Analysis Approach ► K. Nirmal Ravi Kumar (Presenter), M. Suresh Kumar	
OS 4-2	16:15~16:30	Utilization and Performance of ICT-based Rural Groundwater Network System ► Jin-Sung Kim (Presenter), Sung-Ho Song, Byung-Sun Lee, Jung-Gi An, Dong-Kwang Woo, Soo-Jeong Park, Eui-Hwan Oh, Sin-Nam Choi, Cheol-Su Kim	
OS 4-3	16:30~16:45	Assessing the Impact of Seasonal Rainfall Patterns on Indian Rice Production Using Association Rule Mining ► Niketa Gandhi (Presenter), Leisa Armstrong	
OS 4-4	16:45~17:00	Development of a Water Quality Information System for Agricultural Reservoirs ► Jonghwa Ham (Presenter)	
16:00~17:00		**SEMINAR - Current State and Issues on ICT Convergence in Agricultural Industry** (Chair: Prof. Hangjung Zo, KAIST)	Main Conference Room (2F)
SEMINAR 5	16:00~16:30	Issues and Debate: Why are Many ICT Projects buried after Pilot Project Completion in Korean Agricultural Industry?	
SEMINAR 6	16:30~17:00	Discussion	
17:30~		**Welcome Reception**	Lobby (1F)

★ Best Paper Awards Nominee

DAY 2 - JUNE 22 (WED), 2016

SESSION CODE & TIME		CONTENTS	Room
08:30~		Registration	Lobby (1F)
09:30~10:30		**ORAL SESSION 5 - Internet of Things for Agriculture** (Chair: Prof. Kudang Boro Seminar, Bogor Agricultural Univ.)	Wooseok Hall (1F)
OS 5-1	09:30~09:45	IT-Based Supply Chain Traceability of Tuna Fish ► Seminar, K.B. (Presenter), Marimin, Kresna, B.A., Arkeman, Y., Wicaksono, A.	
OS 5-2	09:45~10:00	Analysis of Differences in the Environmental Control of Greenhouses Using ICT Based Sensor Data and its Applications ► Younggeul Yoo (Presenter), Ikhoon Jang, Yongjin Seong, Youngchan Choe, Taewan Kim	
OS 5-3	10:00~10:15	Development of Forecasting and Warning Service System for Reservoir Failure ★ ► Baeg Lee (Presenter)	
OS 5-4	10:15~10:30	Adaptation of Mobile First Strategy for E-Business in Agriculture ► Mechelle Grace Zaragoza (Presenter), Haeng-Kon Kim, Hyun Yeo, Roger Y Lee	
09:30~10:15		**ORAL SESSION 6 - Precision Agriculture and Robotics** (Chair: Prof. In-Bok Lee, Seoul National Univ.)	Main Conference Room (2F)
OS 6-1	09:30~09:45	Farm Tracking. Mobile Application Connected to Cloud-based Field Management Information System ★ ► Hansen, Nicolai Fog (Presenter), Iversen, Anders Haugaard	
OS 6-2	09:45~10:00	Field Experiments with a Mobile Robotic Field Server for Smart Agriculture ► Tokihiro Fukatsu (Presenter), Gen Endo, Kazuki Kobayashi	
OS 6-3	10:00~10:15	Analysis of Cropping Calendar in Northern Area of West Java using Temporal MODIS Data ► Liyantono (Presenter), Yudi Setiawan, Alvin Fatikhunnada, Muhammad Tajul Arifin	
10:30~11:00		Coffee Break	Lobby (1F)
11:00~12:00		**ORAL SESSION 7 - IT for Post-Harvest and Food Marketing** (Chair: To be updated)	Wooseok Hall (1F)
OS 7-1	11:00~11:15	Blog Visitors' Trust toward Restaurant Reviews in Restaurant Review Blog and Business Blog ► Jiyeol Kim (Presenter), Cheul Rhee	
OS 7-2	11:15~11:30	An Analysis of Factors Influencing Consumers' Food Purchasing Behavior in Mobile Shopping Malls: Focusing on the Open Market, Social Commerce, and Integrated Shopping Malls ► Eom Haram (Presenter), Lee Jongtae, Moon Junghoon	
OS 7-3	11:30~11:45	Study on Factors for Improving the Effectiveness of ERP within Korea Agricultural Products Processing Center ► Yeseul Hwang (Presenter), Jungrock Do, Eunjung Woo, Youngchan Choe	
OA 7-4	11:45~12:00	Effect of Vacuum Packaging on Persimmon Fruit Postharvest Quality ► Phuangphet Hemrattrakun (Presenter), Danai Boonyakiat, Nakano Kazuhiro, Shintaroh Ohashi, Pichaya Poonlarp, Parichat Theanjumpol, Phonkrit Maniwara	
11:00~11:45		**ORAL SESSION 8 - IT Convergence for Livestock Farms** (Chair: Prof. Abbas Ahmadi, Univ. of California)	Main Conference Room (2F)
OS 8-1	11:00~11:15	Development of ration Formulation and Enteric Methane Calculation Software for Dairy Cattle in Vietnam ► Ahmadi, A. (Presenter), Kebreab, E., Robinson, P.H.	
OS 8-2	11:15~11:30	Development of Web-based Forecasting System of Airborne Virus of Livestock Infectious Disease using OpenFOAM ★ ► In-bok Lee, Taehwan Ha (Presenter)	

SESSION CODE & TIME		CONTENTS	Room
12:00~13:30		Lunch Break	Cafeteria (3F)
13:30~14:00		**INVITED SPEECH Ⅱ** **- eSagu: Experiences of building an IT-based farm-specific and location-specific agro-advisory system** ► Prof. P.Krishna Reddy (IIIT, India)	Wooseok Hall (1F)
14:00~15:00		**ORAL SESSION 9 - GIS for Agriculture and Natural Science** (Chair: Tien-Yin Chou, Feng Chia Univ.)	Wooseok Hall (1F)
OS 9-1	14:00~14:15	Nutrient Management through GIS and GPS based Fertility Mapping in India ► Rao K T (Presenter), Kumar S Mudda, Babu C G	
OS 9-2	14:15~14:30	Develop the Mechanism of the Parallel Processing Schedule to Increase the Utilization of Agriculture Information Systems in Taiwan ► Chih-Wei Kuan (Presenter), Tien-Yin Chou, Mei-Ling Yeh	
OS 9-3	14:30~14:45	Flood Risk Management in Response on Climate Change in Georgia ► Kakha Nadiradze (Presenter), Nana Phirosmanashvili, Mariami Goginashvili	
OS 9-4	14:45~15:00	Airborne LiDAR Point Cloud Based Agricultural and Pond Culture Modeling ► Péter Riczu, Ildikó Gombosné Nagy, János Tamás (Presenter)	
15:00-15:30		**Case Study 3 - Seedream**	Wooseok Hall (1F)
14:00~15:30		**SPECIAL SESSION** **- Progress Report on InterAct Project, Interdisciplinary Agricultural Information and Communication Technology, Ministry of Agriculture, JAPAN** (Chair: Prof. Takaharu Kameoka, Mie Univ.)	Main Conference Room (2F)
SS 1	14:00~14:15	New Challenge of Agricultural ICT in Japan: A Dynamic e-Crop Calendar for Improving Rice Cultivation Efficiency ► Emi Kameoka (Presenter), Hidemi Kitano, Eisuke Kita, Shunsaku Nishiuchi	
SS 2	14:15~14:30	Wireless Sensor Network System for Fruit-Growing Environment at the Field ► Shinichi Kameoka (Presenter), Atsushi Hashimoto, Ryoei Ito, Takaharu Kameoka	
SS 3	14:30~14:45	Color Calibration of Images Acquired under Artificial Lighting Conditions Based on Illuminating Spectral Information and Geometrical Relationships ► Atsushi Hashimoto, Ken-ichiro Suehara (Presenter), Takaharu Kameoka	
SS 4	14:45~15:00	Low-cost Sensing System Design for Agriculture ► Yoshihiro Kawahara (Presenter), Naoya Miyamoto, Yuki Kojima, Ryo Shigeta, Kazuhiro Nishioka, Naoki Kabaya, Satoru Miyamoto, Masaru Mizoguchi	
SS 5	15:00~15:15	Sensor Observation Service for Connecting Heterogeneous Field Sensor Platforms to Applications ► HONDA Kiyoshi (Presenter), Rassarin Chinnachodteeranun, Apichon Witayangkurn	
15:30~16:00		Coffee Break	Lobby (1F)

★ Best Paper Awards Nominee

SESSION CODE & TIME		CONTENTS	Room
16:00~18:00		**FORUM : Developing Countries' ICT Forum** (Chair: Prof. Cheul Rhee, Ajou Univ.)	Wooseok Hall (1F)
FORUM 1	**16:00~16:15**	(Uganda) Digital Finance for Agriculture: Assessing Trends in Developing Countries ► Kalenzi Cornelius	
FORUM 2	**16:15~16:30**	(Mongolia) Smart Farm Pilot Project in Mongolia ► Erdenebold Tumennast	
FORUM 3	**16:30~16:45**	(Uzbekistan) Current Status of ICT Convergence for Agriculture and Rural Development in Uzbekistan ► JavLonbek Juraev	
FORUM 4	**16:45~17:00**	(Botswana) ICT Development, Policy & Regulation: The case of Botswana ► Meshingo Jack	
FORUM 5	**17:00~17:15**	(Algeria) ICT in Algeria. Between Facts and Perspectives: What opportunities are there for Agricuture? ► Lamia Sekkai	
FORUM 6	**17:15~17:30**	(Kenya) ICT and Agriculture in Kenya ► Francis Gitau Kinvtnia	
FORUM 7	**17:30~17:45**	(Zambia) Agro Extension Services : Digital Opportunities for Zambia ► Moffat Zulu	
16:00~18:00		**SPECIAL SESSION** **- Progress Report on InterAct Project, Interdisciplinary Agricultural Information and Communication Technology, Ministry of Agriculture, JAPAN** (Chair: Prof. Kiyoshi Honda, Chubu Univ.)	Main Conference Room (2F)
SS 6	**16:00~16:15**	Multifunctional High Definition Web Image Viewer for Visualizing Plant Growth Data ► Kazuki Kobayashi (Presenter)	
SS 7	**16:15~16:30**	High throughput phenotyping for cereal crops in outdoor conditions ► Wei Guo, Seishi Ninomiya (Presenter)	
SS 8	**16:30~16:45**	Measurement of Sugar in Phloem Sap by Using IR Spectroscopy ► Wataru Tanida, Atsushi Hashimoto, Ryoei Ito, Shunsuke Ozaki, Shinichi Kameoka, Takaharu Kameoka (Presenter)	
SS 9	**16:45~17:00**	Crop Yield and Quality Prediction for Rice Cultivation ► Hitoshi Sato (Presenter), Shunsaku Nishiuchi, Emi Kameoka, Hidemi Kitano, Eisuke Kita	
SS 10	**17:00~17:15**	Development of a Meteorological Observation System Using Arduino by KOSEN Network ► Shinji Chiba (Presenter), Susumu Yoshida, Yukikazu Murakami, Shinichiro Hoshina, Kazuaki Shiraishi, Tadashi Ishi, Kazuya Kanda	
16:00~18:00		**Poster Presentation**	Lobby (2F)
18:30~		**Gala Dinner**	Beommin Hall (1F)

★ Best Paper Awards Nominee

DAY 3 - JUNE 23 (THUR), 2016

SESSION CODE & TIME		CONTENTS	Room
08:30~		Registration	
09:00~09:30		**PLENARY SPEECH Ⅱ** **- ICT in Korean Agro-Food Industry: The Past and The Future** ► Prof. Young Chan Choe (Seoul National University, Korea)	Wooseok Hall (1F)
09:30~10:15		**ORAL SESSION 10 - Computer Adoption and Extension for Farmers** (Chair: Prof. Cheul Rhee, Ajou Univ.)	Wooseok Hall (1F)
OS 10-1	**09:30~09:45**	The Influence of Organizational Factors on Agricultural Corporation's Use of Information Systems ► Minchul Shin (Presenter), Cheul Rhee	
OS 10-2	**09:45~10:00**	Internet Acceptance and Use Model in Ethiopian Agriculture Education and Research: the case of two Universities ► Milkyas Hailu (Presenter)	
OS 10-3	**10:00~10:15**	An Exploratory study on Successful Adoption of Agricultural Information Systems: Based on Systems Thinking Approach ► Sanghyung Jin, Cheul Rhee, Jongtae Lee (Presenter)	
09:30~10:15		**ORAL SESSION 11 - Big Data Analysis for Agriculture** (Chair: Prof. Adinarayana Jagarlapudi, Indian Institute of Technology Bombay)	Main Conference Room (2F)
OS 11-1	**09:30~09:45**	Technology Trends in ICT – Towards Data-Driven, Farmer-Centered and Knowledge-Based Hybrid Cloud Architectures for Smart Farming ► Jiannong Xin (Presenter), Fedro Zazueta	
OS 11-2	**09:45~10:00**	Critical Zone Observatory and Big-data Approach for Precision Horticulture ► Saurabh S, Suryakant S, Mrunalini B, Surya D, Adinarayana J (Presenter), Srinivasa Rao P, Phanindra KBVN, Rajendra G	
OS 11-3	**10:00~10:15**	SVM Touch: Predicting Agricultural Products Volume with APC ERP Data ★ ► Minjae Jeong (Presenter), Ik-Hoon Jang, Youngchan Choe	
10:30~11:00		Coffee Break	Lobby (1F)
11:00~11:45		**ORAL SESSION 12 - Decision Support Systems for Farmers Ⅱ** (Chair: Hang-Kon Kim, Catholic Univ. of Daegu)	Wooseok Hall (1F)
OS 12-1	**11:00~11:15**	Impact of Informatization Education in Agriculture Corporate Work Effectiveness ► Jihye You (Presenter), Jongtae Lee, Cheul Rhee, Junghoon Moon	
OS 12-2	**11:15~11:30**	Path Analysis on the Determinants of Paddy Yield: Evidence from Two Large-Scale Farms of Japan ► Dongpo Li (Presenter), Teruaki Nanseki, Yuji Matsue, Yosuke Chomei, Toshihiro Butta, Shuichi Yokota	
OS 12-3	**11:30~11:45**	Management of irrigation through a Web-Based Intelligent Decision Support System ► José Moreira, Hélio Sousa, Diogo Martinho, Goreti Marreiros (Presenter), Carlos Ramos, Haeng-Kon Kim, Hyun Yoe, Juan Manuel Corchado	

★ Best Paper Awards Nominee

SESSION CODE & TIME		CONTENTS	Room
11:00~11:45		**ORAL SESSION 13 - IT Convergence for Horticulture Farms** (Chair: Prof. Son, Jung Eek, Seoul National Univ.)	Main Conference Room (2F)
OS 13-1	**11:00~11:15**	A Study on Influence Factors and Performance Analysis by the Introduction of ICT Technology of Horticulture Farms ★ ► Jinhyeung Kim (Presenter), Youngchan Choe	
OS 13-2	**11:15~11:30**	A Fuzzy Expert System For Predicting Pandan Wangi Paddy Productivity in Indonesia ★ ► Yandra Arkeman (Presenter), Muslim Al Khanif, Agus Buono, Kudang Boro Seminar	
OS 13-3	**11:30~11:45**	Analysis of Natural Ventilation for Controlling Internal Environment of Greenhouse built on Reclaimed Land using CFD ► In-bok Lee, Tae-hwan Ha (Presenter), Sang-yeon Lee	
12:00~13:00		Lunch Break	Cafeteria (3F)
13:00~13:30		**INVITED SPEECH Ⅲ** **- IoT System for Agriculture and Food Safety in China** ► Prof. Junyu Wang (Fudan University, China)	Wooseok Hall (1F)
13:30~14:00		General Assembly of AFITA/INFITA Coffee Break	Wooseok Hall (1F) Lobby (1F)
14:00~14:30		Closing Ceremony	Wooseok Hall (1F)

★ Best Paper Awards Nominee

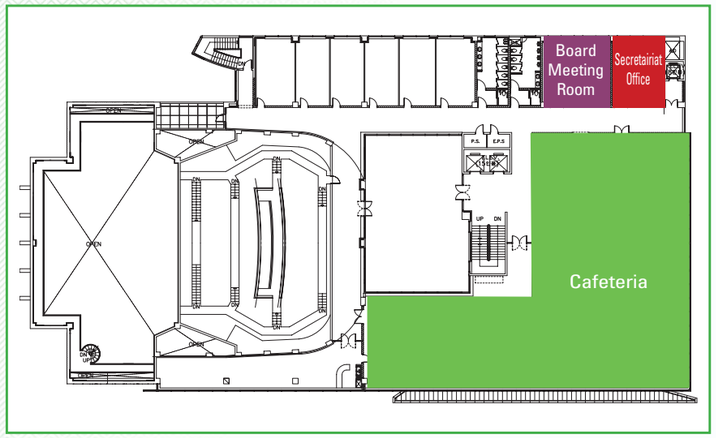
POSTER SESSION CODE

Session Code	Paper No.	Title	Presenter	Organization	Country
2-1	**160410**	Development of a Planting Density-Growth-Harvest (PGH) Chart for Common Ice Plant (Mesembryanthemum crystallinum L.), Sowthistle (Ixeris dentate Nakai) and Quinoa (Chenopodium quinoa Willd.) Hydroponically Grown in Closed-Type Plant Production System	Young Yeol Cho	Jeju National University	Republic of Korea
2-2	**160409**	Development of Models for Estimating Growth of Quinoa (Chenopodium quinoa Willd.) in a Closed-type Plant Factory System	Young Yeol Cho	Jeju National University	Republic of Korea
2-3	**160452**	Developing a Smart Greenhouse Test Bed for the Smart Farm model through ICT Convergence	Youngsin Hong	National Institute of Agricultural Science	Republic of Korea
2-4	**160415**	Cultivation Strategies with CO_2 Balance Models for a Closed Production System of Mushrooms and Lettuces	Dae Ho Jung	Seoul National University	Republic of Korea
3-1	**160440**	Analysis of Relationship between Transpiration Efficiency and Light Intensity for Irrigation Strategy in Paprika Cultivation	Jong Hwa Shin	Andong National University	Republic of Korea
4-1	**160448**	ICT-based intelligent pipeline management system and their applications for efficient use of agricultural water in South Korea	Young Hwa Kim	Korea Rural Community Corporation	Republic of Korea
4-2	**160404**	Development Plan of Intelligent Information System for Rural Water	Jeongdae Kim	Korea Rural Community Corporation	Republic of Korea
4-3	**160433**	Functional linkage of each land in Saemangeum agricultural land	Donguk Seo	Korea Rural Community Corporation	Republic of Korea
5-1	**160382**	A Proposal of Standardization to Smart Greenhouse Data Transmission	Sae Ron Han	Rural development administration	Republic of Korea
5-2	**160439**	Development of a Transpiration Measurement and Environment Monitoring System for Paprika Plants	Jong Hwa Shin	Andong National University	Republic of Korea
5-3	**160451**	Deep Learning –Based Classification of Hyperspectral Images for AMB	Youngsin Hong	National Institute of Agricultural Science	Republic of Korea
6-1	**160366**	Application of A Photovoltaic and Intelligent Resource-Saving System to Aquaculture Facilities	Chi-Yuan Lin	Council of Argiculture	Taiwan
6-2	**160443**	The Development of damage assessment technology for agricultural facilities based on the drone image processing	Joongu Lee	Korea Rural Community Corporation	Republic of Korea
6-3	**160447**	Image Processing-based Disease Detection Algorithm for Tomato Leaf ★	Jeong-Hyeon Park	Sunchon National University	Republic of Korea
6-4	**160414**	Mobile-based Detection and Classification System for Plant Leaf Diseases using Image Processing Technique ★	Podduwa Kankanamge Subash Chaminda Jayasinghe	Sri Lanka Institute of Information Technology	Sri Lanka
7-1	**160365**	Food Safety Risk Assessment: A Method for Risk Companies Mining and Characteristics Analysis ★	Chun-Hsiao Wu	Institute for Information Industry	Taiwan
8-1	**160381**	Development of Traceability Improvement Techniques for Jeju Black Native Pigs Based on DNA Analysis	Taehun Kim	Sunchon National University	Republic of Korea
8-2	**160437**	Utilization of Sensor Network for Fermentation of Opuntia humifusa Grown in Korea	Jiyeon Chun	Sunchon National Universiy	Republic of Korea
8-3	**160364**	Detection of the Laying Habits of Breeder Geese in Environmentally Controlled Goose House with RF Equipment	Chang Shen-Chang	Council of Argiculture	Taiwan
9-1	**160421**	Erosion modeling based on LIDAR data in a Natura 2000 Site	Prof. János Tamás	University of Debrecen	Hungary
9-3	**160418**	3D Analyses of Greenhouse Light Environments and Canopy Light Interception at Diffusive Solar Radiation	June Woo Lee	Seoul National University	Republic of Korea
10-1	**160363**	Study and Development of Inspection System for Rice Seeds with Image Processing	Kuo-Yi Huang	National Chung Hsing University	Taiwan
10-2	**160423**	Microwave electromagnetic field distribution studies using computer simulations in rice weevil elimination	Yenu Wan	National Chung Hsing University	Taiwan
10-3	**160419**	Analysis of Canopy Light Distribution of Lettuce (Lactuca Sativa L.) Plant under LED Lighting by 3D-Optical Simulation	Woo-Hyun Kang	Seoul National University	Republic of Korea
10-4	**160401**	Development of a Coupled Photosynthetic Model of Sweet Basil Hydroponically Grown in Plant Factories	Kyoung Sub PARK	National Institute of Horticultural and Herbal Science	Republic of Korea
11-1	**160396**	Study on the Hadoop based Greenhouse Integrated Management Server System for Big Data Processing	Jeonghwan Hwang	Rural Development Administration	Republic of Korea
11-2	**160416**	Measurement of Income Increase Model by Utilizing Big Data of ICT Controlled Agriculture ; Focusing on tomatoes★	Deok-Hyeon Kim	Jeollanam-do Agricultural Research & Extension Services	Republic of Korea
11-3	**160397**	The Case Study of Increasing the Measured Big Data Utilization in Controlled Horticulture	Hye-rim Lee	Rural Development Administration	Republic of Korea
11-4	**160449**	Visualization of Big Data using Agricultural Data Analysis	Meonghun Lee	Sunchon National University	Republic of Korea

★ Best Poster Awards Nominee

Floor Plan

70 Year Memorial Hall

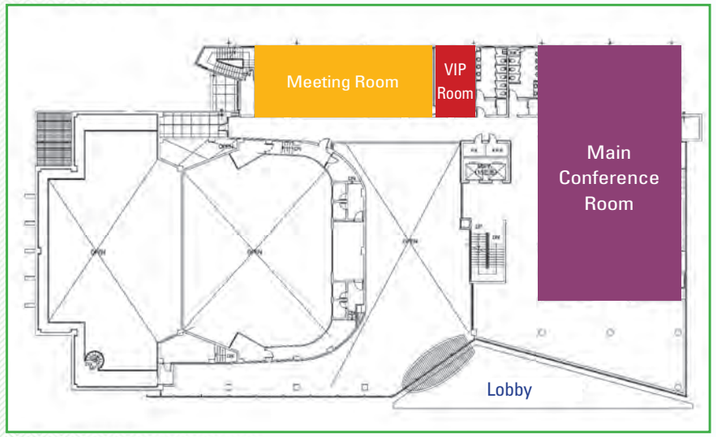


[3F]

Cafeteria

Secretariat Office

Board Meeting Room



[2F]

Main Conference Room

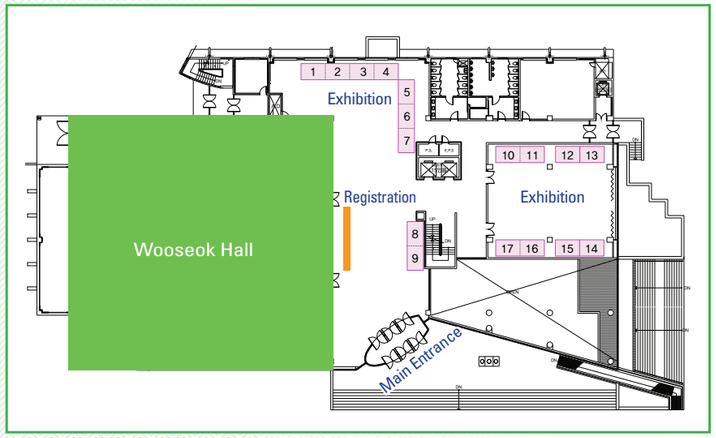
Seminar, Special Session
OS 6, OS 8, OS 11, OS 13

Meeting Room

OS 2, OS 4, Case Study 2

Lobby

Poster Session



[1F]

Wooseok Hall

Opening Ceremony
Keynote Speech
Plenary Speech
Invited Speech
OS 1, OS 3, OS 5, OS 7
OS 9, OS 10, OS 12
FORUM, Case Study 1, 3,
General Assembly of AFITA/INFITA
Closing Ceremony

Exhibition Hall

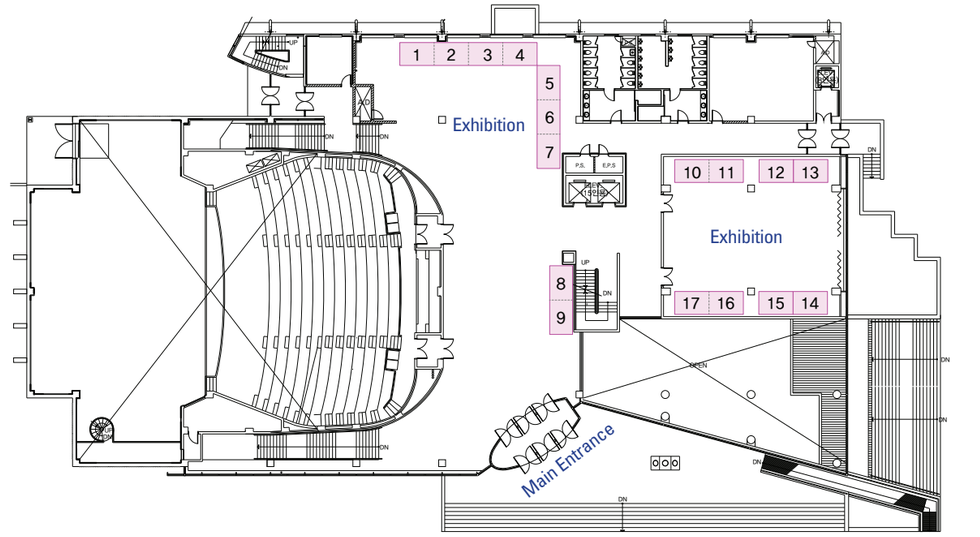
Exhibition

Lobby

Welcome Reception
Registration Desk
Exhibition
Coffee Break

Exhibition

Lobby (1F) & Exhibition Hall, 70 Year Memorial Hall



1, 2, 3, 4	Korea Rural Community Corporation
5, 6, 7	KT
8, 9	Korea Agency of Education, Promotion and Information Service in Food, Agriculture, Forestry and Fisheries
10, 11	Geospatial Information Technology Co., Ltd.
12	IS Technologies Co., Ltd.
13	IROOINFO, INC.
14	SURI Engineering & Consulting Co., Ltd.
15	Infra Information Technology Co., Ltd.
16, 17	EZFARM Co., Ltd.

Congress Information

• Official Language

The official language of the congress is English, which will be used for all presentations and printed materials.

• Registration

Participants are required to wear name tags at all times in order to enter the congress area and to participate social programs. Participants can still make on-site registration at the registration desk located at the lobby (1F) of the congress venue.

Service hours of the registration desk; 08:30~18:00 (June 21 ~ 23, 2016)

Category	On-site Registration	Registration Inclusion
Regular	USD 400	·Admission to Sessions and Exhibition ·Congress Material ·Lunch & Coffee Break ·Welcome Reception ·Gala Dinner ·Technical Tour
Student / Developing Country/ Retired Person	USD 250	
Accompanying Person	USD 100	·Welcome Reception ·Gala Dinner
Single day	USD 100	·Admission to Sessions and Exhibition ·Congress Material ·Lunch & Coffee break

• Certificate of Attendance

A Certificate of Attendance will be issued by Organizing Committee at the registration desk (1F, Lobby).

• Poster Presentation

Poster Session presenters are requested to display accepted posters and give a presentation in an allocated time. Poster Code will be issued and it can be fond on the top of poster board. All posters are displayed during the whole period of the congress and to be removed at the end of the congress.

Poster Set-up Schedule

	Date	Time
Mounting	June 21 (Tue.)	09:00~09:30
Display	June 21 (Tue.)~23 (Thur.)	All Day
Presentation	June 22 (Wed.)	15:30~17:30
Removal*	June 23 (Thur.)	15:00~15:30
Place	Lobby (2F)	

* Posters not removed by 17:30 on June 23 (Thur.) will be discarded by the Secretariat.

• Congress Meals & Coffee Breaks

Meals and coffee breaks are included in the registration fee. Lunches are provided at Cafeteria (3F) and coffee breaks are prepared at the Lobby (1F) of the congress venue.

	June 21 (Tue.)	June 22 (Wed.)	June 23 (Thur.)
Coffee Break (Morning)	–	10:30~11:00	10:30~11:00
Coffee Break (Afternoon)	15:30~16:00	15:30~16:00	13:30~14:00
Lunch Break	12:00~13:00	12:00~13:30	12:00~13:00

• Secretariat Office

The Secretariat Office will be located on the 3rd floor, 70 Year Memorial Hall of Sunchon National University. Service hours are from 09:00 to 18:00 Tuesday through Thursday.

• Technical Tour

Technical tour program of WCCA · AFITA 2016 is designed to offer comprehensive understanding of Korea's successful story of agricultural development and National beauty.
Technical tours for participant will be arranged during the congress as follows:

Technical Tour Program: Suncheon Bay National Garden + Saemangeum (Advance Reservation ONLY)

Date	June 24, 2016
Time	08:50~16:50 (One - day Course)
Itinerary	Sunchon National University – Ecograd Hotel – Suncheon Bay National Garden – Saemangeum – Sunchon National University *The specific schedule can be changed.
Included	Transportation, English-speaking guide, Lunch, Admission fee

Suncheon Bay and the National Garden

Suncheon is the city embracing Suncheon bay, Korea's largest ecological tourist destination. Suncheon Bay is rapidly gaining international recognition as a natural eco-system and protected wetland on the Korea peninsula. Suncheon bay is outstanding for its display of dense reeds, its provision of habitat to a variety bird species and its tidal setting.
Suncheon bay national garden was established in order to turn 1.12 square kilometers of natural habitat into conservation area, where it houses over 505 species of trees and 113 species of flowers. It creates a beautiful wave of color and trees make great shades.

Saemangeum

The Saemangeum project is one of the world's biggest comprehensive agricultural development project. It is a national project that is constructed the world's longest 33㎞ long seadike which connects Gunsan and Buan city by Korea Rural Community Corporation. Inside the seadike, 283㎢ lands are reclaimed and it is about two thirds the size of Seoul. Saemangeum Exhibition Center opened in August 1995, and 1 million visitors are visiting every year. It exhibits the history and the future vision of the Saemangeum Project, and its main facilities are Saemangeum model room, seadike and tidal gate miniatures, Saemangeum Observatory, etc.
Sinsi 33 Center is located in the center of Saemangeum Seadike. The center's name symbolizes the length of Saemangeum seadike, and the building's height is also 33 meter and designed as the shape of ship. In this center, most of the facilities such as sluice gates are monitored and controlled by Korea Rural Community Corporation.

Official & Social Program

• Opening Ceremony

Date & Time 10:00~11:00, June 21 (Tue.)
Location Wooseok Hall (1F), 70 Year Memorial Hall of Sunchon National University

• Welcome Reception

Date & Time 17:30~18:30, June 21 (Tue.)
Location Lobby (1F), 70 Year Memorial Hall of Sunchon National University

• Gala Dinner

Date & Time 18:30~21:30, June 22 (Wed.)
Location Beommin Hall (1F), International Cultural Convention Hall of Sunchon National University

• Closing Ceremony

'Best Paper Awards' will be awarded at the Closing Ceremony. All presenters are advised to attend the Closing Ceremony.

Date & Time 14:00~14:30, June 23 (Thur.)
Location Wooseok Hall (1F), 70 Year Memorial Hall of Sunchon National University

• Technical Tour

Date & Time 08:50~16:50, June 24 (Fri.)
Coures Suncheon Bay National Garden, Saemangeum

General & Local Information

Local Time
GMT +9 hours

Climate
The climate of Korea is characterized by four distinct seasons: spring, summer, fall, and winter. The contrast between winter and summer is striking. The climate features in Summer, the usual temperature is 21.2°C (70.2°F).

Electric and Voltage
The standard voltage in Korea is 220 volts. The outlet has two round holes. Always check the power supply before using your equipment.

Currency
The unit of currency in Korea is the Korean Won (KRW). Notes occur in 1,000, 5,000, 10,000 and 50,000 won denominations, while coins occur in 10, 50, 100 and 500 won denominations. As of Summer 2016, the exchange rate is approximately 1 USD to 1,200KRW.

Business
Hours Government office hours are usually from 9:00 to 18:00 on weekdays and are closed on weekends. Most stores are open every day from 10:30 to 20:00, including Sunday.

Tip
Tipping is not a regular practice in Korea. Service charges are included in your bill for rooms, meals and other services at hotels and upscale restaurants. Koreans occasionally do tip when they are especially pleased with the service they receive.

Congress Secretariat
If you need medical assistance, please contact the Congress Secretariat located at 3F.
In case of an emergency, please dial 119 from any place.

Useful Phone Numbers
- Police 112
- Interpretation Service 1588-5644

WCCA·AFITA 2016

INVITED SESSION

Invited Session

Keynote Speech

11:00~11:50
June 21 (Tue.), Wooseok Hall (1F)

Prof. Fedro S. Zazueta (President of WCCA / University of Florida)

Dr. Zazueta is a professor in the Agricultural and Biological Engineering Department at the University of Florida.
He currently serves as Associate CIO at the University of Florida's Office of Information Technology. He is charged with strategic planning for ICT and the Direction of the Office of Academic Technology. He has served as a consultant for ministers and secretaries of state on strategic applications of IT in Asia, the Americas, Europe and Oceania.
He is past president of CIGR, ASABE Fellow, The Club of Bologna member, and a founding member of iAABE, INFITA and ALIA.

ICT in Agriculture: Technology Convergence as a Driver of Innovation

This presentation will review the evolution and current trends in IT and their relationship to agriculture. It will focus on the use of ICT to improve outcomes of academic, research and extension education programs, including uses of mobile, social, and cloud in the context of big data. Finally, it will speculate on the impact of technological convergence and its relevance to the future of agriculture.

Plenary Speech

13:00~13:30
June 21 (Tue.), Wooseok Hall (1F)

**Dr. Iver Thysen (Innovation Fund Denmark,
Research Technology & Growth, Denmark)**

Iver Thysen holds a M.SC in Animal production and a Ph.D. in Operation Analysis. From 1973 to 2009 he worked as a researcher in several amalgamating Danish research organisations, finally Aarhus University, on information technology and decision support. He was coordinator of an EU concerted action (ENITA, 1994 ~1998) on IT in agriculture, and cofounder and first president of EFITA. Since 2009 Iver Thysen has worked as scientific adviser for the coordinator of ICT-AGRI.

Research and Innovation in ICT and Robotics for Agriculture in Europe

ICT and Robotics for Agriculture have in the recent couple of years attracted a great deal of attention in Europe. The significance of Precision Farming for achieving a sustainable intensification of agriculture is now widely recognised. The goal is in other words to meet the growing future demands for food with less environmental food prints. The investments in research and innovation within ICT and Robotics for Agriculture have also grown significantly. This is the case in the European Union as well as in several European countries. The focus is often on the development of so-called Smart Applications, which utilise the emerging technologies in sensors, automated farm machinery and equipment, internet communication, Big Data, etc. The challenge is, however, to get these Smart Applications into use by farmers.

The EU project ICT-AGRI (ICT and robotics for a sustainable agriculture) is collecting basic information about European projects within ICT and Robotics for Agriculture. The main purpose is to look for options for collaboration between these projects and between the organisations and companies owning the outcome of these projects. Such collaboration may increase the quality of Smart Applications and in particular the uptake of Smart Applications by farmers. The results of this investigation will be presented at the conference.

Invited Speech

13:30~14:00
June 21 (Tue.), Wooseok Hall (1F)

Prof. Noboru Noguchi (Hokkaido University, Japan)

Dr. Noguchi has made many contributions to both industries and universities in the area of applications of advanced technologies to agricultural systems. He is highly recognized internationally for his contributions in robotic applications on off-road equipment. Dr. Noguchi used to be an adjunct associate professor in the University of Illinois to develop the field robot by collaborating with U.S. industries. He was the first researcher who developed a fully autonomous field robot in the world in 1997 with National Research Institute of Agricultural Machinery in Japan. Due to his outstanding achievements on automation technologies in production agriculture, he received two academic awards from major international academic societies; the American Society of Agricultural Engineers (ASAE) and International Commission of Agricultural Engineering (CIGR). Lately, he is devoting to develop a small-sized orchard robot applying a sensor-fusion algorithm. Using his algorithm, even though GPS is invalid situation, the robot can run autonomously based on a local sensing system composed of a laser scanner and a stereo vision. In addition, the sensing system also has a function of obstacle detection and avoidance. And, he is also developing an intelligent machine vision for an agricultural mobile robot.

Agricultural Robotics

Agriculture in developed countries after the Industrial Revolution has tended to favor increases in energy input through the use of larger tractors and increased chemical and fertilizer application. Although this agricultural technology has negative societal and environmental implications, it has supported food for rapidly increasing human population. In western countries, “sustainable agriculture” was developed to reduce the environmental impact of production agriculture. At the same time, the global agricultural workforce continues to shrink; each worker is responsible for greater areas of land. Simply continuing the current trend toward larger and heavier equipment is not the solution. A new mode of thought, a new agricultural technology is required for the future. Intelligent robotic tractors are one potential solution. Sensors are an essential part of intelligent agricultural machinery. Machine vision, in particular, can supply information about current crop status, including maturity and weed infestations. The information gathered through machine vision and other sensors such as GPS can be used to create field management schedules for chemical application, cultivation and harvest. This chapter will give the application of robot vehicles in agriculture using new technologies. Research institutions around the globe are conducting researches about autonomous vehicle for agricultural use and usually they rely on a RTK-GPS (real-time kinematic global positioning system), GIS (geographical information system), image sensors, and VRS (virtual reference station), etc.).

The robot framing system will fully automate the farming from planting to harvesting until to the end user of the products. A robot tractor and a planting robot will be used to plant and seed the crops using navigation sensors. It includes a robot management system, a real-time monitoring system, a navigation system, and a safety system. In the robot farming system, the robot vehicles receive a command from the control center and send information data through a wireless LAN or packet communication. The robot vehicles such as a robot tractor and a robot combine harvester can perform its designated tasks and can work simultaneously with each other. The operator at the control center can analyze the data sent by the robot vehicles in a real-time basis and can immediately send the necessary information to the farmers, retailers, and producer's cooperation, etc. Also, the operator can see the real-time status of the robot vehicles using a GIS while their performing its task. This GIS-base robot management system has a function of communicating with the robot vehicles about status of the work such as work efficiency and the level of fuel, fertilizer and chemicals contained in each tank. The robot management system can also obtain crop information data from the robot vehicles using a smart vision sensor. From this information, a variable rate fertilizing map can be generated and the control center can send it back to the robot tractors for fertilization of the crops.

Invited Speech

13:30~14:00

June 22 (Wed.), Wooseok Hall (1F)

Prof. P.Krishna Reddy (IIIT Hyderabad, India)

Prof P. Krishna Reddy is the head of IT for Agricultural Research Center at IIIT Hyderabad, India. During 2013 to 2015, he has served as a Program Director, ITRA-Agriculture & Food, Information Technology Research Academy (ITRA), Government of India. Since 2004, he has been investigating the building of the eSagu system, which is an IT-based personalized agro-advisory system, to provide scientific agricultural information to farming community. He has also built the eAgromet system which is an IT- based agro-meteorological advisory system to provide risk mitigation information to farmers.

eSagu: Experiences of building an IT-based farm-specific and location-specific agro-advisory system

By exploiting developments in IT, we have developed a eSagu technology (Here, the word `Sagu' means `Cultivation' in Telugu language) which is a farm-specific and location-specific IT-based agro-advisory system. In eSagu, agricultural experts generate expert agro-advicebased on the latest information about the crop situation received in the form of both digital photographs and text. In the farm-specific eSagu system, scientific agro-advice is provided to every farm (or field) at regular intervals, i.e., once in every 10 days from sowing to harvesting. Since 2004, the expert advice has been delivered to thousands of farms of several crops at different places in India. The impact studies show that the farmers have realized considerable monetary benefits by reducing the quantity of fertilizer application, number of pesticide sprays, besides getting the additional yield. To improve the scalability, we have developed a location-specifice Sagu system. In this system, a sample number of farms are selected for each major crop of a location (a group of villages). The agricultural experts provide expert advice to these farms at regular intervals. The expert advice is made available to all the farmers in the village by displaying colour printed sheets of both photographs and advicetext on the notice boards in the corresponding villages. The implementation results show that, in addition to reducing input costs and improving crop productivity, the system is also enabling community discussion and knowledge sharing/ empowerment. Overall, we have demonstrated that, it is possible to provide actionable scientific agro-advisory to every farmer at regular intervals in a cost effective manner by exploiting IT. The eSagu system could bring significant benefits to the farmers and related stakeholders of both developing and developed countries having small farm holdings. In this talk, I will share the experiences of conceptualizing and building eSagu system.

Plenary Speech

09:00~09:30

June 23 (Thur.), Wooseok Hall (1F)

Prof. Young Chan Choe (Seoul National University, Korea)

Prof. Young Chan Choe is a professor of the Department of Regional Information at Seoul National University. He has published research articles for information systems and management for agro-food industry, e-agribusiness, food traceability systems, e-commerce for food products, E-government, and Business Application using Ubiquitous Technologies, ICT convergence in Agro-Food Industry, and Bigdata Analytics for Agro-Food Industry in various journals, including Decision Support Systems, Journal of Environmental Management, Scientometrics, Electronic Commerce Research and Applications, International Journal of Information Management, Online Information Review, Information Systems Review, Technological Forecasting & Social Change, Information Systems Frontier, INNOVATION: Management, Policy, & Practice, Journal of Agricultural and Resource Economics, etc.. He received the best paper award from Americas Conference of Information Systems in 2006 and The Korea Society of Management Information Systems in 2010, and Agricultural Science and Technology Awards from Korean Ministry of Agriculture in 2000.

ICT in Korean Agro-Food Industry: The Past and The Future

For the last 30 years, institutions and researchers in agro-food sector in Korea have tried to build more effective information systems utilizing the amazing progress in ICT environment. ICT in agro-food sector has been started in 1980's as many agricultural institutions built various DB/NWs for agribusiness, farmers, and rural community. In 1990's, they have invested more effort to build better information infrastructure for rural community and to educate farmers and agribusinesses to adopt the information technologies. In 1992, the government has founded AFFIS(Agriculture, Forestry, and Fisheries' Information Service) which become Korean Agency of Education, Promotion, and Information Service in Food, Agriculture, Forestry, and Fisheries. With information infrastructure expending, farms and agribusinesses have used PCs and internet regularly. They have adopted various MIS and ERPs and started e-commerce for food and agricultural products.

In 2000's, fast and consistent telecommunication infrastructure have been expanded to rural area which helped the small business of farms to integrate vertically and horizontally easily. It has also made remote conference and control farms easier and hence reduce socio-cultural gap between urban and rural area. Farm management systems and ERPs are further developed

based on ASP platforms, and high-speed internet has made them easier to use with friendly interfaces and protocol. Farmers also could monitor market and expected prices for their own products in real time through market monitoring system. Various types of ECs and online trading could help agribusiness to keep their own blend and prices. The ubiquitous technologies, mostly RFID, barcode and senor networks, are introduced to farms and agribusinesses. Traceability Systems for food and agricultural production, processing, marketing, and retailing are introduced, especially for livestock industry. E-commerce for food and agricultural products are also evolved to social commerce based on the concept of Web2.0. Various social network service platforms are utilized. The virtual store has also been introduced in a metropolitan subway station.

In 2010's, the Korean ministry of Agriculture, Food and Rural Affairs have emphasized more on ICT convergence of agro-food business which now become smart farm initiatives. Various information and telecommunication technologies with improved robotics and artificial intelligence will allow farmers to increase size of their farm with automated production facilities and equipment. The smart farm technologies will allow food and agricultural sector to build more competitive and comfortable future with optimized control. The Bigdata and intelligence technologies based on Web3.0 concepts will help to optimize the entire value chain of food and agricultural industries, which helps farmers, agribusinesses and consumers. The technologies will help to build seamless value chain for food and agribusinesses.

Invited Speech

13:00~13:30

June 23 (Thur.), Wooseok Hall (1F)

Prof. Junyu Wang (Fundan University, China)

Junyu Wang is a Professor of Fudan University, Shanghai, China and the Associate Director of Auto-ID Lab at Fudan University. He got a Ph.D degree of Computer Science in the University of Science and Technology, Beijing in 2002. He was a Visiting Associate Professor in MIT in the year 2008~2009. Since October 2012, he has been a member of GS1 Architecture Group. In the past 12 years, he has been working on research and development related to Auto-ID and Internet of Things (IoT) technologies, including radio frequency identification (RFID) air interface, RFID security, coding scheme and applications of IoT, etc. He worked as TPC Chair of the 3rd International Conference on Internet of Things in 2012 (IoT 2012). In the year 2011~2013, he was the Executive Manager of the National Project "Agriculture Internet of Things and Food Quality and Safety in China" funded by Ministry of Science and Technology (MOST) China. Currently, he is working with the Information Center of China Food and Drug Administration on another national food safety project (2015~2017). He has 30+ publications, 10+ Chinese patents in the area of RFID and Internet of Things.

IoT System for Agriculture and Food Safety in China

In this talk, the IoT system for agriculture and food safety in China will be overviewed. Research results of Auto-ID Lab at Fudan and other research institute in China will be provided, including but not limited to IoT system architecture, E-pedigree, standards, devices such as sensors, barcodes and RFID tags. The progress of a project with the Information of China Food and Drug Administration will be introduced as well.

WCCA·AFITA 2016

World Congress on Computers in Agriculture (WCCA)
Asia Federation for Information Technology in Agriculture (AFITA)

WCCA·AFITA 2016

ORAL SESSION

CODE 1. e-Business in Agriculture
2. Modeling and Simulation for Agricultural Production
3. Decision Support Systems for Farmers Ⅰ
4. IT for Water Management
5. Internet of Things for Agriculture
6. Precision Agriculture and Robotics
7. IT for Post-Harvest and Food Marketing
8. IT Convergence for Livestock Farms
9. GIS for Agriculture and Natural Science
10. Computer Adoption and Extension for Farmers
11. Big Data Analysis for Agriculture
12. Decision Support Systems for Farmers Ⅱ
13. IT Convergence for Horticulture Farms

SPECIAL SESSION

Progress Report on InterAct Project,
Interdisciplinary Agricultural Information and
Communication Technology, Ministry of Agriculture, JAPAN

OS 1-1

The Effects of Information Security Policy on Information Systems Assimilation within Agricultural Corporation

Chunghan Kang[1], Junghoon Moon[1*], and Cheul Rhee[2]

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Abstract

The importance of information security is getting important all around world [27] The agriculture industry is not an exception, because many agribusiness rely on information systems (IS) to obtain competitiveness. For instance, Kang et al. [16] identified that assimilation of IoT based electronic sow feeder has a positive effects on the productivity of swine farms. Referring current body of relevant literature, however, researchers not yet fully understand the relationship between information security and IS assimilation within agricultural corporations. In this regard, the aim of this paper is to identify the effects of information security on the IS assimilation within agricultural corporations. This study analyzed data collected by the Korean Agency of Education, Promotion, and Information Service in Food, Agriculture, Forestry, and Fisheries (EPIS) for a governmental white paper, namely a survey on the information levels of agricultural corporations. This study identifies that information security policy is important factor affecting to the IS assimilation. Notably, the effect is not just linear, but curve linear. In other words, introduction of information security policy within the agricultural corporations has a positive effect on the information assimilation, but the effect turns to negative at certain point. Thus, immoderate security policy deteriorate the information assimilation within the agricultural corporation. Several implications for academia and practitioners are discusses.

Keywords: Information security policy, Information systems assimilation, Formalization

Acknowledgments

This research was supported by the MSIP(Ministry of Science, ICT and Future Planning), Korea, under the ITRC(Information Technology Research Center) support program (IITP-2016-H8601-16-1007) supervised by the IITP(Institute for Information & communications Technology Promotion).

OS 1-2

The Diffusion of ICT Innovations in Small Hungarian Farms

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Abstract

The impact of the information society on agriculture and rural areas is indisputable. Emerging IT solutions have lent new impetus to agriculture related information technology research and development with the objective of providing new applications for farmers. The aim of this paper is to investigate the impact of ICT innovations on agriculture, especially for small farmers: how do farmers adopt and use these technologies? The data for this research based on a questionnaire survey conducted in May and June 2015 among registered farmers in Hajdú-Bihar county, Hungary. The results show that general-purpose ICT-use (computers, internet, smartphones) of farmers in Hajdú-Bihar county accords with the average for the Hungarian population, the diffusion of these technologies corresponds to the values measured for the adult Hungarian population. The personal characteristics of farmers (e.g. age, education, participation in ICT courses) exert a decisive influence on the adaptation of general-purpose ICT, while the attributes of farms (e.g. size, complexity, income, profitability) do not impact general-purpose technologies but have an influence on the adoption of agriculture-related software and applications.

Keywords: Small farm, ICT-adoption, Diffusion of innovations, Influencing factors

Acknowledgments

I would like to thank my supervisor, Miklós Herdon and the Hajdú-Bihar county directorate of the Hungarian Chamber of Agriculture (NAK) for their help organizing and conducting the questionnaire survey.

OS 1-3

The Activity and Web Service of Bioinformatics Center for Agricultural Genomics in Korea

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Abstract

In Korea, bioinformatics center becomes essential place in which research as transcriptome, metabolomics, proteomics, system biology, comparative genomics, and next-generation sequencing (NGS). In 2016, National Agricultural Biotechnology Information Center (NABIC, http://nabic.rda.go.kr) has updated an access portal to a multi-platform to search, visualize, and share agricultural genomics data. We gathered 28.5 TB of data from agricultural organisms, with tendata types comprising NGS, Sequence Read Archive, genome, gene, nucleotide, microarray, EST, interactome, protein structure, molecular marker, and SNP data sets. Our genomic resources offer information on five animals, seven plants, and one fungus, through a genome browser. We also developed a data submission and analysis system as a web service, with easy-to-use functions and cutting-edge algorithms, including ones for the handling of NGS data. We developed NABIC, an updated collection of agricultural genome data derived from RDA-engaged research institutes. We implemented an online resource to allow users to search, view and download the genome and genetic data. With the wide application of the NABIC, we hope that novel informatics approaches in agricultural biotechnology to support molecular and conventional breeding programs for new crops and livestock become more general in the fields.

Keywords: Genomics center, Genome database, NABIC service

Acknowledgments

This study was conducted with support from the Research Program for Agricultural Science & Technology Development (Project No. PJ010112) of the National Institute of Agricultural Sciences, Rural Development Administration, Republic of Korea.

OS 2-1

Digital Knowledge Ecosystem to Reduce Uncertainty and Coordination Failure in Agricultural Markets - Study of "Govi Nena" Mobile-Based Information System

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Abstract

This paper presents how Digital Knowledge Ecosystem such as "Govi Nena" (translates as agriculture intelligence) can be used to provide a more effective and practical solution to eliminate the inefficiencies in agricultural markets and achieve higher productivity and price stability. In order to establish the framework to analyze the system, this paper uses a set of hypothetical scenarios faced by value chain actors based on a review of the literature, established knowledge and recent developing country experiences. The scenario analysis reveals that "Govi Nena" enables farmers to make effective production decisions, deepens the level of value chain integration, and enhances the level of welfare for the society as a whole.

Keywords: Actionable information, Coordination failure, Uncertainty, Digital knowledge eco system, Mobile-based information system

OS 2-2

CFD-based analysis of temperature distribution and coefficient uniformity on floating hydroponically grown of shallots

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Abstract

This study present an analysis of distribution and the coefficient uniformity temperature on nutrient solution offloating hydroponic during applied of root zone cooling (RZC) treatment in the tropical lowland, Indonesia. The investigation of micro climate inside the nutrient solution (root zone) is based on computational fluid dynamics (CFD) to perform numerical simulation using a finite volumes method to solve the mass, momentum and energy conservation equations. The scenario of root zone cooling was carried out at three different temperatures of nutrient: low temperature (8-10°C), medium temperature (13-15°C) and control (i.e., without cooling at 26-28°C). The treatments of cooling were carried out along the cultivation period of the shallots during the day (i.e., at 09:00-15:00.The uniformity of temperature distribution in each planting hole under low RZC reached 99.94 % at the nutrient level, whereas at the air level reached 94.64%. This is understandable because the functions of nutrient solution that as a conductive medium temperature and the cold nutrient can also maintain the temperature due to the nature of the higher heat capacity than air.The temperature in the planting hole are relatively stable at temperatures 7.6- 9°Cunder low RZC treatment, 13-15.6ºC under medium RZC treatment when chiller/cooler has on, and slowly changing temperatures between 10ºC to 15ºC (low RZC), and 20-21ºC (medium RZC) after cooler off (15:00 o'clock). In the chamber floating system without RZC treatment, nutrient has a significant role as a temperature stabilizer. Indications are visible on nutrient temperature conditions stable in the range of 25-27°C, both of day and night.This condition indicates that nutrient with a floating hydroponics system acts as a damper temperature during the day and warmer temperatures at night. One of advantage in the floating hydroponic, important energy savings can be achieved by maintaining the water covered by styrofoamboards.

Keywords: Computational fluid dynamics (CFD), Floating hydroponic, Root zone cooling,shallot, Temperature distribution,

OS 2-3

A Multiobjective Genetic Algorithm for Land Use Planning for Sustainable Biodiesel Agroindustry

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Abstract

Land use planning may be defined as the process of allocating different activities or uses (such as agriculture and agroindustry) to specific units of area within a region. This is a complex process, as in land use planning decision must be made not only on what to do (selection of activities) but also on where to do it, adding a whole extra class of decision variables to the problem. Depending on the size of the region and the number of objectives considered, an enormous increase in the number of decision variables can easly result. Due to the complexity of the problem a non-traditional optimization method is used in this research. The aim of this research is to develop a genetic algorithm to solve multiobjective land use planning model. There were three objective functions on which optimizations were done. This included profit factor function, carbon sequestration factor function, and soil fertility factor function. Chromosome representation was in the form of matrix that represents the grids of land use. The results show that the complex and large scale land use planning can be solved by multiobjective genetic algorithm effectively and efficiently.

Keywords: Multiobjective genetic algorithm, Biodiesel, Land use planning

OS 3-1

Impact of IT Investment Portfolio in Agricultural Corporations

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Abstract

The importance and amount IT expenditure has been gradually increased in agriculture industry. However, there is limited empirical research on the verification of the effect of IT investment in the agricultural sector. This study aims to examine the effect IT investment on organizational efficiency and effectiveness in agricultural corporations by adopting IT investment portfolio concept. This study uses survey data on informatization of agricultural corporations in Korea, gathered by Korea Agency of Education, Promotion, and Information Service in Food, Agriculture, Forestry and Fisheries (EPIS). The average agricultural firm allocates 49.6%, 13.9%, 22.6%, and 13.9% of its total IT investment each year to infrastructure, transactional systems, information systems, and strategic systems, respectively. The results of the linear regression show that spending more on transactional asset and strategic asset than the infrastructure asset increase organizational efficiency and effectiveness. Regarding effectiveness, more positive effect exist on transactional asset than infrastructure asset. Corporations should invest more on transactional asset or strategic IT asset than infrastructure to increase organizational efficiency and effectiveness.

Keywords: IT portfolio, Organizational efficiency, Organizational effectiveness

Acknowledgments

This research was supported by the MSIP(Ministry of Science, ICT and Future Planning), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2016-H8601-16-1007) supervised by the IITP (Institute for Information & communications Technology Promotion).

OS 3-2

Information and Communication Management System (ICMS) in India – Connecting the Resource Poor Farmers to Knowledge and Institutions

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Abstract

Information and communication technologies (ICTs) have always mattered in agriculturetoo. In day-to-day practices of agriculture and allied sectors, the farmers often share their information. Farmers in India find it difficult to obtain answers to the questions raised, eventhough they are repetitive for them in agriculture. Changing weather patterns, soil conditions, pests and diseases always throw challenges to small and marginal farmers. So, the farmer needs up-dated information to cope with and even benefit from these changes. However, because of the highly localized nature of agriculture, the information must be tailored specifically to distin ctconditions. In the developing countries like India, where agriculture still plays a crucial role (over 58% of the rural households depend on agriculture as their livelihood) and the rising population from 1027 million to 1419 million during 2001-16 (a total rise of 38 percent or 1.3 percent per year) pose a lot of pressure on land and other resources to meet the food security needs on one hand and to meet the challenges of globalization on the other. Though Globalization brought unique opportunities to small and marginal farmers into supply chains, it has still intensified competition among the farmers, as they got exposed price shocks, incomparable quality standards of products, deficiencies in rural infrastructure, increased emphasis on cost-effective production etc. Understanding and addressing these challenges arevery crucial, in which ICT can play a major role. The role of ICT is to contribute to ‘smart; agriculture, and incentivize farmers through making them aware about the modern technology and its application to boost agricultural production. With the booming mobile, wireless, and Internet industries, ICT has found a foothold even in poor marginal and small holder farms and in their activities. The study conducted among the 120 farmers in Srikakulam district in India revealed that, ICT has revolutionized the agriculture in the modern days. Production and marketing information is accessed by 91% of the sample farmers through mobile in 2015, whereit was only 5% in 2005. The extent of use of mobile phones by the farmers varied with the decision to be taken by them like harvesting, packing, and storing (94%), Selling Decision(91%), Seed purchase (89%), Application of fertilizers and pesticides (88%) and Land preparation and planting (84%), other package of practices (77%). The farmers further opined that, ‘Voice’ was the dominating source of communication (96%) compared to Short Message Service (SMS) (only 27%) and Internet access (10%), as majority are illiterate. The use of camera (71%), Bluetooth (33%), Radio (61%) TV (41%) are the other means of sharing the information. Having noticed, The National Agriculture Policy lays emphasis on the use of Information Technology (IT) for achieving a more rapid development of agriculture in India through a National e-Governance Plan in Agriculture (NeGP-A) , (AGRISNET); (AgRIS etc. Inthis context of importance of ICTs in Indian agriculture, greater attention justifies about the applications of ICT’s to alleviate poverty and promote economic growth of the farming population.

Keywords: ICTs, Mobiles, Networking, Resource poor farmers

OS 3-3

Pearl Model for Detecting Contaminated Shellfish Growing Areas and Aquarius Model for Adjusting Closure Rules of Contaminated Bays

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Abstract

Pearl and Aquarius are shellfish sanitation models that are now combined into a single application. The application is a powerful tool capable of rapidly analyzing Public Health shellfish sanitation datasets to monitor bay conditions over multiple years, characterize fecal coliform concentrations by time and magnitude, micro-adjust shellfish harvest closure rules and assist in overall bay sanitary management. The models employ the identical equations and procedures as mandated by the United States National Shellfish Sanitation Program (NSSP), Model Ordinance, but in place of regression analyses the models employ non-regression equations that consider sample size, and increase sensitivity of analyses.

Although the total model applications are named Aquarius, the heart of the system is now Pearl. The Pearl model can be used in one of two modes; in the stand-alone mode Pearl performs multi-year analyses, for example 30 years, using observed fecal coliform data collected from within shellfish growing areas to profile fecal coliform concentrations to profile the historical conditions, and determine that under current closure rules if harvesting shellfish from those areas may pose a human health risk for shellfish consumers. Pearl outputs are scattergrams that illustrate data points appearing as either in the True Positive, False Negative, or True Negative zones relative to the NSSP 14/43 MPN/100 mL standard or the Pearl 8/26 standard for a 5-tube test. The model also adjusts the zones to match conditions for a 3-Tube Test, 12-Tube Test, Membrane Filter (MF); and Restricted 3-, 5-, and 12- Tube Test.

Shellfish growing areas that are identified “at risk” through the stand-alone Pearl analysis under current rules are candidates for closure rule adjustments. Pearl is then operated in tandem mode with Aquarius, and the two models can be used together to micro-adjust closure rules and maximize the number of days a shellfish growing area can remain open to harvest with no increased risk of illness to shellfish consumers.

Keywords: Aquaculture, Decision support system, Modeling

OS 4-1

Performance of Drip Irrigation System in Banana Cultuivation – Data Envelopment Analysis Approach

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Abstract

India is largest producer of banana in the world producing 29.72 million tonnes from an area of 0.803 million ha with a productivity of 35.7 MT ha-1 and accounted for 15.48 and 27.01 per cent of the world’s area and production respectively (www.nhb.gov.in). In India, Tamil Nadu leads other states both in terms of area and production followed by Maharashtra, Gujarat and Andhra Pradesh. In Rayalaseema region of Andhra Pradesh, Kurnool district had special reputation in the cultivation of banana in an area of 5765 hectares with an annual production of 2.01 lakh tonnes in the year 2012-13 and hence, it was purposively chosen for the study. On 23rd November 2003, the Government of Andhra Pradesh has commenced a comprehensive project called ‘Andhra Pradesh Micro Irrigation Project (APMIP)’, first of its kind in the world so as to promote water use efficiency. APMIP is offering 100 per cent of subsidy in case of SC, ST and 90 per cent in case of other categories of farmers up to 5.0 acres of land. In case of acreage between 5~10 acres, 70 per cent subsidy and acreage above 10, 50 per cent of subsidy is given to the farmer beneficiaries. The sampling frame consists of Kurnool district, two mandals, four villages and 180 sample farmers comprising of 60 farmers each from Marginal (<1ha), Small (1~2ha) and Other (>2ha) categories. A well structured pre-tested schedule was employed to collect the requisite information pertaining to the performance of drip irrigation among the sample farmers and Data Envelopment Analysis (DEA) model was employed to analyze the performance of drip irrigation in banana farms. The performance of drip irrigation was assessed based on the parameters like: Land Development Works (LDW), Fertigation costs (FC), Volume of water supplied (VWS), Annual maintenance costs of drip irrigation (AMC), Economic Status of the farmer (ES), Crop Productivity (CP) etc. The first four parameters are considered as inputs and last two as outputs for DEA modelling purposes. The findings revealed that, the number of farms operating at CRS are more in number in other farms (46.66%) followed by marginal (45%) and small farms (28.33%). Similarly, regarding the number of farmers operating at VRS, the other farms are again more in number with 61.66 per cent followed by marginal (53.33%) and small farms (35%). With reference to scale efficiency, marginal farms dominate the scenario with 57 per cent followed by others (55%) and small farms (50%). At pooled level, 26.11 per cent of the farms are being operated at CRS with an average technical efficiency score of 0.6138 i.e., 47 out of 180 farms. Nearly 40 per cent of the farmers at pooled level are being operated at VRS with an average technical efficiency score of 0.7241. As regards to scale efficiency, nearly 52 per cent of the farmers (94 out of 180 farmers) at pooled level, either performed at the optimum scale or were close to the optimum scale (farms having scale efficiency values equal to or more than 0.90). Majority of the farms (39.44%) are operating at IRS and only 29 per cent of the farmers are operating at DRS. This signifies that, more resources should be provided to these farms operating at IRS and the same should be decreased towards the farms operating at DRS. Nearly 32 per cent of the farms are operating at CRS indicating efficient utilization of resources. Log linear regression model was used to analyze the major determinants of input use efficiency in banana farms. The input variables considered under DEA model were again considered as influential factors for the CRS obtained for the three categories of farmers. Volume of water supplied (X1) and fertigation cost (X2) are

the major determinants of banana farms across all the farmer categories and even at pooled level. In view of their positive influence on the CRS, it is essential to strengthen modern irrigation infrastructure like drip irrigation and offer more fertilizer subsidies to the farmer to enhance the crop production on cost-effective basis in Kurnool district of Andhra Pradesh, India. This study further suggests that, the present era of Information Technology will help the irrigation management in the context of generating new techniques, extension, adoption and information. It will also guide the farmers in irrigation scheduling and quantifying the irrigation water requirements in accordance with the water availability in a particular season. So, it is high time for the Government of India to pay adequate attention towards the applications of 'Information and Communication Technology (ICT) and its applications in irrigation water management' for facilitating the deployment of Decision Supports Systems (DSSs) at various levels of planning and management of water resources in the country.

OS 4-2

Utilization and Performance of ICT-based Rural Groundwater Network System

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Abstract

The rural groundwater network system consisting of the rural groundwater monitoring network (RGMN) and the seawater intrusion monitoring network (SIMN) has been managed by Korea Rural Community Corporation (KRC) since 1998. Currently, 364 monitoring wells have been installed; 210 wells in 89 municipalities for RGMN and 154 wells in 53 ones for SIMN, respectively. Two sub-networks commonly monitor three physical properties such as groundwater level, temperature, and electric conductivity every hour. Monitored data are automatically transferred to the management center located in KRC. Also, bidirectional communication using RTU and CDMA makes this system efficient to operate. Moreover, result will be automatically sent to the administrator when the data are exceeded the threshold for each well. Data are opened to the public throughout website named to be the Rural Groundwater Network System (www.groundwater-m.or.kr). Anyone who concerns about RGMN and SIMN can freely download them through it.

Keywords: Groundwater network system, Groundwater, Monitoring well, RTU, CDMA

Acknowledgments

This work was supported by groundwater resource management project of Ministry of Agriculture, Food and Rural Affairs.

OS 4-3

Assessing the Impact of Seasonal Rainfall Patterns on Indian Rice Production Using Association Rule Mining

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Abstract

Rice crop production plays a vital role in food security of India, contributing more than 40% to overall crop production. Various climatic factors such as rainfall and temperature influence crop yield. While overall seasonal rainfall is one factor which determines yield, the distribution of rainfall through the growing season can also affect the final crop yield. Understanding the role that growing seasonal patterns play in final crop yield can assist farmer and decision makers to make important decision about the crop agronomy and crop choice. This paper assesses the impact of seasonal rainfall patterns on rice crop yield of Maharashtra state, India using association rule mining. For the present study 27 districts of Maharashtra state were selected on the basis of data availability. The rainfall data of Kharif season (June – November) for five years from 1998 to 2002 were considered for the present study. Three divisions were made of the season namely, beginning of the season (June, July), middle of the season (August, September) and end of the season (October, November). The summation of monthly mean rainfall was considered for each division of the season. The rainfall was categorized as extremely poor (0 to 100 mm), very poor (101 to 200 mm), poor (201 to 350 mm), average (351 to 600 mm), good (601 to 850 mm), very good (851 to 1100 mm) and extremely good (1101 to 1400 mm). Depending on the category of rainfall for each division of the season, the classes of rice crop yield were studied which are defined as low (0.15 to 0.60 tonnes/hectare), moderate (0.61 to 1.10 tonnes/hectare) and high (1.11 to 3.16 tonnes/hectare). The study revealed some interesting conclusions concerning the impact of seasonal rainfall patterns on rice crop yield of Maharashtra state, India which are presented in this paper.

Keywords: Association rule mining, Crop yield, Data visualisation, WEKA

OS 4-4

Development of a Water Quality Information System for Agricultural Reservoirs

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Abstract

Agricultural reservoir water quality is being monitored from 2001 for analysis of water quality condition, and these data is serviced to the reservoir water quality manager by information system. In this study, we developed new internet GIS-based water quality information system because serviced data and functions from the existing agricultural reservoir information system are limited. Several functions were developed to service selected detail information such as reservoir basic information, water quality data, pollutant loading and distribution data, water quality management history data, GIS layers, and CCTV image. Pollutant discharge facility information edit function was developed using Google Map api to easily edit pollutant discharge facility information by computer and smart phone in the field. Reservoir water quality model which was developed from other research using artificial intelligence techniques was modified and added to developing water quality information system to predict reservoir water quality due to changing pollutant loading in the watershed. Feasible action, cause analysis of reservoir pollution, and development of water quality improvement measures are possible because integrated and reasonable analysis and decision is available by developed internet GIS-based water quality information system.

Keywords: Agricultural reservoir, Water quality, Information system

OS 5-1

IT-Based Supply Chain Traceability of Tuna Fish

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Abstract

Indonesia is one of the largest producers of tuna, which is one of the leading commodities of Indonesian marine products. A supply chain of tuna fish has a network of complex (involving many actors and processes) and vulnerable to contamination along the supply chain. Therefore, supply chain traceability of tuna fish is highly demanded to ensure the movement of tuna from fishing vessels up to retailers is traceable, controllable and well secured. Some of the critical issues of tuna supply chain are content of histamine and bacterial pathogens, such as Salmonella, *E.coli* and Vibrio cholera in tuna products and the compliance of the distribution process with ISO 28000. The information technology (IT)-based supply chain traceability system for tuna is proposed and discussed in this paper, along with the implementation issues. The proposed system is equipped with the ability of recording and documenting all pertinent information related to products, processes, and actors involved along the supply chain to support quick and accurate monitoring and decision making. One of the abilities of the proposed system is to track tuna movement throughout the supply chain cycle with the use of RFID technologies that use tags sending electronic identification codes and relevant data to targeted receivers in the system.

Keywords: Information technology, Supply chain, Traceability, Tuna fish

OS 5-2

Analysis of Differences in the Environmental Control of Greenhouses Using ICT Based Sensor Data and its Applications

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Abstract

This study has two primary objectives. First, by using aggregated environmental data from many farms, we analyze the differences of data among farms and we propose the operational points to be considered by each greenhouse type. Second, we present some application implications expected from merging environmental and actuator control data. Lately, with the progression in information and communications technology(ICT), the number of greenhouses with an automated environmental control system based on a sensor network is increasing in South Korea. For greenhouses using ICT equipment, environmental and actuator control data are being collected in real-time. However, most farmers have been utilizing the data only they develop weekly environmental controlled greenhouse management reports. Farmers do not link the data through an analysis of aggregated data from different farms or an analysis on linked data between environmental and actuator data. In this study, data from six tomato farms in South Korea were collected from November 2014 to October 2015. The greenhouses were categorized by roof windows type, cultivation method (hydroponics or fertigation), covering type, heating system, and temperature setting for roof window. The outcome of this study shows how the information collected from many farms can be utilized usefully. Implications can be driven by both analyzing the environmental and actuator control data.

Keywords: Environmental control, Greenhouse data analysis, Sensor network, ICT

Acknowledgments

This work was carried out with the support of "Cooperative Research Program for Agriculture Science & Technology Development (Project No. PJ0117082016)" Rural Development Administration, Republic of Korea.

OS 5-3

Development of Forecasting and Warning Service System for Reservoir Failure

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Abstract

Ageing induces weakening of the structure and climate change is threatening the safety of agricultural reservoirs. These make more vulnerable structure and then may induce failure. Previously failure of reservoirs usually caused loss of properties only, however, after development of the downstream area, concerning loss of life as well. In this situation, suggesting forecasting and warning service system for reservoir failure in order to monitor reservoirs under risk and to issue an alert to the residents that will be one of the answers to minimize life and property loss based on ICT.

Keywords: Reservoir, Failure, Sensor, Forecasting, Warning, USN, ICT

Acknowledgments

This research was supported by a grant (MPSS-NH-2015-78) through the Natural Hazard Mitigation Research Group funded by Ministry of Public Safety and Security of Korean government.

OS 5-4

Adaptation of Mobile First Strategy for E-Business in Agriculture

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Abstract

E-business is having connections everywhere especially purchasing, advertising and acquiring 24 hours and 7 days is one of the easiest ways to start and manage a business for it has no boundaries and restrictions. However, the rise of competetors using websites to purchase their products in agriculture doesn't come in handy. Mobile already elevates the entire business lifecycle today. Mobile First means meeting your customer where a customer is looking for you in a manner appropriate to the screen the customer is using to interact with you. Undesrtanding the adapation of mobile first for e-business will help upsurge the recognition of agricultural products.

This reseach paper will help agricultural or not, understand the importance of adapting mobile first strategy to increase not only their crop production but also their also production profit as well.

Keywords: E-business, Mobile first strategy, Agriculture

Acknowledgments

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OS 6-1

Farm Tracking. Mobile Application Connected to Cloud-based Field Management Information System

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Abstract

It was never easier for the farmer to get the right decision support at the right time and place. The application Farm Tracking utilises the GPS and the notification system of the cell phone and download data from the cloud-based AgroIT service, thus ensuring that the farmer gets all relevant context specific notifications and alerts.

The cloud-based solution AgroIT offers a standard for exchange of data across FMIS solutions (e.g. Farm Tracking) and technical equipment (e.g. weather stations).

Using solutions capable of communicating with AgroIT the farmer avoids complicated technical setup and is also free to choose between a wide range of products as the platform is an open-source type.

Farm Tracking provides the farmer with i.a. information about sowing time, fertiliser recommendations, and sprayings. He can receive notifications concerning alerts and tasks. He has access to information about stocks of e.g. pesticides and he can easily report and create hotspots in the field. This helps the farmer to solve his tasks more efficiently and at the same time it ensures high data quality and traceability which are essential to Danish food exports.

Farm Tracking is developed by SEGES in connection with the EU-project AgroIT in cooperation with project partners from Slovenia, Poland, Portugal, Macedonia, Austria and Romania.

Keywords: Precision agriculture, FMIS, Smartphone, Context aware, Localization, Cloud, AgroIT, Denmark.

Acknowledgments

This project is supported by EU through the CIP-ICT PSP Call 7, Grant Agreement No.621031 AgroIT.

OS 6-2

Field Experiments with a Mobile Robotic Field Server for Smart Agriculture

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Abstract

We propose a mobile robotic Field Server to realize an advanced monitoring system. The mobile robotic Field Server consists of a locomotion unit for moving in target fields, a manipulator unit for measuring the targets, and a Field Server unit to operate the system at a remote location. To test our proposed system, we developed a prototype robotic Field Server system with a pair of three-legged platform and a lightweight arm with three degrees of freedom. To evaluate the prototype system, we conducted some field experiments in farm fields. The results demonstrated the system's effectiveness and feasibility, and clarified future research needed toward practical management.

Keywords: Monitoring system, Walking robot, Light duty arm, Field Server

Acknowledgments

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OS 6-3

Analysis of Cropping Calendar in Northern Area of West Java Using Temporal MODIS Data

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Abstract

West Java is the province that experienced the largest rice field in Java Island. Land cover monitoring method with MODIS has been done by developed acquisition system and image data processing that allows user to monitor agricultural landuse pattern and its dynamic. The aim of this research is to analyzed cropping pattern based on cropping calendar and monitoring data in northern area of West Java. MODIS product that used in this research is MOD13Q1, which take daily vegetation index data to display seasonal dynamics pattern of rice fields. MODIS EVI dataset has contains atmospheric disturbances, therefore correction signal by wavelet coiflet transformation filter needed to reduce its. Then crop pattern grouping was done by k-mean methods to get the same group of cropping pattern, intensity, and changes. The results showed an actual cropping pattern was less appropriated within cropping calendar. Based on the overlay analyzed, 22% of the actual cropping pattern was appropriate with cropping calendar and 76% was behind cropping calendar for the planting schedule until December. However, for the planting schedule after December, 35% of the actual cropping pattern was appropriate with cropping calendar and 36% was faster than cropping calendar. The cropping pattern based on monitoring data could be improved and update the cropping calendar for better schedule.

Keywords: MODIS, Cropping pattern, Cropping calendar, Seasonal dynamics

Acknowledgments

The authors would like to thank the NASA LP DAAC for making MODIS data available. This research was financially supported by Directorate General of Higher Education, Ministry of Research, Technology, and Higher Education Republic of Indonesia.

OS 7-1

Blog Visitors' Trust toward Restaurant Reviews in Restaurant Review Blog and Business Blog

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Abstract

Food industry is one of the fast-growing industry and many food companies and restaurants are doing well today. In this situation, companies and customers are caused information overload by generating an overwhelming amount of information about food and restaurant. The information overload makes people need to search information about restaurant and food. When people trying to find restaurant information online, People look for restaurant's information from not only restaurant review blogs which have relevance topic with post about restaurant, but also other blogs like business blogs which have irrelevance topic. The purpose of this study is to investigate the effect of perceived relevance between restaurant post and blog's topic makes different influence to message trust.

Keywords: Blog, visitor's trust, Message trust, Perceived relevance, Restaurant review

OS 7-2

An Analysis of Factors Influencing Consumers' Food Purchasing Behavior in Mobile Shopping Malls: Focusing on the Open Market, Social Commerce, and Integrated Shopping Malls

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Abstract

This study focuses on searching for ways to stimulate the growth of mobile businesses in food and agricultural sectors - specifically, analyzing the factors that influence consumers' purchasing behavior in the open market, social commerce, and integrated shopping malls, and also comparing these different factors

A survey was answered by various mobile shopping mall users. Among the considerations were participants' frequency of purchasing agrifood, as well as eight additional factors: brand image; guaranteed after-sale service; reasonable price; variety of products; quick delivery service; simple payment system; convenience of using an app; and various advantages that influence consumers' purchasing behavior in the open market, social commerce, and integrated shopping malls.

Using regression analysis, three results were produced. First, in the open market, brand image, reasonable price, simple payment system, convenience of using an app, and various advantages were the factors that influenced the individual consumers' purchasing behavior. Second, in social commerce, reasonable price, quick delivery service, convenience of using an app, and various advantages were the factors that influenced the individual consumers' purchasing behavior. Third, in the integrated shopping malls, brand image, guaranteed after-sale service, variety of products, quick delivery service, convenience of using an app, and various advantages were the factors that influenced the individual consumers' purchasing behavior.

Keywords: Mobile shopping, Food purchasing behavior, Food shopping

Acknowledgments

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OS 7-3

Study on Factors for Improving the Effectiveness of ERP within Korea Agricultural Products Processing Center

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Abstract

ERP implementation issues have been given much attention as the size of Agricultural Products Processing Center (APC) in Korea gets bigger and bigger. The goal of this study is to find the factors that influence the effect of Enterprise Resource Planning (ERP) adoption to help improve the business environment of the ERP users, especially in agricultural industry. This study tries to apply traditional IS theory into agricultural industry. By testing multiple aspects in different stages, the study derives more comprehensive factors that positively influence the adoption of ERP. By conducting a survey, the study observed hands-on ERP operators who work at APC which had previously adopted ERP. The study categorizes independent variables into three stages such as pre-adoption, adoption, and post-adoption. Satisfaction, system utility, work efficiency, professionalism, and standardization are examined as dependent variables. Cronbach's alpha is used to test the reliability of the survey questionnaires in each category and multiple regression analysis is used to derive factors that have an effect on ERP adoption. Discussions on the results of data analysis are made.

Keywords: ERP, Implementation of ERP, APC, Critical success factor

Acknowledgments

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OS 7-4

Effect of Vacuum Packaging on Persimmon Fruit Postharvest Quality

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Introduction

High carbon dioxide concentration has been believed to eliminate astringent characteristic of several agricultural commodities. The treatment unavoidably provides negative effects to the products, for examples fruit softening, internal breakdown and discoloration shortly after high CO_2 treatment. Very limited literatures have reported about combination of high CO_2 concentration and low oxygen state (vacuum packaging) for eliminating astringent taste in persimmon fruit. This study aimed to determine persimmon fruit quality after astringent removal by high CO_2 concentration and vacuum packaging implementations.

Methods

Persimmon fruit were firstly fumigated by 100% CO_2 for 72 hours at ambient temperature. Six hundred grams (about 4 fruit) of fresh persimmon were subsequently packed in 2 different packaging conditions, namely, (i) vacuum wrapping by linear low-density polyethylene (LLDPE) and (ii) conventional plastic tray wrapping by polyvinyl chloride film (PVC). The aforementioned treatments were studied along with persimmon fruit packed in vacuum wrapping by linear low-density polyethylene (LLDPE) alone (without CO_2 fumigation). All packaging samples were stored at 5°C, 80-85% relative humidity. Three packaging samples from each treatment were weekly sampled in order to determine chemical quality and sensory evaluation.

Results/Conclusion

Persimmon fruit without CO_2 treatment had the greatest fruit firmness, however, it had the lowest score of sensory acceptability since the fruit had high tannin content and exhibited unacceptable astringency. Combination of CO_2 treatment and vacuum wrapping provided the highest score of overall acceptability, and resulted in the longest storage life. The CO_2 fumigation and vacuum wrapping also effected on persimmon fruit sweetness, pulp fermentation and percentage of weight loss.

Acknowledgements

This work has been supported by the Royal Project Foundation of Thailand and the Graduate School of Science and Technology, Niigata University, Japan.

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OS 8-1

Development of Ration Formulation and Enteric Methane Calculation Software for Dairy Cattle in Vietnam

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Abstract

Dairy cattle contribute to global warming by releasing methane (CH_4) gas through enteric fermentation. Dairy cattle in the USA are estimated to contribute only 0.55% of anthropogenic greenhouse gases [1], but in developing countries where pastoral grazing is common, ruminant livestock can be a higher contributor to greenhouse the gas inventory [2]. The amount of CH_4 produced by dairy cattle is mainly a function of feed intake, and secondarily by its chemical composition. PCDAIRY, developed at the University of California - Davis (UCD) [3], is a computer program that formulates a least cost ration for dairy cattle using the "Primal-Dual" algorithm described by Wolfe [6]. This software was updated to incorporate mathematical models to predict enteric CH_4 emissions, as developed by Kebreab and co-workers [4] [5] into the PCDAIRY ration formulation software. In this paper we describe a software tool to translate the PCDAIRY program from English to Vietnamese and to adopt it to the Vietnamese dairy cattle production system. This gives Vietnamese dairy farmers and advisors a tool to formulate several least cost rations and the option to select the one(s) with lower predicted CH_4 emissions. This will assist dairy cattle producers in Vietnam to implement dietary strategies to decrease CH_4 emissions of their cattle since reducing enteric CH_4 losses from cattle may have a long-term environmental benefit by reducing the impact of dairy farming on climate change.

Keywords: Methane emission, Dairy cattle, Ration formulation, Decision support system, Modeling, Mitigation.

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OS 8-2

Development of Web-based Forecasting System of Airborne Virus of Livestock Infectious Disease using OpenFOAM

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Abstract

Infectious livestock diseases such as FMD and HPAI can cause numerous economic and social damage to livestock industry. When these infection diseases outbreak, farmers and government should take prompt actions such as preventive measure to prevent the spread of the disease. However, among various factors, airborne spread is sophisticated to cope with the situation because of insufficient information, difficulties of detecting airborne virus, invisibility of aero flow pattern, instantaneous changes of the wind environment, etc. Therefore, a simulation approach for predicting the spread of airborne virus can be one of the solution to make countermeasure and strategies against disease outbreak. Furthermore, forecasting the spread range of airborne virus is also important to provide the order of priority of prompt measure against disease and to determine the slaughter plan with the real-time meteorological forecast system. In presented study, free license CFD code, OpenFOAM, was used to simulate airborne virus at the studied terrain. For real-time forecasting for next 48 hours, meteorological data from the KMA was directly linked to the CFD model at every three hour interval. Then, the web-based integrated airborne virus forecasting system which aim to provide information of dispersion range of airborne virus, local weather forecast, and livestock farm information was constructed and test-operated.

Keywords: Airborne virus, Foot-and-mouth disease (FMD), GIS, Highly-pathogenic-avian-influenza(HPAI), OpenFOAM

Acknowledgments

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OS 9-1

Nutrient Management through GIS and GPS based Fertility Mapping in India

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Abstract

The precision nutrient management concept, modifiedtosuit India’s unique farming systems, is expected toprovideways to reverse the productivity and fertility trends in India. Geo-statistical analysis and GIS-based mapping can provide an opportunity to assess variability in the distribution of native nutrients and other yield limiting/improving soil parameters across a large area. This can aid indeveloping appropriate nutrient management strategies leading to better yield and environ mental stewardship. Research has shown a direct correlation between variability and production conditions and improvement in production and profit under different scales of operation by managing variability. GIS based soil fertility mapping appears as a promising alternative for providing dependable information on fertility status of the soils without going into detailed plot by plot soil testing. The spatial variability of soil properties is typically performed by taking soil observations on a rectangular grid or on places whose spatial coordinates were recorded by Global Positioning System (GPS) and interpolating values between sampling points by making use of geostatistics (Anderson et al., 2005). After analysis of soil samples, the attribute’s spatial variability is assessed using spatial descriptive statistics such as range, mean, standard deviation and co-efficient of variability. In the next step, location information of the sampling point (latitude/longitude) and the corresponding attribute information of the sample (nutrient content, pH, organic carbon content etc.) are integrated in a GIS platform to create continuous surface maps of the attribute. Each point in the map, created through interpolation technique, now has an attribute value associated with location information, which allows estimation of attribute values from latitude/longitude values of unsampled point within the map.

Key words: GIS Mapping, Nutrient management, SSNM, Cropping systems, Fertility

OS 9-2

Develop the Mechanism of the Parallel Processing Schedule to Increase the Utilization of Agriculture Information Systems in Taiwan

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Abstract

In the recent years, there are huge demands for agriculture applications in Taiwan, such as sustainable land use, agriculture conservation, balance between supply and demand in agriculture, widespread pollution from the overuse of agriculture, adjustment of resources and so on. Those requests nearly come from different government units. Although the abundant spatial data have been published by official institutions, most demanders hardly use the spatial data to analyze. Because plenty of spatial data have been collected by different units, including crops distribution, agriculture land cadaster, land use, weather information etc. There is no interoperable platform to share among government units. It leads to lower utilization rate to access the spatial data. The paper will propose the solution to develop the mechanism of the parallel processing schedule. Therefore, the web-based application systems with parallel processing mechanism will improve the possibility of usage. At the first beginning, design the warehouse to gather the spatial data in the agriculture fields from the related agriculture units by asynchronous exchanging. Second step, a parallel processing procedure is designed to respond to larger number of requests concurrently. In the last phase, the solution provided the users to make their orders by functional calculating. The figures of functional modules at the systems are demonstrated in this paper.

Keywords: Agriculture, Parallel scheduling, Geospatial

OS 9-3

Flood Risk Management in Response on Climate Change in Georgia

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Abstract

Climate change is affecting the coastal areas of Black Sea in west Georgia (Adjara Region) in a different ways. Well known, that coasts are sensitive to sea level rise, erosion, water quality changes in the frequency and intensity of storms, increases in precipitation and landslides in addition. The rising of atmospheric concentrations of carbon dioxide (CO_2) are causing the Seas and Oceans absorbing more of the gas and become more acidic. This rising world Waters acidity could have significant and negative impacts on coastal and marine ecosystems. As a result of this, the intensity of rainfall has increased tremendously causing floods in Adjara Region as natural hazard and more and more Farmers are becoming migrants as eco-migrants due to the flooding risks. We started cooperation with different research groups for modeling and forecasting the rivers and sea hazard mapping by using a System ArcGIS, spatial technology and in this research, was provided an effective flood modeling, which was created. For establishing a viable flood forecasting modeling is a best platform for creation early warning systems for communities risks minimization which is requires the combination of data, forecast tools, and trained forecasters. Our mission is to lower the level of damages and loss of life among communities and Farmers living in risky zones. By provided trainings from AFRD rural communities and organizations are prepared to mitigate impacts of flooding and landslides. The motivation for our project comes from mutual interest of natural disaster response and mitigation and adaptation also. We learned using of ArcGIS software which contains specialized tools for working with and deriving new information from hydrologic and landscape information about new and possible risky zones for 5 and 10 years periods. By using these tools is easy to generate a flood forecasting model to identify affected parcels of lands to prioritize for remediation or damage assessment for our Farmer Members.

OS 9-4

Airborne LiDAR Point Cloud Based Agricultural and Pond Culture Modeling

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Abstract

Spatial and temporal changes of the environment could be very important from different point of views. Landscape characteristics are determined by features of terrain, biomass, agricultural fields and artificial environment with roads, buildings, etc. Mapping of these elements with traditional tools and methods are costly, time consuming and sometimes the access to the given area is practically impossible. Nowadays, developing of information technology provides tools (GPS, GIS, RS), which are useful for effective survey of a relative larger area. These technological elements contribute the recognizingof the features of arable land or an open water area, which couldbe goteffective the agricultural production and the pond culture.

A part of the largest artificial lake in Hungary, called Lake Tisza, and the surrounding agricultural areas were surveyed by a long range waveform digitizing airborne laser scanner (Riegl LMS Q680i) in the frame of ChangeHabitats2 FP7 project in 2012 and 2013. In our investigation, a smaller subset of the LiDAR (light detection and ranging) point cloud was used for analyzing the coastal zone, woody and herbaceous vegetation on agricultural field and in the lake. Different software environments were effective to analyze the runoff conditions on fields based on the digital elevation model (DEM) preparing by high resolution point cloud data. In order to define the vertical distribution of cultivated plants, efficient digital surface model (DSM) was used. Due to the surveys in different seasons, it was well evaluated the changing in water level and spatial and temporal changes of the vegetation.

Keywords: LiDAR technology, Laser scanning, Pond culture, Lake Tisza, DEM, DSM, Runoff

Acknowledgments

Our researches were made in the frame of FP7 IAPP Marie Curie ChangeHabitats 2 project supported by European Union, which is gratefully acknowledged.

OS 10-1

The Influence of Organizational Factors on Agricultural Corporation's Use of Information Systems

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Abstract

There have been domain-specific studies to explore factors which influence use of information systems in organization. However, many researches didn't consider peculiarity of agricultural industry. The goal of this study is to explore former factors and agricultural peculiar factors that influence use of information systems of agricultural corporation.

This study conducted interview survey from agricultural corporation in South Korea. The number of response is 2,986. Regression analysis were used to analyze the data. The results support that former factors which used in prior researches (e.g., size, year) are supported. In addition, agricultural peculiar factors, such as types of side business, have an influence on use of information systems of agricultural corporation.

This research identifies peculiar factors of agricultural corporation's use of information systems. These factors need to be considered in understanding agricultural use of information systems and the finding provides an insight for future studies

Keywords: IT Usage,

OS 10-2

Internet Acceptance and Use Model in Ethiopian Agriculture Education and Research: The case of Two Universities

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Abstract

Many studies in developed world have proposed models of ICT acceptance and use in order to better predict and explain users' behavior to account for the changing technologies. Hence, a question is whether models of technology use and acceptance that have been developed and used in the developed world can be applied to explain Internet acceptance and use by Agriculture staff of two Universities in Ethiopia. To this end, this study applied the Technology Acceptance Model (TAM). A survey was administered to 293 agricultural faculties in Haramaya and Jimma University. The data were analyzed using Structural Equation Modeling. The result of the model indicated that the model variables explained over 59% of the variance in teaching and 29% variance in research. As a result, the study underlined the importance of designing intervention in the study area to support academic and research works of the staff.

Keyword: Technology acceptance model, Ethiopian higher education, Internet, Africa

OS 10-3

An Exploratory Study on Successful Adoption of Agricultural Information Systems: Based on Systems Thinking Approach

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Abstract

To enhance the performance, the effectiveness, the efficiency of business performance in an organization, it has become popular to adopt IT systems into the organization. However, even though it is quite popular that an IT system would be enough to manage complex business processes more easily and more meaningfully, still the agricultural fields may not accept the IT as much as in other industries. There are diverse studies on investing the gap between agricultural industries and others, but many previous studies might focus on defining and illustrating the effect of factors in quantitative views.

This study focuses on investigating the factors on the adoption of IT in agricultural fields and on explaining their effects in qualitative ways. This study investigates the case of implementing an agricultural information system in a Korean public company. In the results, it is found that the perceived compatibility and usefulness which are well-known factors to motivate the users to adopt IT into organizations would be less effective or meaningless when an end user of the systems would not understand the relationship between the improved performance and the capable benefit. In detail, we could understand the reason why an agricultural organization would hesitate to adopt agricultural IT system despite of its usefulness – First, when reducing costs by adopting IT system would not be considered as to cause the explicit revenues of the organizations. Second, when an individual employee would not consider the reduced costs not to be essential to their personal interests even though the benefit in their organizations to be possible.

Keywords: IT Adoption, Information Systems, Agricultural Information System

Acknowledgments

This work was supported by a research grant from Seoul Women's University(2016)

OS 11-1

Technology Trends in ICT – Towards Data-Driven, Farmer-Centered and Knowledge-based Hybrid Cloud Architectures for Smart Farming

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Abstract

Over the past four decades advances in Information and Communication Technology (ICT) have resulted in unprecedented opportunity and innovation in improving farming outcomes. Ongoing innovations such as mobile, social media, agricultural drones, Internet of Things (IoT), Big Data, and cloud computing present new challenges and opportunities for agribusinesses to redefine and rethink the role of ICT towards achieving better farming outcomes. With recent advances in infrastructure, data (collection, storage and retrieval), and better understanding of all aspects of the food chain, new challenges and opportunities are presented. Unstructured data is now being generated real time, in large volumes, and at a high speed that results in challenges to current approaches for decision making and require a focus on analytics. These new sources of data create the opportunity to inform and drive a change in decision making from one that is highly intuitive to one that is data driven and processed in real-time. This paper highlights recent trends in ICT and introduces a hybrid cloud architecture for smart farming. The proposed architecture emphasizes data-driven, farmer-centered, and knowledge-based decision tools through service integration, aggregation and interoperation. As a customized solution for farmers, the proposed architecture contains components of 1) data integration of on-farm sensors and data from public sources, 2) farm management modules, 3) knowledge-based software solutions from different providers, 4) service integration, aggregation and interoperation, and 5) a customized dashboard focused on usefulness and usability. This cloud-based solution allows the integration of businesses services, things, and technology from any channel and can be used anywhere. At this time, hybrid cloud environments have shown promise to integrate these different services and provide smart farming solutions to both big and smallholder farmers.

Keywords: Mobile, Big data, IoT, Farm management, Decision tools

OS 11-2

Critical Zone Observatory and Big-Data Approach for Precision Horticulture

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Abstract

During the past few decades, precision horticulture has led ways for technological developments in agricultural policies and practices. It has also served as a medium to increase productivity while reducing risks associated with conventional farming. Sustainability in agricultural systems can only be assured with optimal utilization of resources, smart data analytics, IoAT (Internet of Agricultural Things) and data/process/event driven models that can precisely analyze plant-soil-water-atmosphere interactions.

Main focus of this study is to develop an integrated modelling and prediction framework (CZO – Critical Zone Observatory) that relates various Horticultural (CWR, Nutrient dynamics, Phenology, Pest and Disease etc.), Hydrological (surface, subsurface and groundwater resource), Atmospheric (agrometeorological conditions at micro/macro scales) and remote sensing (high resolution data, spectroscopy, NDVI, time-series analysis etc.) aspects at field and regional scale using multi-modal process driven models that help in better understanding the long term dynamics between different agricultural systems.

CZO's tend to have massive state-of-the-art infrastructure (sensors and systems, extensively used scientific instruments, long term observatories, remote sensing data etc.) and requires dedicated data analysis approaches to efficiently mine the possible interaction between components of biogeochemical cycles. This gigantic infrastructure generates large datasets (Big data) which are effectively managed and processed using big data analytics and machine learning algorithms that explore the nexus between plant-soil-water-atmosphere-disease-yield and interactions.

Keywords: Internet of agricultural things, Critical Zone Observatory, Big data, Remote sensing, Proximal sensing system, Horticulture

Acknowledgments

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OS 11-3

SVM Touch: Predicting Agricultural Products Volume with APC ERP Data

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Abstract

The purpose of the study is to predict agricultural product volumes using Agricultural product processing center (APC) enterprise resource planning (ERP) data from Korea. So far, great attention by the government has been shown to predict agricultural product volumes to stabilize price, especially high volatility products such as cabbage. In the past, it was hard to predict volumes precisely due to the lack of useful data. Recently, useful data has been accumulated from various sources such as sensors in greenhouses, information systems and public areas. This makes it possible to predict agricultural product volumes more precisely. For this study, we employ the support vector machine (SVM) to predict cabbage volumes. SVM is a semiparametric technique with origins in the machine-learning literature of computer science and its prediction performance is well known. We explore results using SVM against three other methods: ordinary least square (OLS), auto regression (AR), and vector auto regression (VAR). The results show that the prediction performance of SVM is better than that of the other three methods. We expect that the results can be applied to predict domestic cabbage volumes and ERP dashboard for top management at the APC.

Keywords: Support vector machine, APC ERP data

Acknowledgments

This research was supported by the MSIP(Ministry of Science, ICT and Future Planning), Korea, under the ITRC(Information Technology Research Center) support program (IITP-2016-H8601-16-1007) supervised by the IITP(Institute for Information & communications Technology Promotion).

OS 12-1

Impact of Informatization Education in Agriculture Corporate Work Effectiveness

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Abstract

This study aimed to clarify the effect of informatization education on the efficiency and effectiveness in the working process of agriculture corporates. Using survey data from 222 agriculture corporates were collected by the Korean Agency of Education, Promotion, and Information Service in Food, Agriculture, Forestry, and Fisheries (EPIS) for a governmental white paper, namely a survey on the information levels of agricultural corporations. Structural Equation Modeling was used for analysis. This study found that informatization education increases the ratio of the use of information systems in the working process, especially via SNS usage and use of data accumulated through ICT. With an increase in information system usage in the working process, the corporate's efficiency and effectiveness increases.

Keywords: Informatization, Education, Agriculture corporate, Effectiveness

Acknowledgments

This research was supported by the Ministry of Science, ICT, and Future Planning, Korea, under the Information Technology Research Center support program (IITP-2016-H8601-16-1007) supervised by the Institute for Information & Communications Technology Promotion.

OS 12-2

Path Analysis on the Determinants of Paddy Yield: Evidence from Two Large-Scale Farmsof Japan

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Abstract

This paper measures the interacting effects of the paddy yield determinants, trough the adopting of path analysis. The data issampledin 2014, upon 301 paddy fields planting Koshihikari, from two large-scale farms of Japan. The result indicates that significant interactions exist among the determinants and affect the total effects to the yield, in forms of indirect effects. Solar radiation and temperature are most effective; and the former affects the latter significantly. Farm difference is another important factor to explain the yield variation among paddy fields, through the indirect effects via some other determinants.

Keywords: Determinant, Japan, Koshihikari, Paddy yield, Path analysis

Acknowledgments

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OS 12-3

Management of Irrigation through a Web-Based Intelligent Decision Support System

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Abstract

Fresh water is currently considered the gold of the century, given their importance for the survival of human beings, animals and plants. Water scarce and drought are increasing in European countries, and several factors were identified as being contributing for that, namely at the climate changes level. European Union and its states members are aware of this situation and several polices were developed and implemented. The adequate and efficient use of water in the different areas (e.g. agriculture, domestic, industries) has demanded the incorporation of new technologies, mainly in the area of ICT. According to Food and Agriculture Organization of the United Nations (FAO), it is expected that the world population increases from 6.9 billion to 9.1 billion in 2050. This will bring new challenges and demands to a more efficient use of natural resources in general and more specifically the water resources.

In this paper we propose an architecture for a web-based intelligent Decision Support System (*iZ Watering*) supporting users in the management of green spaces and crop irrigation, envisaging a rational and proper use of water. The system gathers data from different sources (e.g. meteorology, hydrology, and information about the plantations) and assists the user on the irrigation process management. The proposed system also includes a small prototype that was developed based on Arduino. A set of experiments were performed with the developed prototype and the obtained results were very promising. As future work we are preparing a real case study that will use the developed Decision Support System to manage the irrigation of the green spaces of a municipality in the north of Portugal.

Keywords: Group decision support systems, Smart cities, Green spaces

Acknowledgments

The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under project EKRUCAMI - Europe-Korea Research on Ambient Intelligence and Ubiquitous, REA grant agreement No 318878 (PIRSES-GA-2012-318878) and from FEDER Funds through COMPETE program and from National Funds through FCT under the project UID/EEA/00760/2013.

OS 13-1

A Study on Influence Factors and Performance Analysis by the Introduction of ICT Technology of Horticulture Farms

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Abstract

The development of Information and Communications Technology (ICT) has an impact on various industries including agriculture. The Ministry of Agriculture, Food and Rural Affairs in Korea promoted the 'Horticulture ICT convergence project' for distributing technologies such as smart phone remote control, and an automatic control system in a single shell vinyl house. The smart farm is a small distributed single-span greenhouse and is different from other remote control management models that use a multivariable controller for glass and plastic greenhouses. We compare the performances of tomato, cucumber and strawberry. We investigate twenty-eight farms in Se-Jong city that cultivate tomato, strawberry and cucumber. The research method is a field interview survey. We implemented a t-test for analyzing the performance on the introduction of each items' smart farm. For strawberry farms, increasing rate of output, income and time saving have significant differences ($p<0.05$). However, for tomato farms, decreasing rate of income per year has significant differences ($p<0.05$). The coincidence of satisfaction and performance can facilitate performance evaluation only through a Likert-type measurement. To guide activation of ICT convergence technology, we have to promote management achievement in productivity and income improvement and management efficiency in time savings to farmers.

Keywords: Information and communications technology, Smart farm, Horticulture

Acknowledgments

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OS 13-2

A Fuzzy Expert System For Predicting Pandan Wangi Paddy Productivity In Indonesia

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Abstract

The aim of this research is to develop a fuzzy expert system for predicting Pandan Wangi paddy productivity in Indonesia. Pandan Wangi is one of the best Indonesian paddy varieties which has specific characteristics such distinctive taste, round shape, fragrant aroma and flavored rice fluffier. More uniquely, this variety will have the good result if the planting is done in Indonesia, especially Cianjur District, West Java. As the production of this variety is now decreasing due to social, economics and climate variability factors, so there is a need to develop a fuzzy expert system to predict the productivity of this paddy at specific land and environmental condition so that it can help the decision maker to decide where to plant this paddy to get maximum productivity.

The system developed is called FES-P4 (Fuzzy Expert System for Predicting PandanWangi Paddy Productivity) that consists of three Fuzzy Inference Systems (FIS). The first is to determine the condition of the land with the input levels of nitrogen, phosphorus, potassium, and the acidity level of the soil. The second is to determine the environmental condition with rainfall, land elevation and irrigation (water discharge) as inputs. Both outputs of these inference systems will become the inputs for the third inference system which has Pandan Wangi paddy productivity as the final output. This expert system using Mamdani fuzzy logic model and Mean of Maximum (MOM) for defuzzification. The system testing shows that this fuzzy expert system has a very promising performance with an accuracy of 61.72%, 62.96% and 88.88% for the first, second, third inference systems respectively.

Keywords: Fuzzy, Expert system, Inference, Pandan Wangi, Paddy, Productivity

OS 13-3

Analysis of Natural Ventilation for Controlling Internal Environment of Greenhouse Built on Reclaimed Land using CFD

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Abstract

Recently, the Korea government announced a development plan for the greenhouses complex in a reclaimed land. Wind environments of reclaimed land are entirely different from those of inland. In this study, CFD simulation models of greenhouse were designed to evaluate natural ventilation rates of greenhouses built on reclaimed land according to greenhouse types, vent openings, and wind conditions, etc.The wind profile at a reclaimed land was designed using ESDU program. Validation of CFD simulation model with single even span greenhouse was conducted by comparing with results of PIV test which was experimented in wind tunnel. Mesh size, turbulence model, wind profile and turbulence profiles were mainly considered for high accuracy of CFD simulation. Based on the validated CFD simulation model, air exchange rates were computed using mass flow rate and tracer gas decay methods to compute overall and local ventilation efficiency of various greenhouse types. The deviation of the CFD model was about 7~10% compared to the measured results of wind tunnel-PIV test indicating that the designed CFD model was reliable. The results of analyzing the overall ventilation rates will be used as basic data to establish design standards for greenhouses built on reclaimed lands. Additionally, the results of analyzing the local ventilation rates are expected to be utilized for controlling the microclimate in greenhouses uniformly.

Keywords: Computational Fluid Dynamics (CFD), Greenhouse, Natural ventilation, Particle Image Velocimetry (PIV), Reclaimed land

Acknowledgments

This study was carried out with the support of "Cooperative Research Program for Agriculture Science & Technology Development (Project No. PJ009412)", Rural Development Administration, Republic of Korea

SS 1

New Challenge of Agricultural ICT in Japan: A Dynamic e-Crop Calendar for Improving Rice Cultivation Efficiency

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Abstract

Reduction of the quality of rice due to climate change is one of the most serious agricultural problems in Japan. Flexible adjustment of cultivation management is necessary for obtaining good quality rice under fluctuating environmental conditions. To attain this purpose, we tried to establish a dynamic "e-crop (rice) calendar" which can adjust the scenarios of cultivation management according to the rice phenology model and environmental conditions through application of agricultural ICT.

Keywords: Agricultural ICT, Fluctuating environment, Phenology model, Quality of rice

Acknowledgments

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SS 2

Wireless Sensor Network System for Fruit-Growing Environment at the Field

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Abstract

New wireless sensor network (WSN) system which consists of weather station and soil water potential sensor was constructed. In order to design low-cost WSN, a new water potential sensor was developed and connected to the WSN. Daily weather data acquired by WSN system are collected and stored in a local server, and then transferred to cloud sensor infrastructure named cloudSense which standardizes the terminology and units of measures based on Sensor Observation Service (SOS). This integrated system makes it possible to add and modify sensors easily and to develop an effective web application for farmers.

Keywords: Wireless sensor network, Interoperability, Soil water potential sensor

Acknowledgments

This work was supported by the Project “Integration research for agriculture and interdisciplinary fields,” Ministry of Agriculture, Fisheries and Forests, Japan.

SS 3

Color Calibration of Images Acquired under Artificial Lighting Conditions based on Illuminating Spectral Information and Geometrical Relationships

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Abstract

To develop a quantitative color appearance evaluation method using an image taken by a digital camera in agricultural fields under artificial illumination, the geometrical relationships between the plants, camera and light sources were studied for color calibration using simulatedvirtual color chart image. As the results, the images taken under the artificial illumination were calibratedand the color parameters of the seedlings images could be successfully obtained using the RGB values of the virtual color chart.

Keywords: Agricultural fields, Color image, Color calibration, Geometrical relationship, Quality

Acknowledgments

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SS 4

Low-cost Sensing System Design for Agriculture

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Abstract

Field sensing is one of the most important technologies for increasing farming efficiency. However, the production and operation costs of field sensors are not consistently cost-effective. We therefore previously proposed a holistic approach to realizing precise monitoring of field information for farmers. Digital fabrication and robotics technologies enable this approach. In this paper, we introduce the design rationale for our low-cost field sensing system and describe our method for realizing it.

Keywords: Field sensing, Soil moisture sensing, Internet of things

Acknowledgments

This research was supported by grants from the Project of the NARO Bio-oriented Technology Research Advancement Institution (Integration Research for Agriculture and Interdisciplinary Fields).

SS 5

Sensor Observation Service for Connecting Heterogeneous Field Sensor Platforms to Applications

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Abstract

We have established a sensor web service infrastructureusing Sensor Observation Service (SOS) for InterAct (Interdisciplinary Agricultural Information and Communication Technology, Ministry of Agriculture, Japan) research project. We have connected different types of field sensor platforms to the infrastructure and provided single web service end point with standard API to applications that required sensor metadata and data. SOS based sensor service infrastructure contribute agricultural applications development that accesses heterogeneous field sensor data.

Keywords: Field sensor networks, Sensor observation service, Interoperability

Acknowledgments

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SS 6

Multifunctional High Definition Web Image Viewer for Visualizing Plant Growth Data

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Abstract

Plant growth information can assist farmers' decision making in their field management. This study proposes a multifunctional Web-based high definition image viewer that visualizes growth data of plants in a field. Users can easily access to collected images, extract growth information in a numerical form, record the numerical information and their interpretations as annotations on plant images and share the recorded annotation through a social network service. The apple fruit growth rate was obtained by measuring its radius on the viewer.

Keywords: Field monitoring, High definition image, Sensor network

Acknowledgments

This research was partially supported by the Japanese Ministry of Agriculture, Forestry and Fisheries Integration Research for Agriculture and Interdisciplinary Fields (InterACT: Interdisciplinary Agricultural Information and Communication Technology).

SS 7

High Throughput Phenotyping for Cereal Crops in Outdoor Conditions

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Abstract

The change in food demand pattern and climatic change of the 21st century is now forcing breeding to be highly efficient to provide appropriate cultivars timely. However, while genotyping has been being dramatically accelerated reducing the time and cost for gene sequencing, phenotyping is now a serious bottleneck in efficient breeding because phenotypes are always needed to be evaluated in order to maximally utilize and understand genotypic information. Thus, the developments of high throughput phenotyping methods are really desirable particularly for outdoor conditions where breeding is usually conducted. In this paper, we report three practical approaches to accelerate phenotyping for cereal crops using image analysis; e.g., crop segmentation from background under varying natural light condition, detection of rice flowering and drone use as a platform for phenotyping. In all the cases, machine learning takes an important role.

Keywords: Canopy coverage, Flowering and heading detection, Drones, Machine learning

Acknowledgments

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SS 8

Measurement of Sugar in Phloem Sap by Using IR Spectroscopy

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Abstract

NIR spectroscopic measurement system was constructed using a mini-spectrometer, and newly developed diffused reflex-type probe with a light source. A plant stem model that woody paper was pasted to the cylindrical wood by starch paste, was applied to the performance confirmation of this system. As the result, it was shown that sugar content of woody paper which corresponds to phloem could be detected by this system.

Keywords: NIR, Phloem, Sucrose, Spectroscopy

Acknowledgments

This work was supported by the Project “Integration research for agriculture and interdisciplinary fields,” Ministry of Agriculture, Fisheries and Forests, Japan.

SS 9

Crop Yield and Quality Prediction for Rice Cultivation

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Abstract

This paper describes the accurate prediction of the heading day, the yield and quality index ofjaponica paddy rice (Oryza sativaL.cv. Koshihikari). The cultivar-specific prediction rules are defined by multiple linear regression and the neural network analyses. The results show that the neural network analysis is better than the multiple linear regression analysis in the prediction ofthe heading day and the yieldand that the multiple linear regression analysis is superior in the prediction of the quality index.

Keywords: Rice grains, Data mining, Heading day, Yield, Quality index

Acknowledgments

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SS 10

Development of a Meteorological Observation System Using Arduino by KOSEN Network

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Abstract

In recent years, acquisition and analysis of farmlands weather are expected to improve the productivities because the environmental management on farmlands becomes easy. However, it is difficult to install the existing meteorological equipment on farmlands because of the high prices. We developed low-cost and low consumption meteorological equipment. The equipment is operated with power saving controlled by Arduino in order to enable continuous operation by the solar panels. We built a weather data acquisition system for farmlands and started to the nationwide demonstration experiment by using KOSEN network that is an organization of national institute of technology in Japan.

Keywords: Low-cost meteorological Equipment, Nationwide experiment

Acknowledgments

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POSTER SESSION

CODE 1. e-Business in Agriculture
2. Modeling and Simulation for Agricultural Production
3. Decision Support Systems for Farmers Ⅰ
4. IT for Water Management
5. Internet of Things for Agriculture
6. Precision Agriculture and Robotics
7. IT for Post-Harvest and Food Marketing
8. IT Convergence for Livestock Farms
9. GIS for Agriculture and Natural Science
10. Computer Adoption and Extension for Farmers
11. Big Data Analysis for Agriculture
12. Decision Support Systems for Farmers Ⅱ
13. IT Convergence for Horticulture Farms

PS 2-1

Development of a Planting Density-Growth-Harvest (PGH) Chart for Common Ice Plant (*Mesembryanthemum crystallinum* L.), Sowthistle (*Ixeris dentate* Nakai) and Quinoa *(Chenopodium quinoa* Willd.) Hydroponically Grown in Closed-Type Plant Production System

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Abstract

Planting density is an important factor affecting the growth and yield of vegetables. In this study, Planting density-Growth-Harvest (PGH) charts were developed to read easily the growth and harvest factors such as crop growth rate, relative growth rate, shoot fresh weight, harvesting time, marketable rate, and marketable yield of common ice plant (*Mesembryanthemum crystallinum* L.), sowthistle (*Ixeris dentate* Nakai) and quinoa (*Chenopodium quinoa* Willd.). The plants were grown in a nutrient film technique (NFT) system in a closed-type plant factory using fluorescent lamps with three-band radiation under a light intensity of 140 μmol·m^{-2}·s^{-1} for common ice plant, sowthistle and quinoa. The photoperiods were 12 h/12 h (day/night). Growths and yields of common ice plant, sowthistle and quinoa grown with the nutrient solution at EC 1.0 and 2.0 dS·m^{-1} were analysed under four planting densities: a 15-cm between-row distance with four within-row distances of 15×10 cm (67 plants/m2), 15×15 cm (44 plants/m2), 15×20 cm (33 plants/m2), and 15×25 cm (27 plants/m2). Crop growth rate, relative growth rate and lost time were described using quadratic equation. A linear relationship between shoot dry weight and fresh weights was observed. PGH chart was constructed based on the growth data and making equations. Planting Density-Growth-Harvest (PGH) charts were constructed based on the growth data and existing models. With this chart, we could easily obtain the growth factors such as crop growth rate, relative growth rate, and lost time and the harvest factors such as shoot fresh weight, marketable yield per area, and harvesting time with at least two parameters, for instance, planting density and shoot fresh weight of the plants. PGH charts will be useful tools to estimate the growth and yield of crops and to practical design of a closed-type plant production system.

PS 2-2

Development of Models for Estimating Growth of Quinoa (*Chenopodium quinoa* Willd.) in a Closed-type Plant Factory System

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Abstract

Crop growth models are useful tools for understanding the crop growth and for integrating the knowledge about crop growth. Models for predicting plant height, net photosynthesis rate, and plant growth of quinoa (*Chenopodium quinoa* Willd.) for a leafy vegetable in a closed-type plant factory system were developed using the model equations which were linear or quadratic, non-rectangular hyperbola and expolinear equations, respectively. The plant growth and yield were measured at 5 days intervals after transplanting. The photosynthesis and growth curve models were calculated. A linear and a curve relationship were obtained between plant heights and days after transplanting (DAT). However, accuracy equation to estimate the plant height was 5.4+0.58·DAT. The non-rectangular hyperbola model was chosen as the response function of net photosynthesis. The light compensation point, light saturation point, and respiration rate were 29 μmol·m^{-2}·s^{-1}, 813 μmol·m^{-2}·s^{-1} and 3.4 μmol·m^{-2}·s^{-1}, respectively. The shoot fresh weight was a linear relationship with the shoot dry weight. The regression coefficient of shoot dry weight was 0.75 (R2=0.921***). A non-linear regression was carried out to describe the increasing of the shoot dry weight of quinoa as a function of time using an expolinear equation. The crop growth rate and relative growth rate were 22.9 g·m^{-2}·d^{-1} and 0.28 g·g^{-1}·d^{-1}, respectively. It is concluded that these models can accurately estimate the plant height, net photosynthesis rate, shoot fresh weight, and shoot dry weight of quinoa.

PS 2-3

Developing a Smart Greenhouse Test Bed for the Smart Farm Model through ICT Convergence

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Abstract

There has been growing interest in the development of technology to test and evaluate smart horticulture facilities in a smart farm model through ICT convergence as to adapt its effectiveness to similar cultivation and farming facilities on-site. The purpose of the research was to develop a smart greenhouse test bed through ICT convergence. The research was conducted to take advantage of the conformation and evaluation of the smart farm model. The ICT convergence smart greenhouse test bed in the study consists of a single bay greenhouse (7m (w) x 1.7 m (h) x 80m (l)) and a three-bay greenhouse (21m (w) x 4.0m (h) x 80m (L)). Two roll types and one rack & pinion system was used for ceiling structure of the greenhouse. Growing beds are made up for the ground cultivation, the elevated strawberry cultivation system, and tomato cultivation system by nutrient solutions. Two types of supplementary light radiation were used. They areultra-constant discharge (UCD) lamps and light emitting diode (LED) lamps. A1mm square screenmash was attached to the side window, and the ground coveredwith water-resistant fabric for hydroponic cultivation area. The environmental resistance was studied at high temperature, constant temperature and humidity, and low temperature conditions respectively. The center of the control system was conformed to the Internet connectivity, sensor data collection and communication, and remote monitoring and control. The control system of the greenhouse test bed transmits data through a single wired or wireless line while it performs the interlocking control function by receiving various signals from the remote sensors and from the CCTVs installed in surveillance areas. Therefore, it is capable of the integrated operations, multi-function control, and management of multiple embedded devices. Each device has a unique device identifier. This can prevent an attack or infection of computer virus as the data information processing bypasses data transfer devices such as PCs, but directly communicates with the control system equipped with real-time control and data transmission. The security monitoring system that operates via smart devices and CCTVs was applied.

PS 2-4

Cultivation Strategies with CO_2 Balance Models for a Closed Production System of Mushrooms and Lettuces

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Abstract

A large amount of CO_2 emitted from mushrooms can be reused for plant production by a systematic approach. The objective of this study was to establish appropriate cultivation strategies with CO_2 balance models in a closed production of mushroom and lettuce. A CO_2 emission model of mushroom and a photosynthetic model of lettuce were developed. A closed plant production system with mushroom and lettuce chambers was developed. Simulations were conducted at an actual cultivation condition by using MATLAB, where fixed portions of the total number of plants were transplanted step by step for continuous cultivation. For validation, actual and estimated CO_2 concentrations in cultivations of mushrooms and lettuces were compared. CO_2 concentrations in the mushroom and lettuce chambers were stably maintained within adequate ranges under 2000 μmol·mol^{-1} for mushroom and over 1000 μmol·mol^{-1} for lettuce) in the continuous cultivation. Compared to the single cultivation of mushroom, the mixed cultivation could reduce the CO_2 emissions into the atmosphere by 81%. It is concluded that the continuous cultivation strategy will reduce the greenhouse gas emissions and can be applied to the closed crop production, such as space agriculture.

PS 3-1

Analysis of Relationship between Transpiration Efficiency and Light Intensity for Irrigation Strategy in Paprika Cultivation

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Abstract

Since paprika is very sensitive to water condition, irrigation control plays an important role in increasing yield. An irrigation method based on solar radiation is widely usedbecause transpiration is known to have a close relationship with light intensity. However, even in the same irrigation treatment using light intensity, the yield can bechanged depending on region because the diurnal variation of light intensity is locally different. In this study, the relationship between transpiration rate and light intensity was analyzed by a precise irrigation system developed by our research team. Transpiration efficiency was analyzed and used for establishing irrigation strategy. Generally, transpiration rateincreased with increasing light intensity. However, when light intensity exceeds the certain level, transpiration amount did not proportionally increase with light intensity anymore. The transpiration efficiency, the relationship between accumulated radiation and transpiration, could be shown as a negative exponential regression[$y=a\times(1-\exp^{(b\cdot x)})$]. Reduction of transpiration efficiency was appreciably observed under higher light intensity. This result indicated that the compensation for the loss of transpiration rate is required for establishing an adequate irrigation strategy under higher light intensity.

PS 4-1

ICT-based Intelligent Pipeline Management System and Their Applications for Efficient Use of Agricultural Water in South Korea

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Abstract

Efficient irrigation water operation and management plays an important element in the sustainable agricultural water. In South Korea, the traditional irrigation management of agricultural water is delivered in irrigation open canals has led to water efficiency limitations. These problems include such as water distribution systems with irregular delivery rates, and low irrigation efficiency and uniformity. An accurate measurement and real-time monitoring of pipeline distribution system, that can easily control the water supply, is essential to overcome these issues of water efficiency and availability. The objective of this study was to develop an information and communication technology (ICT)-based intelligent pipeline management system for rural area in South Korea. In this study, ICT-based accumulated measurement and automated irrigation control system of real-time pipeline network monitoring was developed to improve intelligent operation and management. Results from this study can be used to develop or improve water management policies that enable irrigation planners to improve spatial and temporal water efficiency in water distribution.

PS 4-2

Development Plan of Intelligent Information System for Rural Water

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Abstract

By gathering various information occurring in rural areas and providing IT-based rural water information service, making foundation for rapid policy support and providing information to the public is being attempted. So necessary data structure is being established according to the division of information systems. And we research rural water resources step by step and develop basic data management system. Water resources analysis system is analyzed development phase to develop Intelligent Information System for Rural Water by deducing service target-specific information provision & implementation plan. First, the system is designed to utilize to make intelligent rural water policy by connecting Korea Rural Community Corporation System such as Rural Infrastructure Management System, Rural Agricultural Water Resource Information System and weather information of Korea Meteorological Administration, VWorld of Ministry of Land, Infrastructure and Transport. Second, basic data of test bed was constructed to display spatial and attribute data organically by providing GIS based Intelligent Information System for Rural Water. And basic data is able to managed with location information visually by this system. Third, cities & counties basic DB was constructed and prototype system was developed by linking the digital map(Map service API) to mange basic data regarding rural water and for analysis and application. VWorld is used for back ground map to construct gateway to link rural water DB of test bed and infrastructure, district, agricultural water area. Finally the foundation to display process and result of GIS analysis over the map was established.

PS 4-3

Functional Linkage of Each Land in Saemangeum Agricultural Land

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Abstract

Since a land-use plan of Saemangeum agricultural land have been made, in order to introduce the concept Agropark in Saemangeum agricultural land, it is necessary to cooperate with each industry sector and agriculture cluster via production, processing and distribution for circulation efficiency of resources. Therefore, we suggest a functional linkage operation plan of agricultural land by setting technical elements such as resource circulation, Orgware(organization), biogas plants, connecting lines, etc. utilizing agricultural products, by-products, waste, food, tourism, services, and so on. It will be used as a reference in the plan to achieve the purpose of use of Saemangeum agricultural land.

PS 5-1

A Proposal of Standardization to Smart Greenhouse Data Transmission

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Abstract

The definition of a smart farm is agriculture improvement, automation and robotization by applying the Big Data, Cloud technology and Robot. Currently many products have been developed for the smart farm. However, the products have different protocol for each other.

In this thesis, we developed a system for greenhouse smart cloud services and big data collection for greenhouse data standardization. We made a system for transferring a smart greenhouse data using java and the used data is xml formatted. The json(Javascript Object Notation) is better than the xml in speed. However, because the existing system uses xml, we used xml formatted data for compatibility. Compatibility with other devices is very important.

Since manufacturer is different, products should be not incompatible with each other. If you are using a product that is incompatible with any other company, and the product is broken. Unfortunately, if the company fails, all of equipment should be replaced with new one. It would be much of a burden to the farmer.In order to use the cloud system, I installed Ubuntu and pydio. Pydio is a cloud system that is comprehensive sync and share solution for your collaborators used in the Linux. Smart greenhouse standardization is being in RDA(Rural Development Administration). If you use this system, you are able to get greenhouse environmental data easily in real time. In addition, it helps the smart greenhouse development and improves farm productivity. I would like to propose applying the implemented system to the government's smart greenhouse standardization policy.

Keywords: ICT, IoT, Smart farm, Smart greenhouse, Standardization

Acknowledgments

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PS 5-2

Development of a Transpiration Measurement and Environment Monitoring System for Paprika Plants

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Abstract

Paprika is one of the most profitable vegetable crops which classified as a typical Solanaceae crops in the world. Since drought stress significantly affectsthe switching processbetween vegetative and reproductive growth, irrigation management is especiallyimportant for fruit productivity. For more precise control, irrigation methods based on substrate moisture content or plant response have been used recently. However this approach has several limitations of less accuracy and inaccurate reflections of theplant response to microclimate changes. Therefore, precise irrigation devices using continuous monitoring of environmental conditions and plant responses are required. The weight of six plants including substrates was continuously measured. The transpiration amount was calculated by the following concepts:transpiration = irrigation –drainage – change of plant weight with substrate. The developedsystem could monitor the environmental changes by consecutive measurements of light intensity, temperature, humidity, andelectrical conductivity of root-zone. In this study, continuous estimation of transpiration and monitoring of environmental factors were availableusing the developed system. Furthermore, a precise irrigation control reflecting environmental factors and plant response could be developed.

PS 5-3

Deep Learning – based Classification of Hyperspectral Images for AMB

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Abstract

Apple MarssoniaBloth(AMB) is one of the major diseases in apple farms. An early and prompt diagnosis of the AMB by farmers plays an important role in minimizing the damage caused by AMB. Deep learning is a type of learning by machine, or a computer through the inference pattern analysis and classification, using autonomous and multi-layered learning features, such as information of images, sounds, and characters. Moreover, deep learning affords higher-level learning and abstraction of multi-layered information by performing non-linear activation through an artificial neural network. Deep learning algorithm of visual information plays a significant role in monitoring changes in crops and the crop conditions by providing data to diagnose pest and physicaldisorders. In this study, deep learning-based classification of hyperspectral image was applied as a method of early diagnosis of AMB. An infected AMB leaf and appeared disease (sample a), a latent AMB leaf (sample b), and a healthy leaf (sample c) were taken in hyperspectral range. A short-wave infrared spectral camera (SWIR) took images with 45 nm intervals. Then, the images were converted by Matlab for histogram equalization, a technique for adjusting image intensities to enhance contrast. The results showed that the symptomof infected AMB leaves appears a wide range of wavelength values compared to the hard-to-gross-looking leaves or to the leaves identified as healthy. Although samples b and cmay not look different visually, the histogram equalization can provide detailed information of the symptoms. Since the symptoms of the disease can be identified in hyperspectral images through histogram equalization, application of DNN algorithmis recommended for early diagnosis of the AMB disease.

PS 6-1

Application of a Photovoltaic and Intelligent Resource-Saving System to Aquaculture Facilities

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Abstract

In this study, a photovoltaic intelligent resource monitoring system was created to provide automatic feedback for controlling the electricity and groundwater usage during aquaculture by monitoring the water quality parameters of ponds as well as weather data. The goals of this system were to reduce power and water consumption to comply with energy conservation and carbon reduction policies and to mitigate the land subsidence issues of Taiwan.

This system included green electrical, aquaculture monitoring and intelligent controlling subsystems. Data from the field equipment and monitoring devices, which were connected via RS-485/Modbus interfaces, was compiled and wirelessly sent to a monitoring center via Zigbee networks. The electrical subsystem comprised a photovoltaic generator with 5KW solar panels, an inverter, and a digital power meter. The other two subsystems comprised a graphic control software system that collected and calculated various parameters from a digital water-volume meter, digital power meters, water quality sensors, and a metrological station to provide automatic feedback for controlling the water volume valve, air blower, and feeder.

Preliminary analysis of the electricity benefits indicated that each single aquaculture pond (16 meters by 11 meters; 268 tons of water) could generate more than 7000 KWH over one year, which would save approximately NT$20,000 annually in electricity fees. Moreover, the pond water did not need to be constantly exchanged when the quality was good, such that each pond could save 965 tons of water (60% of the original usage) every month.

Keywords: Aquaculture, Intelligent Resource-Saving System, Photovoltaic, Groundwater Monitoring

Acknowledgments

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PS 6-2

The Development of Damage Assessment Technology for Agricultural Facilities based on the Drone Image Processing

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Abstract

Amid an active application of drone the research of agricultural facilities damage assessment under natural disaster was also performed by using drone. The scale of damage could be checked at a glance of image that achieved by flying drones over the damaged land. The causal relationship between cause and destruction could be revealed easily too. The length, area and volume of damaged structures could be measured on the orthophoto and DSM(Digital Surface Model) at the VST(Virtual Survey Tool) and these dimensions can be used to estimate how amount of damage was occurred at the facilities and lands. Central Disaster and Safety Countermeasures Headquarters for Integrated Disaster Countermeasures at the Ministry of Public Safety and Security announces unit cost for disaster restoration project every year. The restoration cost estimation tool which consists of announced unit costs established as data base and the dimension measuring function, VST function, was developed on the ArcGIS system.

PS 6-3

Image Processing-based Disease Detection Algorithm for Tomato Leaf

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Abstract

There are numerous studies actively being conducted focusing on utilizing images taken at the farms in various ways such as extracting growth information of crops, prediction of crop yields, and diagnosis of disease and insect pests. However, there is a point which makes the traditional studies on how to diagnose crop disease and insect pests difficult to apply to farming practically. This study attempts to improve this challenging point. To this end, this study proposes the algorithm which enables to investigate and analyze the crop leaf image taken by image camera and detect the infected area within the image. We applied the enhanced k-means clustering method to the images captured at horticulture facility and farms in outdoor environment and categorized the areas in the image. Then we used the edge detection and edge tracking scheme to decide whether the extracted areas are located in inside of leaf or not. Performance evaluation results indicate that the proposed algorithm outperforms the traditional algorithms in terms of classification capability.

Keywords: Image processing; Leaf disease; k-means clustering; Edge detect;

Acknowledgments

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PS 6-4

Mobile-based Detection and Classification System for Plant Leaf Diseases Using Image Processing Technique

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Abstract

The classification and recognition of leaf diseases are technically and economically important in the agricultural Industry. The detection of the disease in the earlier stages is very important to avoid the loss in terms of quality, quantity and finance. With the recent advances in wireless communication technology and availability of multimedia capable smart phones has become vital to enable query operation in image databases and retrieve results based on the image content. This paper presents a mobile-based image retrieval application to identify and classify plant leaf disease symptoms of Mukunuwenna (Alternanthera sessilis) green leafy vegetable plant grown in Sri Lanka. This study consisted of two stages, first stage was to classify the leaf disease using image processing technique and the second stage was to develop a mobile-based application. The images of diseases affected Mukunuwenna leaves were acquired using a digital camera under various conditions in several fields. The diseases of these images were basically identified with the help of plant pathologist. Then, several analytical techniques were used to classify the images according to the investigation of plant pathologist. All these information were stored in a database. A client-server architecture was used to develop mobile application to retrieve plant leaf diseases by mobile phone (smart phone) in the field. An Android based application was developed in client-side and a Content Based Image Retrieval (CBIR) application was developed in server-side. The client and server communicate through the internet. The developed system will then compare the image inserted by the client with image stored in the database in the server-side. The extracts the features of query image compares the stored features and calculates a similarity value for each image in the nearest cluster. Then server responds to the image query by sending results to the client. Finally, disease with an acceptable accuracy will be detected and the client system will display the results as the output. In server side, a revised averaging algorithm was used to extract the features of query image. The development of a mobile-based image processing system to detect, recognize and classify diseases affected on crops leaves will helps farmers avoid consulting from agricultural advisors and assist them to identify the disease in an early stages to control it.

Key words: Mobile application, Image processing, leaf diseases, Sri Lanka, classification

PS 7-1

Food Safety Risk Assessment: A Method for Risk Companies Mining and Characteristics Analysis

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Abstract

Unlike our government could only can passively handle food safety issues as a crisis afterwards in the past, this study proposes the “food safety risk assessment method and architecture” pioneered by Taiwan for taking active risk control from the sources of hazardous substances, so as to discover risk companies which may allow hazardous substances enter into the food industry illegally. Past researches were adopted a bottom-up pattern began from the terminals of food sales. But in this research, we change to a top-down pattern began from the sources of hazardous substances and propose the design concepts, including the “risk assessment approach” and the “food safety risk control center”. This study selected the formaldehyde as a case of hazardous substances toinvestigate its characteristics, business style, and illegal cases used in foods. And it found out the risk companies list and analyzed their characteristics in depth. We propose a new concept of “business operating behavior” with three design features: node status, co-existence relationship, and upstream-downstream relationship, and build the risk matrix table and its model. And we also modularized two data products: statistical analysis model and exploration analysis model.

This result showed that there are many cases of formaldehyde into the food industry, and it may be directly into the food and beverage manufacturing industries. And it is found in “food-drug manufacture”, “agriculture-food co-existence”. All are risky at a certain level. This study also found three clusters in the clustering model of risk companies included “food manufacturing type”, “intermediate compound manufacturing type”, and “drug manufacturing type”. After several food safety expert meetings, this results indeed found some suspected hazardous companies. It is hoped that this study can provide a reference to develop a risk control center for food safety in the future to prevent hazardous substances from entering the food industry.

Keywords: Food safety, Risk assessment, Data science, Data analysis, Big Data

PS 8-1

Development of Traceability Improvement Techniques for Jeju Black Native Pigs Based on DNA Analysis

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Abstract

DNA was extracted from 1,045 pigs from 11 sites in Seoul and Kyounggi provinces. The genotyping of the SNP markers was done for more than 100 of the DNA samples. Comparative tests on EP1 system of Fluidigm and QuanStudio 12K Flex Real-time PCR system of AB Company were conducted on the same samples. From 96 SNPs, 24 SNPs were not satisfied by the Hardy Weinberg value. Allele frequency range between 0.3~0.7 had the lowest NE-I (Combined Non-Exclusion Probability (Identity)) (2.02E-21) and NE-SI (Combined Non-Exclusion Probability (Sib-Identity)) (1.10E-11) implying the probability of distinct identity and sib identity in Jeju Black Native pigs. SNP 8 had potential for use as a characteristic marker for Jeju area because of the presence of the whole T allele. Another 49 SNPs selected showed similar results for appropriate test of sameness. The comparison of SNP genotyping results between Fluidigm's and AB's analyses indicated that the numbers of SNPs used by Fluidigm's and AB's analyses were 102 and 96 respectively. Only 59 SNPs were similar. Samples for Fluidigm's and AB's analyses were 474 and 1045 respectively. Call rate was 96.56% and 84.98% for Fluidigm's and AB's analyses respectively, with that of Fluidigm being 10% higher than that of AB. NE-I and NE-SI values of Fluidigm's analysis were less than that of AB analysis. Fluidigm's analysis had a higher possibility for distinct identification.

Keywords: Pigs, Traceability, DNA sequencing, SNP

Acknowledgments

This research was supported by the MSIP (Ministry of Science, ICT and Future Planning), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2016-H8601-16-1007). It was supervised by the IITP (Institute for Information & communications Technology Promotion).

PS 8-2

Utilization of Sensor Network for Fermentation of *Opuntia Humifusa* Grown in Korea

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Abstract

Cactus plants have been known as good sources for medicinal and cosmetic purposes. *Opuntia humifusa*, a member of the Cactaceae family, isgrown in the eastern United States and occasionally transplanted into northern regions. Nowadays itis cultivated in the south area of Korea due to climatic change caused by greenhouse gases. Fermentation with lactic acid bacteria (LAB) is a desirable method to improve sensory and functional properties of plants as well as storage stability. In order to optimize fermentation conditions for *O.humifusa* grown in Korea, various environmental and nutritional factors affecting LAB growth should be investigated. However, real-time monitoring the changes in fermentation conditions and quality properties of *O.humifusa* duringfermentation is highly time and labor consuming. In this study, sensors detecting temperature, humidity, and pH coupled with an Arduino program are applied for monitoring fermentation profilesof *O.humifusa*. Total 12 conditions with two carbon sources (brown sugar and *O.humifusa* extract (OH extract, 50% sugar) and sixcarbon source concentrations (25, 30, 35, 40, 45 and 50%) were tested for fermentation of *O.humifusa* for a month. Temperature was fluctuated in the range of 36 to 38°C and humidity was controlled by 29% during the entire of fermentation period. pH of *O.humifusa* fermented with brown sugar rapidly decreased from 4.92~5.06 to 4.25~4.56 while those with OH extract increased during the initial 9 days of fermentation. Sugar content rapidly decreased for all samples as fermentation time increased. Degree of the changes in pH and sugar content were affected by the concentrations of carbon sources. Samples with 30 and 35% carbon sources showed more remarkable changes in pH and sugar content than those with 25, 40, 45, and 50% ones, indicating that the range of 30 to 35% carbon sources is desirable for LAB growth in *O.humifusa*. Total polyphenol content was observed to be higher in the samples showing lower pH.A number of experimental data can be collected with minimized time and labor due to use of biosensor and an Arduino program, which would be desirable for testing various fermentation conditions of *O.humifusa*.

PS 8-3

Detection of the Laying Habits of Breeder Geese in Environmentally Controlled Goose House with RF Equipment

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Abstract

This experiment investigated the laying habits of the White Roman Goose and floor egg distribution with radio frequency (RF) equipment. In Trial 1, 676 white roman breeder geese (155 ganders and 521 geese) were selected from the third parity and 92 laying cages with RF equipment in the experimental pen to investigate the habit of egg laying and egg distribution of breeder geese. In Trial 2, conducted during January 13 and March 9, there were 20 breeder geese (including five ganders and 15 geese) and four laying cages with RF equipment in the goose pen, and monitor (Closed-Circuit Television, CCTV) was installed outside the laying cages to investigate when breeder geese entered the laying cages and laid eggs. The results showed that most breeder geese entered the laying area at 07:00 and 08:00, accounting for 19.7% and 19.5%, individually; and the number reduced afterwards. Breeder geese laid eggs mostly during 00:00 to 08:00. The geese laying quantity of each interval accounted for 8.64%, 13.6%, and 9.87% at 05:00 to 07:00, respectively. The laying quantity at 13:00, 14:00, and 16:00 accounted for 6.17%, 7.41%, and 6.17%, individually. The daytime and nighttime laying ratios of breeder geese were 53.1% and 46.9%. About 83.6% of breeder geese laid eggs in the nest box, with 16.4% of floor eggs. Ten days after laying in the environmentally controlled goose pen, there was a greater change in the floor egg ratio. Until day 58 after laying, the floor egg ratio maintained at 15.8%. The laying duration in the next box was about 0.5~1 hour, 1.5~2 hours, and 2.5 hours and up, accounting for 20.3%, 21.1%, and 25.7% of breeder geese. Up to 53.1% of the White Roman Goose lay eggs in the daytime and in a broader time range. Therefore, the frequency of egg collection should be increased to reduce breeder egg contamination.

Keywords: RF equipment, Egg laying habit, White roman goose

PS 9-1

Erosion Modeling based on LIDAR Data in a Natura 2000 Site

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Abstract

Recognizing the environmental problems of the accelerated erosion processes raises the significance of forecast beside detailed knowledge of the process. Climate change causes strengthening of Mediterranean and semi-arid character in Hungary's climate. As a consequence, soil erosion will be determined by the less frequent, short duration but high intensity rainfall events. The soil erosion reducing soil fertility by degradation of organic and nutrient-rich topsoil and erosion of the surface causes serious environmental problems, because chemicals are moving down with the erodated soil and washed out by the runoff from the slopes.

High precision laser scanner based data acquiring were carried out by Riegl LMS LMS Q680i full waveform laser scanner. Leaf-on and leaf-off point data were collected from the area of the Sopron Mountains by the instrument. This Natura 2000 site is a primarily humid, forested area mainly on siliceous soils. Most part of the area is afforested, covered by acidophilous beech and oak-hornbeam forests and mostly planted Pinus and Picea stands and Castanea species. Airborne laser scanning (LIDAR) data provide ultra-resolution data sets both horizontally and vertically, on which base agroforestry activity can be replanned. Based on the digital elevation model of the area, runoff and water ponding conditions can be analyzed. Combining information technology with an erosion risk model, location of potential deforestation areas, where this operation does not increase the risk of erosion can be determined. What-if analyzes will be run for several future scenarios, considering input data (e.g. rainfall, slope length, slope angle, vegetation, cultivation type, runoff) of the most soil erosion models (e.g. RUSLE, WEPP, SWAT). Since DEM obtained from LIDAR provided new quality data, erosion and sedimentation modeling ensures more precise information, on which base landscape management is supported to be redesigned in a more environmentally friendly way.

Keywords: Soil erosion, USLE model, LIDAR survey, DEM

Acknowledgments

Our researches were made in the frame of FP7 IAPP Marie Curie ChangeHabitats 2 project supported by European Union, which is gratefully acknowledged.

PS 9-3

3D Analyses of Greenhouse Light Environments and Canopy Light Interception at Diffusive Solar Radiation

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Abstract

Spatial light distribution in greenhouse as well as canopy light interception are important factors for estimating crop production and designing light-control systems. Meteorological factors, especially diffusive solar radiation, affect the light environments in greenhouse, however, actual measurement is not easy and requires much time and cost. 3D ray-tracing simulation would be a power method for analysis of diffusive radiation effects on greenhouse light environments. The spatial light distributions and light interception into crop canopy at different ratios of diffusive solar radiation were analyzed by 3D ray-tracing simulation. 3D plant models with 3D light models were combined to analyze the complex pattern of canopy light interception. For validation of the 3D greenhouse and plant models, the measured spatial light distributions with light intensities were compared with the estimated ones, and showed good agreements. The transmission of the total solar radiation into the greenhouse was much lower at a higher ratio of diffusive solar radiation, while the light interceptions by crop canopy were almost the same at both conditions. With this method, we could estimate light interceptions by crop canopy at various meteorological conditions as well as greenhouse structures, and could develop adequate light control systems.

PS 10-1

Study and Development of Inspection System for Rice Seeds with Image Processing

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Abstract

This study developed a rice conveyor device that automatically feeds rice, counts grains, captures images, recollects grains, and constructs an image database. An automatic rice feeding and image capture device has thus been built. Image capture testing was conducted for five varieties of 2014 foundation rice seeds using this device, including Taichung sen 10, Taichung 192, Tainan 11, Taikong 14, and Taikong 9. Currently, the average image capture rate is 97.5%, and the image capture speed is 60 images per minute.

Keywords: Rice seed, Seed purity analysis, Image processing system

PS 10-2

Microwave Electromagnetic Field Distribution Studies for Rice Weevil Elimination with Computer Simulation

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Abstract

Rice weevil is a difficult to completely eliminate stored grain insect pest in rice and often causes the commodity quality deterioration and serious economic loss to the related industries. Developing efficient and non-chemical grain pest elimination methods using high-frequency electromagnetic wave energy was always a great demand in the world. In this study, the characteristics of microwave energy distribution in the rice in a cylindrical resonant cavity of a designed microwave insecticidal device were examined by a computer simulation finite element model of Maxwell and heat transfer equations using the comical software COMSOL and its 3-D electromagnetic field distribution diagrams. The correlation coefficient between the measured and simulation predicted rice temperatures heating 20 sec was about 0.97, however heating longer to 30 sec and 40 sec, the rice moisture vaporization will cooling the rice which the corresponding prediction curve is about 100℃, making over all correlation coefficient is about 0.89. The experiments showed the microwave energy distributions in rice varying with the amount of the insecticidal rice and differ from the electric field distributions in a multi-mode or single mode resonant cavity. The microwave energy distribution in the rice is non-uniform with cold and hot spots can let some eggs or larvae survive in the rice making the microwave insecticidal efficiencies difficult achieving mortality 100% even through a longer heating time and rice average temperature exceed 80℃, which is the main reason for rice weevil appearing in the microwave insecticidal processed polished rice in one month. If more uniform system is applied with its outlet rice temperature variance within ± 2℃, the egg and imago can be completely eliminated when the rice temperature is above 54℃. Thestudy demonstrates using computer simulation method to investigate the characteristics of applying microwave energy for grain insect elimination and showed the microwave energy distribution among the insects and rice determine the ability to completely eliminate the insects in rice.

Keywords: Computer simulation, Rice weevil, Microwave insecticidal system, Electric modes, Dielectric heating

PS 10-3

Analysis of Canopy Light Distribution of Lettuce (*Lactuca Sativa* L.) Plant under LED Lighting by 3D-Optical Simulation

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Abstract

Optical properties of artificial light source significantly affect light distributions within plant canopy, resulting in different light use and photosynthetic efficiencies. However, prediction of the light distribution on the complex plant canopy surfaces is impractical in conventional methods. The objectives of this study were to investigate the light distribution within plant canopy under LED lighting by 3D optical simulation and compare its processed result with actual ones. For analysis of the light distribution, optical simulation software Optisworks (Optis, La Farléde, France) and 3D-CAD software Solidworks (Dassault Systèmes, Vélizy-Villacoublay, France) were used. 3D models of light sources and lettuce plants were developed according to their actual properties. For measuring the canopy photosynthetic rate, lettuce (*Lactuca Sativa* L.) plants, sealed acrylic chamber, and gas analyzer (LI-840, LI-COR, Lincoln, NE, USA) were used. The optical simulation well predicted the light distribution on the plant canopy surfaces under light sources with different optical properties. The results showed that the light distribution within plant canopy were highly heterogeneous under LED lighting. Use of diffuse glasses substantially improved the uniformity of light distribution as well as light use efficiency. The estimated canopy photosynthetic rates were well agreed with the actually ones. The 3D optical simulation method was useful and accurate in prediction of light distribution on complex plant canopy surfaces. We expect that the 3D optical simulation method can be used as a powerful tool in related researches, such as plant light absorption, growth modeling, and cultivation lighting designs.

PS 10-4

Development of a Coupled Photosynthetic Model of Sweet Basil Hydroponically Grown in Plant Factories

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Abstract

For the production of plants in controlled environments such as greenhouses and plant factories, crop modeling and simulations are effective tools for configuring the optimal growth environment. The objective of this study was to develop a coupled photosynthetic model of sweet basil (*Ocimum basilicum* L.) reflecting plant factory conditions. Light response curves were generated using photosynthetic models such as negative exponential, rectangular hyperbola, and non-rectangular hyperbola functions. The light saturation and compensation points determined by regression analysis of light curves using modified non-rectangular hyperbola function in sweet basil leaves were 545.3 and 26.5 $\mu mol \cdot m^{-2} \cdot s^{-1}$, respectively. The non-rectangular hyperbola was the most accurate with complicated parameters, whereas the negative exponential was more accurate than the rectangular hyperbola and could more easily acquire the parameters of the light response curves of sweet basil compared to the non-rectangular hyperbola. The CO_2 saturation and compensation points determined by regression analysis of the A-Ci curve were 728.8 and 85.1 $\mu mol \cdot mol^{-1}$, respectively. A coupled biochemical model of photosynthesis was adopted to simultaneously predict the photosynthesis, stomatal conductance, transpiration, and temperature of sweet basil leaves. The photosynthetic parameters, maximum carboxylation rate, potential rate of electron transport, and rate of triose phosphate utilization determined by Sharkey's regression method were 102.6, 117.7, and 7.4 $\mu mol \cdot m^{-2} \cdot s^{-1}$, respectively. Although the A-Ci regression curve of the negative exponential had higher accuracy than the biochemical model, the coupled biochemical model enable to physiologically explain the photosynthesis of sweet basil leaves.

PS 11-1

Study on the Hadoop based Greenhouse Integrated Management Server System for Bigdata Processing

Jeonghwan Hwang[1], Hye-rim Lee[2], Yongbeen Cho[3] and Keunseop Shim[4]

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Abstract

In order to improve the crop growing environment and create high income of farmers, farmer-specific personalized services should be provided by collecting and analyzing big data on environment factors and growth factors for crops. This paper proposes a Hadoop-based greenhouse integrated management server system that can efficiently collect, store and manage large-scale data regarding controlled horticulture and support the processing and analysis of big data collected. The proposed system consists of big data middleware server for storage and processing of greenhouse big data and Web application server providing greenhouse management and related services and provides a greenhouse integrated environmental monitoring service, greenhouse integrated environmental control service, greenhouse integrated production monitoring service through this system.

Keywords: Agriculture, Greenhouse, Management system, Bigdata, Hadoop

Acknowledgments

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PS 11-2

A Case Study on Consulting Using Big Data in Controlled Agriculture

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Abstract

Recently smart farms applied with ICT technology have been expanded primarily into protected horticultural crops. In the meantime, it is necessary to do the research on consulting utilizing various types of big data which can contribute to productivity and income increase to improve efficiency for those farms who introduced ICT controlled agriculture.

This study employed the environment and growth information of farms cultivating a tomato cultivar (Dafnis) in a plastic green house (13,200㎡) to develop a consulting model utilizing big data. The planting date was August 13, 2014 with the harvest date on July 12, 2015, and the complex environment control system was in use since 2011. To accomplish the research purpose, this study developed consulting stages for the subject farms and collected and analyzed the environment affecting growth and 56 items of liquid fertilizer information.

For the target of big data collected, this study conducted the relation analysis between the solar radiation and tomato growth (year 2014~year 2015), the relation analysis between the solar radiation and CO_2-related growth (year 2014~year 2015), and the relation analysis between growth and environmental factors. Scientific consulting by utilizing big data yielded approximately 30% increase in quantity, and this study presented a consulting plan analyzing big data in the field of agriculture.

Acknowledgments

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PS 11-3

The Case Study of Increasing the Measured Big Data Utilization in Controlled Horticulture

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Abstract

It is booming to develop the image sensing, standard and crop growth model on controlled horticulture in Information and Communication Technologies (ICT) development. There are many farms using automatic controller from controlled horticulture, and collected the environment and controlled big data. But the most of farms do not make a decision the control own horticulture, for example, controlling temperature, opening and closing the skylight or side window using accumulated big data. This purpose of the study is the case statistical analysis for making decision in controlled horticulture, and the farm understand condition of easily plant and controlled horticulture on own data. In this study, it was used the data for tomato, installed the controlled environment system in horticulture. The collected data was environment, controlled and growth in tomato. The statistical analysis methods were basic horticulture environment and the correlation of environment and growth of plant. This statistical analysis has the pros and cons: the former is that farm applies own plant and horticulture in a convenient, the latter is that it cannot reflect the precise physiology of crop growth. This study will be expected to the management of controlled horticulture smart farm using data and increasing productivity of crop.

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PS 11-4

Visualization of Big Data using Agricultural Data Analysis

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Abstract

As the big data era, importance of data visualization has been increased. In order to get the insight in the big data where huge data are rapidly increasing, the insight which enables to recognize at a glance is required even though the analysis is important. To execute this role is big data visualization. D3 library has been used to give visualization of a variety of big data in Web environment, where D3 library is one of the best open source visualization tools accommodating the current HTML5. However, this library provides data visualization with files such as CSV, JSON. In this paper, we propose a method of visualization using agricultural data analysis after performing a specified format for desired data by directly accessing public cloud computing services. Our proposed technique was carried out the visualization for manufacturing agricultural data and its analysis results stored in the public cloud computing services.

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