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On the Need for the Establishment of Centres for Integrated Research in Computing and Agriculture (CiRCA) in African Universities

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ABSTRACT

Centres of excellence are established in world class institutions of higher learning to aid research, innovation, institutional global ranking, visibility, impact and to also cluster academia and practitioners under an umbrella that can create a synergy of mutually benefiting relationships between the gown and the town. These Centres provide a unique platform that allows the integration of knowledge across different disciplines within and outside an institution thus facilitating internationalization, linkages, mentoring and the transformation of knowledge to useful outputs. This paper raises the need to establish a Centre for Integrated Research in Computing and Agriculture (CiRCA) in African Universities in order to annex the potentials and opportunities offered by the nexus of computing and agriculture. .

Keywords: Agriculture, Centre of Excellence, Green Computing, Precision Agriculture

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INTRODUCTION

The vision of Leading Agriculture Research Universities is to spearheads an agrarian revolution on the African continent through the exploration of hidden treasures in the mother-earth in order to restore the dignity of the black race provides the needed impetus to continuously explore opportunities offered by cutting edge research collaborations through linkages and joint efforts with other world-class Universities that churns out research findings through various established research Centres. Centres of excellence are established in world class institutions of higher learning to aid research, innovation, institutional global ranking, visibility, impact and to also cluster academia and practitioners under an umbrella that can create a synergy of mutually benefiting relationships between the gown and the town. These Centres provide a unique platform that allows the integration of knowledge across different disciplines within and outside an institution thus facilitating internationalization, linkages, mentoring and the transformation of knowledge to useful outputs.

The Proposal

This paper raises the need to establish a Centre for Integrated Research in Computing and Agriculture (CiRCA) at Agricultural Universities in order to annex the potentials and opportunities offred by the nexus of computing and agriculture. .

Goals & Objectives

The goal of the Centre will be to support and contribute to Landmark University's Institutional thrust of becoming a leading world class University that spearheads an agrarian revolution with resultant positive impact on food production, human capital/manpower development, innovations, enterpreneuship and global relevance. These goals will be achieved through the proposed Centre by pursuing the following Vision and Mission.

Vision

Be a high impact interdisciplinary and multidisciplinary research Centre that will accelerate solutions to agricultural research problems using the latest advancements in computing and agrarian techniques while also clustering brilliant minds within and outside African Universitries at the nexus of Computing, Agriculture and other allied domains in partnership with other existing national and international institutions/Centres of excellence in our core area of mandate.

Mission

Initiate precision agriculture research using relevant computing models, geospatial analysis and agricultural techniques that will impact positively on site-specific management' (SSCM) such as observation, impact assessment and timely strategic response to fine-scale variation in causative components of agricultural as well as pre and post production processes in Agriculture.

2. BACKGROUND ON PRECISION FARMING PRACTICES

Precision farming technologies affect the entire production function which includes both site management, farm management function as well as post production.

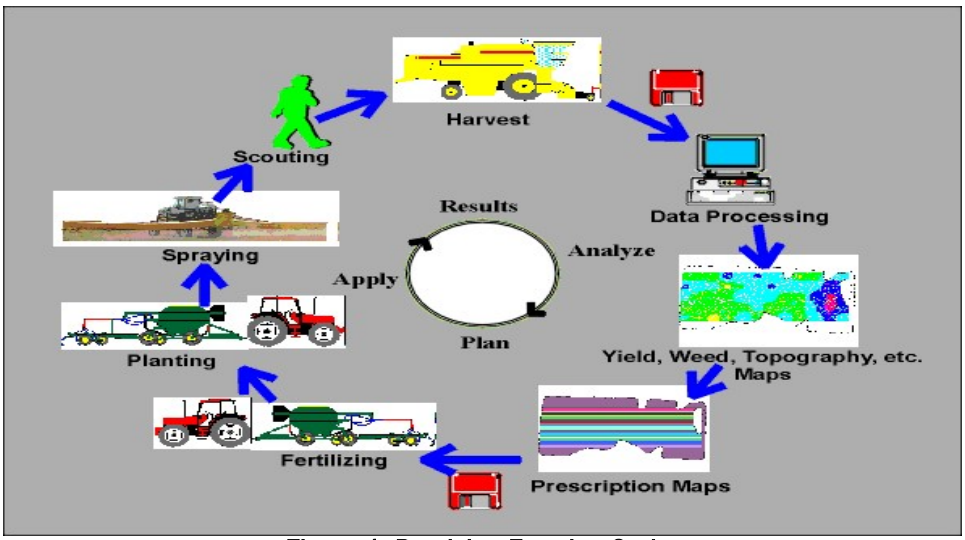

Figure 1. Precision Farming Cycle.
Source http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag1951

The components in precision farming (presented in Figure 1) includes yield monitoring, yield mapping, variable rate fertilizer, weed mapping, variable spraying, topography and boundaries, salinity mapping,the use of gGuidance systems for spraying or seeding. Activities of CiRCA will be address these precision farming/agriculture components.

Site Specific Management

Site-specific crop management is a form of precision agriculture whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they vary in a field. Collectively these actions are referred to as the 'differential' treatment of field variation as opposed to the 'uniform' treatment that underlies traditional management systems. The five main components for a site-specific management system which will also form part of the research thrust for CiRCA are illustrated in the Figure below.

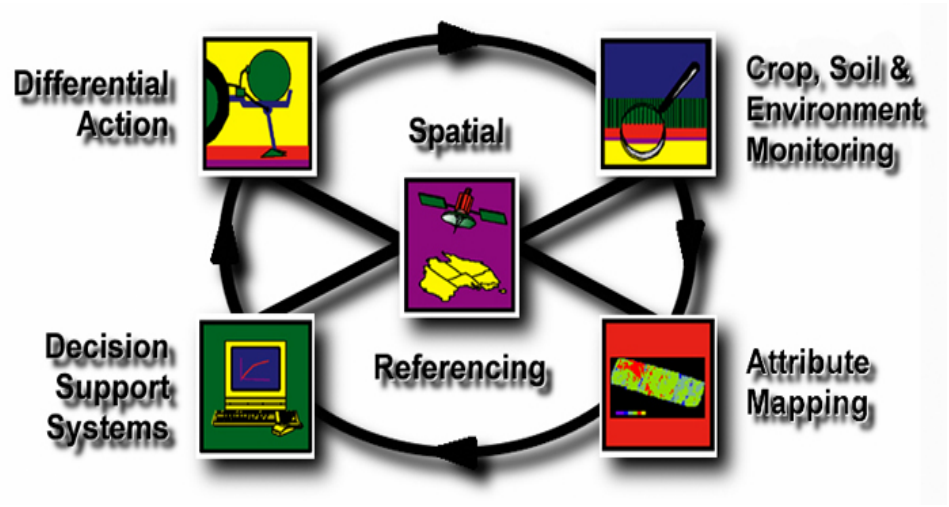

Fig.1: Components of Site Specific Management
Source (http://sydney.edu.au/agriculture/pal/about/what_is_precision_agriculture.shtml)

3. THE CiRCA AGENDA

Research in the Centre will be interdisciplinary and multidisciplinary cutting across the sciences, agriculture, engineering, management and behavioural sciences. Special attention will be given to the following:

1. The application of computing concepts such as classifications, sensors (RFIDs), machine learning, artificial intelligence, forensics, optimization models, electronic vision and imaging, simulation and modeling, scalable algorithms and heuristics to a range of agricultural enterprises such as animal husbandry, horticulture, crop production, pre- and post-production operations (i.e. drying, storage, production assessment, trimming and dissection of plant and animal materials).
2. The development of new techniques, models, frameworks and artifacts to aid precision agriculture thereby providing a basis for sustainability for the activities of the Centre and engender entrepreneurship spirit in LMU graduates
3. The creation of synergy between the Centre , the industry and practice with a view to transform knowledge and research findings from the Centre into useful outputs by leveraging on the creative talents that abounds among LMU students and Staff .

4. The development of grants/proposals documents that can attract funding from notable national and international organizations that offers support in the area of LMU's core mandate
5. Partnership with world class Centres of excellence on collaborative research, training and other initiatives in the area of Precision Agriculture through exchange programmes, fellowships, conferences, summer schools and short/medium term research visits.
6. Work with nationally established institutes in our area of core mandate such as IITA, IAR&T to promote and develop solutions to challenges facing agrarian practices using local contents
7. The identification of community-based needs and the initiation of research activities to address these needs so as to satisfy the requirements for community service in the host community
8. Mentoring of young and mid-career academia within LMU in order to properly position and align them with the LMU's vision be a leading world class university that spearheads an agrarian revolution
9. The generation of revenue (IGR) for the University through the development of marketable artifacts, tools and techniques that can be patented.
10. The creation of accessible and pay per use basis web/mobile-based repository of solutions to existing and evolving pre and post agricultural process, crop/animal production challenges

4. ORGANIZATION OF CENTRE

The Centre will be headed by a Professor who will engage Research Assistants in applicable disciplines to create a multidisciplinary stream for the Centre. The Centre will function through the formation of research groups. It will also host scholars from across the globe in different categories such as Postdoctoral researchers, short term scholars and Research Fellows, Visiting Professors etc.

Funding

- The University should set aside an endowment fund that can be accessed to run the Centre.
- The centre will also write grants and proposals as well as approach funding agencies to secure funds to assist in running the centre. It is also expected that the centre will develop patentable artifacts whose adoption and use can contribute to the finances for the centre

5. EXPECTED DELIVERABLES

The Centre is expected to produce measureable impact in the following forms:

- Research Outputs published in reputable Journals and presented at leading conferences indexed in Thompson Reuters, Scopus, Web of Science, ISI, Proquest, PubMed etc.
- Initiate linkages and exchange experience for staff and students of the University as well as host scholars from other partnering institutions globally.
- Developed artifacts that can attract investor's interest in different spheres of business and human endeavors in the domain of our core competence and mandate.
- Support the production of well-balanced graduates with leadership skills, entrepreneurial skills and a passion for creativity, Innovation and start-ups.

- Consult for Government, governmental agencies, international organizations and corporate organizations in LMU's area of core mandate
- Establish the LMU Journal of Advances in Computer-based Agricultural Research

6. POSSIBLE TAKE-OFF AGENDA

The Centre will work with scholars at locally and internationally to kick off its activities by pursuing the following take-off agenda:

1. **Mobile Applications Development to Aid Precision Agriculture Using Machine Learning**: The design and development of mobile applications to enhance agricultural extension services and rural development initiatives using social network facilities and mobile digital systems
2. **Automatic Measurement of Fractional Vegetation Cover (FVC) Using Pattern Recognition**: The use of automated methods to estimate fractional vegetation cover (FVC). Efforts here will engage the use of computer vision algorithms and image processing techniques for automated, accurate and unsupervised measurement of fractional vegetation cover (FVC).
3. **Classification of Fruit Ripeness and Quality Using Computer Imaging**: Efforts here will be directed at the classification of fruits ripeness and quality using non-destructive evaluation of the internal qualities and external qualities through the application of image processing and pattern recognition techniques. Particular interest will be in crops and agricultural products prevalent in the host community as well as tomatoes, mango etc
4. **The Identification of Plant Diseases Using Image Processing Techniques**: This research stream will use image processing techniques for the identification and classification of plant and crop diseases as necessary and critical information for predicting the likely crop yield losses, evaluating the economic impact of the disease, and determining whether preventive treatments are worthwhile or particular control strategies could be taken..
5. **The Development of a Mobile Intelligent Poultry Feed Dispensing System Using Particle Swarm Optimized Control Techniques**: This research will focus on improving and optimizing the manual pattern of feeding poultry birds which incurs an exorbitant cost on poultry farming and gives low return on investment by developing a mobile intelligent poultry feed dispensing system using Particle Swarm Optimized PID control technique.

7. CONCLUDING REMARKS

In conclusion, thr proposed centres can collaborate with the following existing centres globally

1. Leverhulme Centre for Integrative Research on Agriculture and Health (LCIRAH), London, United Kingdom
2. Global Forum for Agricultural Research Rome, Italy.
3. Geospatial Information Science Research Centre, University Putra Malaysia
4. Federal University of Agriculure, Abeokuta, Nigeria - PARMLA Researh Group
5. Centre for Tropical Agriculture, Cali, Columbia
6. International Centre for Information Technology & development, Louisiana, USA
7. Robotic Institute, Carnegie melon University, Pittsburgh, USA.
8. College of Agriculture and Consumer Sciences, University of Ghana
9. University of Buea, Faculty of Agriculture and Veterinary Medicine, Cameroon
10. Faculty of Agriculture, Cairo University

11. Kemptville College, Ontario Agricultural College in Kemptville, Ontario
12. Jomo Kenyatta University of Agriculture and Technology
13. Stellenbosch University, Faculty of AgriSciences
14. China Agricultural University, Beijing
15. University of Agricultural Horticultural Sciences, Shimoga
16. University of Western Australia
17. University of Waikato, New Zealand
18. Wageningen University and Research Centre
19. Universidade Estadual Paulista "Júlio de Mesquita Filho" in Botucatu, São Paulo
20. The Federal University of Technology, Minna, Nigeria
21. Royal Veterinary and Agricultural University
22. Faculty of Agriculture and Forestry, University of Helsinki
23. AgroParisTech (also named Institut des sciences et industries du vivant et de l'environnement), Paris
24. Landwirtschaftlich-Gärtnerische Fakultät, Humboldt Universität, Berlin (formerly Agricultural University of Berlin) Germany
25. Norwegian University of Life Sciences
26. Faculty of Agriculture, Forestry and Natural Environment, Aristotle University of Thessaloniki
27. University College Dublin, Dublin
28. Scotland's Rural University College (SRUC)
29. Berkshire College of Agriculture
30. Centre for Agriculture Excellence, University of the Fraser Valley in Chilliwack, British Columbia
31. Ontario Agricultural College, University of Guelph in Guelph, Ontario
32. Alabama Agricultural and Mechanical University
33. Colorado State University
34. Penn State University College of Agricultural Sciences
35. Texas A&M University
36. College of Agriculture and Bioresources at University of Saskatchewan in Saskatoon, Saskatchewan
37. University of Florida College of Agricultural and Life Sciences
38. University of Maryland, College Park
39. International Institute for tropical Agriculture
40. Swedish University of Agricultural Sciences

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