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Department of Agricultural Economics & Extension,
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Abstracts of presentation from the 32nd West Indies Agricultural Economic Conference

Using Satellite Imagery for Estimating Crop Evapotranspiration

Dave Goorahoo, Florence Cassel S., Touyee Thao, Forrest S Melton and Lee Johnson

Department of Plant Science, California State University, Fresno.

Accurate estimation of crop water requirement (CWR) is essential for the implementation efficient irrigation schedules in an effort to optimize water use efficiency. This is particularly important in the central San Joaquin Valley (SJV), California, USA, where severe droughts have accentuated the need to conserve water and improve on-farm water management. In the current study, we adopt an integrated approach for estimation of crop evapotranspiration (ETc) involving the use of weighing lysimeters and satellite imagery. In the first phase of the study with the crop lysimeter, conducted on a clay loam soil with processing tomatoes grown under sub-surface drip irrigation, observations of crop ground cover were conducted weekly and evapotranspiration (ET) data were collected daily to derive relationships between crop coefficients and fractional cover. Generally, the crop coefficients (Kc) obtained at peak season were relatively higher than those generally reported for tomatoes commonly grown in the central SJV. There was a good correlation between fractional cover and crop coefficients (r2 = 0.91), with the average peak ET and Kc values ranging from 6 to 7 mm per day and from 0.8 to 0.9, respectively. Data obtained from satellite imagery, representing relatively larger spatial measurements than the lysimeters, are being compared with the surface observations from the lysimeters and will also be discussed in our presentation.

Keywords: *Crop Coefficient, Water Requirement, Irrigation Scheduling, Lysimeter, Satellite.*

Impact of National Culture on Food Security

J. Kalu Osiri[1], Colin Ramsay[1], Victor Oguledo[2] and Donna Morrison[3]

[1]*College of Business Administration, University of Nebraska-Lincoln, Lincoln, Nebraska, USA*
[2]*Department of Economics, Florida Agricultural and Mechanical University, Florida, USA*
[3]*Faculty of Agriculture and Forestry, University of Guyana, Turkeyen, Guyana;*

According to a 2015 United Nations report, the current world population of 7.3 billion is expected to reach 8.5 billion by 2030, 9.7 billion in 2050 and 11.2 billion in 2100. The UN report adds that most of the population growth is expected to occur in developing countries. This growth will inevitably result in an overuse of land, water, and energy, and, coupled with the adverse effects of climate change on food production, make food security a top priority for developing countries. Obvious solutions proposed to address food security are increasing food production, reducing food waste, changing diets, and expanding aquaculture. These solutions, however, rely heavily on scientific and technological innovation, which in turn are dependent on national culture. National culture plays crucial roles in determining the levels of national innovation and in the changing of architectural landscape of a country's physical ecosystem. Since developing countries are mostly affected by food security, it is therefore, important, to understand the role of culture in the absorption of the innovations proposed to address food security. Without a proper consideration of national culture prior to developing and deploying innovations, the global strategy for food security will likely fail. We propose to study the relationship between food security and national culture worldwide. We will use a national food security index to proxy the country's level (or projected level) of food security. National culture will be determined using Hofstede's dimensions of Individualism, Masculinity, Uncertainty Avoidance, Power Distance, Long-term Orientation, and Indulgence. To the best of our knowledge, no other study has investigated the relationship proposed herein. Findings from the study will provide scholars, practitioners, and policy makers with the crucial cross-cultural context they need in making decisions related to food security.

Keywords: *National Culture, Food Security*

Institutional Arrangements of Agricultural Marketing Cooperatives in St. Lucia and its Impact on Value-Adding

Randel Esnard[1], Michael Lyne[2] and Kevin Old[3]

[1]Ministry of Agriculture in St. Lucia; [2]Associate Professor, Lincoln University, New Zealand; [3] Senior Lecturer, Lincoln University, New Zealand.

St. Lucia intends to privatise its marketing and processing parastatals, and expects agricultural cooperatives to play a much greater role in value-adding. This study examines the institutional, governance, group and management attributes of agricultural marketing cooperatives in St. Lucia and assess their impact on value added. Theoretical propositions relating these attributes and the level of value-adding observed were tested using a qualitative, multiple-case study approach. Four cooperatives with different levels of value-adding were purposefully selected for in-depth interviews. The results indicated that the cooperatives studied had very conservative institutional arrangements constraining their ability to finance and sustain value-adding activities. Value-adding performance was highest in the cooperative that marketed a single product, and low in the cooperatives that were unable to hold managers accountable for poor decisions, and which had not benefited from grant funding. The findings highlight the need for the cooperatives to hybridise their structure by issuing non-redeemable, tradable delivery rights and equity shares that carry limited or no voting rights if sold to non-patron members. Further, directors should retain the right to hire and terminate managers; managers should report to elected directors; elected directors should retain a voting majority on the board and elected directors should be nominated by shareholders. Finally, donor agencies should promote these governance arrangements in the cooperatives that they support.

Keywords: *St. Lucia, Agricultural Marketing Cooperatives, Institutional Arrangements, Value-Adding, Hybrid Cooperative Models*

Modelling Farmers' Perception and Knowledge and Willingness to Pay for Soil Testing Services in Northern Haiti

Sènakpon Kokoye, Joseph J. Molnar, Curtis M. Jolly, Dennis Shannon and Gobena Huluka

Department of Agricultural Economics and Rural Sociology, College of Agriculture, Auburn University, Auburn, Alabama

Soil testing in the prospect of taking relevant action for agricultural sustainability is one of the actions being implemented by the United States Agency for International Development (USAID) project in Northern Haiti. Using a structural equations model and choice model, this study investigates factors affecting farmers' perceptions and knowledge of soil testing benefits and fertilizers use in Northern Haiti. The soil testing benefits and knowledge on fertilizers use included the following: insufficient fertilization reduces plant growth, excess use of fertilizer leads to money loss, insufficient fertilization reduces crop yields. Soil tests help the producer to apply the right amount of fertilizer that will generate profits. Too much fertilizer pollute the environment. Knowledge about these items was collected using Likert scale. Data were collected from 452 farmers within 17 localities in Northern Haiti. The findings reveal that farmers currently have no or little knowledge of soil testing benefits but know better about fertilizer use. Factors such as farm size, participation in project, rice, banana, and cocoa growers, affect farmers' perceptions and knowledge of soil testing benefits. Factors affecting willingness include group membership, type of crops grown, whether farmer' land is on the slope, his farm size and whether he participates in the USAID project. Knowledge on fertilizer use is influenced by rice and banana growers, fertilizer use, participation in soil testing program and AVANSE/USAID. The effects of both latent variables are found to be positive but non-significant. As a policy implication of the study; farmers need training module to be better informed on soil testing benefits.

Keywords: *Soil Testing Benefits, Structural Equation Model, MIMIC Model, WTP, Theory of Planned Behavior, Hybrid Choice Model, Northern Haiti*

Integration of Scholarly Research, University Services and Experiential Learning Opportunities for Teaching Enhancement

Florence Cassel S.[1], Dave Goorahoo[1] and Govind Seepersad[2]

[1]Department of Plant Science, California State University, Fresno;
[2] The University of the West Indies, St. Augustine

In an effort to better prepare undergraduates for the multidisciplinary demands of the entry level management jobs in the agricultural sector, we explored a combination of experiential learning and entrepreneurship as part of our agriculture courses. In order to teach concepts of opportunity recognition, feasibility analysis and developing business models, students were allowed to participate in a series of workshops on the concepts of entrepreneurship for students in non-business classes. We share our experience of applying and integrating scholarly research and services into pedagogy to enhance students' learning. We focus on strong scientific foundation and relating complex concepts to real-life examples derived from research and outreach activities with various stakeholders and external collaborators, where students are directly involved and academically empowered. Another emphasis is student engagement with practical learning experience using the university farm and the water centers, as well as opportunities provided to students to interact with scientists and students from other universities and governmental agencies through field visits, guest lectures, workshops, conferences and publications. Post session surveys indicated that students unanimously found that the field experiences significantly impacted their thinking on the amount of time and labor required to complete various irrigation and fertilizer application related tasks, and overall they developed greater empathy for the challenges that growers encounter on a daily basis. In the case of the entrepreneurship exposure to one of the workshops dealing with the National Organic Program (NOP), more than 90% of the respondents indicated that they had improved their overall knowledge about the challenges and opportunities involved in organic trade.

Keywords: *Experiential Learning; Entrepreneurship; Service Learning; Teaching Enhancement*

Hearing versus Experiencing: The Impact of a Short-Term Study Abroad Experience in California on Students' Perceptions Regarding Globalization and Cultural Awareness

Videsh Mosodeen

The University of the West Indies, St. Augustine

This study examined the impact on learning outcomes of agricultural students participating in a short-term 8-day study abroad trip to California to experience globalization, agriculture and the environment. Pre- and post- questionnaires were completed by 8 students in terms of the changes in the knowledge and attitudes of the students and were determined by analyzing changes in their responses on the two occasions. Point Score Analysis and Paired data two tail T-tests were used to determine the significance of changes between the pre- and post- study abroad activities. It was found that the experience contributed significantly to the students' knowledge of California agriculture and environmental issues and to their understanding of the general nature of the global economy from their visits to large scale enterprises such as Tanimura and Antle. In contrast, the study abroad experience did not profoundly alter the students' cultural self-awareness and outlook on global political issues as they all indicated that they were knowledgeable of these issues prior to going to the United States of America. The most perceptible learning outcomes for students were not in globalization, agriculture or the environment because of their pre- expectations of the trip, but in the cultural and personal development of students. It was concluded that significant personal development can be achieved even on very short study abroad experiences.

***Keywords**: Study Abroad, Cultural Sensitivity, Personal Development, Globalization Internationalization*

Student Perceptions of International Education and Study Abroad: A Pilot Study at the Faculty of Food and Agriculture, UWI, Trinidad

Ashley Hines[1], Govind Seepersad[1], Wendy-Ann Isaac[1], Terry Sampson[1], Nequesha Dalrymple[1] and Dave Goorahoo[2]

[1] The University of the West Indies, St. Augustine; [2]Department of Plant Science, California State University, Fresno

International student mobility has been identified as a key strategy for the internationalization of higher education at the University of the West Indies, such that an entire Department was created for Institutional Advancement and Internationalization for both student and staff mobility. However, there have been very low levels of international student mobility, with only about < 1% of full-time university students participating in study-abroad programmes. This pilot study examined the value that agriculture students place on international education, their awareness of opportunities made available by the university, their attitudes toward, perceptions of, and preferences toward study abroad, and the institutional and individual factors that influence their intent to engage in study abroad. The study identified three distinct groups of students, those intending to study abroad, those unsure about their plans, and a third group who does not seek to pursue study abroad and the underlying factors influencing each group. In terms of applied value, the findings will inform curriculum developers on ways they can formulate a course on study abroad.

***Keywords**: International Education, International Mobility, Barriers*

The Effects of Climate Change and Aquaculture Production in Jamaica

Carel Ligeon[1] and Curtis M. Jolly[2]

[1]College of Public Policy and Justice at Auburn University Montgomery, Al; [2]Auburn University Montgomery, Al

Global warming is a real phenomenon that is expected to influence climate change in the world. Climate change (CC) is expected to generate temperature increases, sea level rise, increase and change in frequency of hurricanes and ocean acidification that are likely to devastate regional fisheries and aquaculture. The influence of CC on the ocean is expected to result in the lowering of quantity of fish caught and changes in migratory pattern of high value species. Fish consumers in Jamaica will become more dependent on aquaculture as a source of fish protein as the levels of ocean fish caught decrease. However, aquaculture will be affected by CC in the long run as temperature increases and rainfall become more erratic leading to floods or draughts that may affect aquaculture production on marginal lands. It is the common belief that aquaculture in Jamaica might not be greatly affected by CC since the dominant species, the Jamaica red tilapia is tolerant to temperature increases. However, given that temperature will increase by 0.7oF to 1.4oF per year, it is expected that aquaculture intensification will be affected in the long run. We use enterprise budget and a simulation technique to evaluate the effects of CC on aquaculture production in Jamaica for the period 2017 to 2050. Using different scenarios of CC we found that farm profitability will remain stable up to 2020 and then will begin to decrease because of increasing costs due to aeration and feed costs after the temperature attains a critical limit above 95oF degrees. Total production will first increase with temperature increases from 2017 to 2030 to about 5000 tons per annum, all things remaining constant. Then will production remain stable from 2030 to 2035 and then begin to decrease because of higher costs of inputs. Unless farmers adopt a new strategy of increasing the use of recirculating systems production is likely to fall less than 3000 tons. Hence government should provide access to credit to farmers who want to participate in production using the recirculating system. The recirculating system produces more fish per acre but requires higher levels of investments and technology.

Using Growing Degree Days to Estimate Crop Water Requirements for Processing Tomato

Touyee Thao, Florence Cassel S. and Dave Goorahoo

Department of Plant Science, California State University

California leads in the production of processing tomatoes in the U.S., most of which is concentrated in the Central Valley where irrigation provides the primary and often only water supply. Given the extent of tomato production in the state and its reliance on irrigation, it is critical to accurately estimate the crop water requirements (CWR) to optimize water applications and improve water use efficiency. CWR are most accurately determined through measurements of crop evapotranspiration (ETc) using precision weighing lysimeters. ETc generated by lysimeters can then be used to develop precise crop coefficients (Kc) that are needed for irrigation scheduling. Studies have suggested that Kc can be influenced by crop varieties and that expressing Kc as a function of growing degree days (GDD) can account for the climatic conditions of a specific growing season (heat units). Therefore, the objectives of this study were to: 1) determine the seasonal differences in ETc and Kc for processing tomato (Lycopersicon esculentum) grown over a three-year period; and 2) develop ETc and Kc curves as a function of both time and GDD. The study was conducted at the UC Westside Research and Extension Center lysimeter facilities in Five Points, CA. The results indicated that seasonal ETc amounted to 598 mm, 463 mm, and 407 mm in years 1, 2, and 3, respectively. Midseason Kc was slightly above 1.2 in year 1 and ranged from 0.75 to 0.88 in years 2-3. Daily GDD accumulation varied from 73 to 136 heat units among years. Maximum canopy cover was achieved at 84 DAT (1206 GDD units), 118 DAT (1638 GDD units), and 106 DAT (1434 GDD units) in years 1, 2, and 3, respectively.

Keywords: *Tomatoes; GDD; Evapotranspiration; Crop Coefficient; Lysimeters*

Leveraging Climate-Smart Agriculture for Sustainable Farming Livelihoods - A Caribbean Perspective

Tigerjeet Ballayram[1] and Martina Duncan[2]

[1]Conservation International-Guyana, [2]Food and Agriculture Organization

Over the past fifteen years approaches to food and nutrition security in the Caribbean have focused on formulating and implementing policies and related activities to address the key challenges to food availability, food access, consumption/utilization and the stability of these components or pillars of food security. Yet many segments of farming livelihoods in the region are at risk to food insecurity because they: (i) have limited livelihood assets; (ii) do not benefit from external risk management through policies, laws and regulations; and (iii) engage in livelihood activities that are affected negatively by shocks, trends and seasonality, and therefore lack the resilience to sustain their livelihoods above a given food security threshold should an event such as a natural disaster or economic shock were to occur. Climate Smart Agriculture (CSA) was proposed by the FAO in 2010 to address food insecurity and the effects of climate change. While there has been a rapid uptake of the term CSA by international and national agencies, implementing this approach has not proceeded with the same enthusiasm. The paper demonstrates that Climate-Smart-Agriculture (CSA) is one way of building resilience to the effects of climate change. The approach seeks to articulate the technical, policy and investment conditions to facilitate the implementation of CSA, thereby contributing towards achieving sustainable agricultural development for food security under climate change. Finally, the paper supports the focus and refinements of the CSA approach to advance the food and nutrition security agenda, and provides arguments for its implementation in the Caribbean.

Keywords: *Climate Smart Agriculture; Food Security*

Determination of the Impact of Agricultural Policies on Greenhouse Gas Emissions in Latin America and the Caribbean

Srini Konduru[1], Pei Xu[1], Dave Goorahoo[1] and Govind Seepersad[2]

[1]California State University, Fresno; [2]University of West Indies, Trinidad & Tobago

This paper utilizes data from agricultural support estimates in the IDB Agrimonitor database and Greenhouse Gas Emissions (GHG emissions in CO2 equivalents) from the FAOSTAT database to determine the relationship between agricultural policies and GHG emissions in the agricultural sectors of various Latin American and Caribbean countries. The analysis is expected to show whether the protection given to the agricultural sectors by respective countries leads to more GHG emissions from those countries. This study follows the methodology used in a report published on Jamaican Agriculture (Josling, 2016). Although the analysis in this paper does not take into consideration many other factors impacting GHG emissions, the results from this paper can open up opportunities for more detailed research. The analysis also shows the mitigating effects of sustainable agricultural practices on GHG emissions from the agricultural sectors of the countries in Latin America and the Caribbean.

Keywords: *Agricultural Policy, Greenhouse Gas Emissions, Climate Change*

Optimizing Crop Water Use Efficiency by Recycling Carbon Dioxide Emissions

Florence Cassel S., Dave Goorahoo, Shawn Ashkan and Bardia Dehghanmanshadi

Department of Plant Science, California State University, Fresno

Climate change, air quality, water scarcity, and energy security are important political, environmental, and agricultural issues all over the world. Global warming is linked to increases in anthropogenic greenhouse gas concentrations, largely carbon dioxide (CO2). These CO2 emissions will be vented directly into the atmosphere if not captured and sequestered. A novel use of these emissions could be found in the agricultural sector since CO2 is the primary component of photosynthesis and therefore plant growth. Numerous experiments have examined the beneficial effects of CO2 enrichment on crop production, and have verified enhanced crop yield and water use efficiency (WUE). The goal of our current research was to develop a CO2 application program aimed at delivering CO2 cost-effectively vegetable crops. Tomatoes were grown on a sandy loam soil within sixteen open-top chambers (15ft W x 5ft L x 10ft H). Half of the chambers received ambient air and the other half were subjected to elevated CO2. For the CO2 enriched plots, mean daily CO2 levels within the crop canopy was around 600 ppm during the 8 hours of application, whereas concentrations in the ambient plots averaged around 390 ppm. Subsurface drip irrigation was used to apply water at rates equivalent to 100% the evapotranspiration (ET) and 80% ET. Elevated CO2 increased the yield of harvestable fresh market tomatoes. Irrigation treatments did not have any significant effect on plant height and above ground biomass. However, elevated CO2 had positive effects on plant height, above ground biomass, and root weight. These results are very encouraging as we continue to evaluate the productivity, quality and WUE of tomato crop subjected to elevated CO2. More importantly, the current research highlights the potential of using agronomic crops to capture and utilize CO2 emissions, as much as 80% of the crop biomass is ultimately incorporated into the soil after harvest of the marketable product.

Keywords: *Water Use Efficiency; Tomatoes; Carbon Dioxide; Global Warming.*