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At the Sanming Forest Ecosystem and Global Change Research Station in Fujian, China, scientists and researchers from various fields have gathered to utilize experimental plots designed as mesocosm studies and in-field sampling and monitoring stations to study forest hydrological change, forest carbon management, and future global change. The Sanming facility is the result of collaboration between the University of Hawaii (UH) at Hilo’s Associate Professor Yiqing Li and the Fujian Normal University School of Geographical Science in Fuzhou. Dr. Li and his research partnerships in the Fujian Province made it possible for Erin Busch, a Tropical Conservation Biology & Environmental Studies graduate student and teaching assistant for Ag 230, and Tim Zimmerman, an Ag Major, to explore the approaches another university is taking to study their own tropical ecosystems. In many ways tropical environments and associated geochemical processes are behind the curve in our overall understanding of how all ecosystems work. In particular, debate surrounds how tropical environments are impacted and changed by certain internal and external influences. Part of the problem is that there are few studies on primarily tropical environments, such as those found in Hawai‘i, and even then, findings and specific influences can be difficult to interpret as they are dependent on the many natural differences between study sites.

Sanming’s experimental plots incorporate factors such as changes to precipitation patterns, erosion, nutrient loads, soil and air temperature, plant growth and composition, and litter composition. The visiting students were able to collect and test soil samples for a study about the long-term effects that warming and nitrogen addition would have on microbial composition and enzyme production. They ran analysis on soil samples including Phospholipid fatty acid analysis (PLFA), dissolved organic nitrogen, carbon fractionation, and enzyme analysis in one of the many laboratories at Fujian Normal University School of Geographical Science in Fuzhou. The visiting students worked with local students, developing relationships across cultural and language barriers. They were also able to meet professors from other universities to discuss different methods in study design, observe sample processing and analysis, as well as explore writing and formatting scientific articles journal publications. (Continued in page 7)
Guizhou Academy of Agricultural Sciences Enters a Collaborative Research with CAFNRM

By Dr. Christopher D. Lu

Upon invitation, Professor Christopher Lu visited Institute of Animal Husbandry and Veterinary Medicine of Guizhou Academy of Agricultural Sciences during the summer of 2016. Dr. Lu presented an invited paper entitled “Overview of Global Meat Goat Industry”. There are approximately one billion goats in the world, mostly for meat purposes. The top ten countries with the largest goat populations are China, India, Pakistan, Nigeria, Bangladesh, Sudan, Kenya, Ethiopia, Iran, and Mali. There are about three million goats in the United States with a continued increasing trend since 1980’s. Dr. Lu discussed the history, anatomy, behavior and diseases of meat goats. He also covered major breeds of meat goats such as Boer, Spanish, San Clemente, Pygmy, Arapawa and interesting breed such as Tennessee Fainting goats. The “fainting” is due to a genetic neuromuscular disorder called myotonia congenita that affects the muscle movement when startled. It was theorized that the goats were used when traveling to protect the herd. When a predator is chasing the herd the fainting goats will be targeted and sacrificed, allowing the herd to escape. They attract interest because of the increased muscle mass as a result of the stiffening of the legs. Role and implication of meat goats in biological control of weeds, mixed grazing, heat stress resistant, efficient water utilization, environmental adaptation, and production potential were also discussed. Dr. Lu emphasized the importance of nutrition, reproduction, genetic and breeding, disease control, integrated production systems, and packaging and marketing for a successful meat goat enterprise. Dr. Lu cautioned the audiences on the potential environmental cost of meat goat production such as greenhouse gas emission, waste management, and deforestation and overgrazing, but pointed out the potential of meat goat production in the alleviation of poverty, economic development in marginal land and meeting the demand of ethnic groups.

He suggested that performance testing is an important tool to improve the production efficiency in meat goats.

Guizhou Institute of Animal Husbandry and Veterinary Medicine is a growing research organization and aspires to the transformation of being more internationally visible. The Institute has a long research and extension history and is in the process of constructing a new campus due to urban expansion. It works with important livestock and poultry species in the Guizhou Province of China. Because of a wide range of availability of natural plant species in the largely mountainous terrain in the Guizhou Province, meat goat production holds an important economic role in rural development and poverty alleviation. To further their objectives, Guizhou Institute of Animal Husbandry and Veterinary Medicine signed an agreement with College of Agriculture, Forestry and Natural Resource Management of University of Hawaii at Hilo. The agreement encompasses: (1) implement cooperative research activities on breeding, management and reproductive technology, disease control and prevention, biological control technology, nutrition, nutrigenomics and molecular biology; (2) support exchange of researchers and students; and (3) jointly apply for international collaborative projects from the Chinese Government. A Chinese news release can be accessed at: http://www.gzxms.cn/News/ShowDetail/5833. Accompanied by Professor Gongyi Xu of Sechuan Agricultural University and others, Dr. Lu visited several goat operations in Sechuan, Guizhou and Guangxi provinces. Most notable are one organic goat operation using bioactive plants to control disease, one extensive goat operation leveraging browsing, and one goat operation that improves and maintains the landscape diversity. To conform to organic standards and avoid using chemicals, one goat operation utilizes the abundant bioactive plants that have been used as Chinese medicine for centuries.
Crop of the Month: Macadamia Nut *(Macadamia integrifolia)* Kea’au 660

*By Damon Adamson*

Hailing from southern Queensland and northern New South Wales on the continent of Australia and belonging to the Proteaceae family, first imported into Hawaii in 1882 by William H. Purvis. Purvis, the young manager of the Pacific Sugar Mill at Kukuihaele on the Big Island, planted seeds that year at Kapulena. Though many species exist of *Macadamia* ssp., only two species produce kernels or nuts that are edible in their raw form; *Macadamia integrifolia* and *Macadamia tetraphylla*. Generally, both tree species grow medium to large (40-60 ft with very mature trees), produce lengthy green leaves, and make for very attractive orchard specimens. While many traits are similar, between the two species, it is *M. integrifolia* that is the most important as a tree crop macadamia due to its likability and preference by individuals across the globe.

Sub-species Kea’au (660), according to Richard A. Hamilton, Professor Emeritus of Horticulture, College of Tropical Agriculture and Human Resources, University of Hawaii (CTAHR) was selected in 1948 and named in 1966. It has an upright growth habit, allowing somewhat closer planting than varieties with more spreading trees. ‘Keau’u has outstanding nut and kernel characteristics, with 42 to 46 percent kernel; more than 95 percent of its kernels are grade 1. Kea’au trees have performed well in most areas where this variety has been tested.

The singular seed, rarely double, boasts an extremely hard shell accompanied by an outer husk. The singular seed or kernel is pale in color, smooth, and circular in shape unlike s, *M. tetraphylla*, which produces slightly spindle shaped nuts. Nutritionally, the kernel yields a powerhouse of beneficial vitamins and minerals such as significant levels of vitamin B6, manganese, iron, iron, magnesium and protein. Additionally, like all nuts, macadamia, are noted for higher fat levels. The kernel is enclosed within a round shell usually between 0.6 to 1.1 inches in size which is enclosed in a husk outershell. The slightly pointed leaves are medium in length (150-200mm) with a slightly undulating margin, narrow, has few spines and a long petiole. A moderate to dense canopy which can yield high production rates. Flowers have medium to long racemes (150-200mm), are highly concentrated, and have variable timing and bunch numbers. It is prone to early nut drop and generally tends to germinate in wetter conditions. Many commercial orchards maintain the practice of utilizing *M. tetraphylla* as a rootstock for propagation of *M. Integrifolia*, though both stocks are viable. *M. Tetraphylla* is suggested to be preferred for its ability to germinate uniformly, grow faster, and are considered somewhat easier to graft and transplant. There is, however, a possible problem whenever *M. Tetraphylla* seedlings are used as rootstocks for *M. Integrifolia* varieties. The trunk of *M. Integrifolia* varieties sometimes grows faster and increases in diameter more rapidly than the *M. tetraphylla* rootstock.

Happy growing…

Source: nwww.ctahr.hawaii.edu
Unlocking Hawaii’s Food Production Potential is Likely to Remain a Slow March Forward

By: Dr. Bruce Mathews

While there have been calls for at least 50 years for the State of Hawai‘i to improve its food self-sufficiency and hence food security, the progress to reduce dependence on imports has been painfully slow. This being said, community interest in increasing locally grown food is rapidly expanding. However, interest alone will not be sufficient to turn the dial substantially without major changes in consumer behavior or extreme market distortions.

Economies of Scale

In order to be competitive one needs to be farming at an economy of scale and price point differentials that work, particularly when the competition is imported from continent based mega-farms. Even in Hawai‘i the entrepreneurial produce farmer success stories that are most often mentioned tend to be on the larger side. It takes a unique mix of entrepreneurial skills, hard work, and capital access to make a decent middle class living let alone a small fortune as a family farmer. Locally grown produce may become more competitive as continental growers deal with increasing water costs and climate change.

The gradual transition from plantation agriculture to small family farms in Hawai‘i has not been easy. Many small family farms have tended to be on a roller coaster because of challenges in providing a relatively stable middle class lifestyle even when they are multi-income families. Farming is a tough profession with plenty of risks and it is common to see small farms with lots of starts, stops, and changes in players. We also have a poor track history in Hawai‘i of our small farmers uniting in cooperatives to better position themselves in the marketplace, access inputs more reasonably in terms of purchasing power, and to comply with food safety standard expectations and regulations. Hawaii’s outer island farmers need scale to fill shipping containers in order for transportation costs to the large Honolulu markets to be more reasonable and cooperatives could also help in this regard.

Near Term Opportunities

A lot of people talk about potential of the organic sector which presently comprises approximately 4% of Hawaii’s agriculture. Increased local organic production, particularly for leafy greens and beans/pulse crops would also mean reduced risk of imported pests that are more common on organic produce. Some challenges that are associated with organically grown in Hawai‘i include i) limited local and reasonably prices sources of manures and crop/biomass residues for quality composts, ii) high cost of the most effective imported fertilizer and pest/disease control products approved for organic farming, iii) green manures/crop rotation strategies which work well with our soil and environmental conditions in terms of nutrient release synchrony and breaking pest/disease cycles, iv) often immense challenges with weeds, and v) an apparent unwillingness of most residents to pay much of a locally produced price premium for organic. Organic production in Hawai‘i has a long way to go before the deliverables begin to match the constant advocacy. Furthermore, as was discovered by Hawaii’s agronomists and horticulturalists during the early 1900s many of our inherent soil fertility constraints and environmental conditions are no Garden of Eden panacea for commercial scale organic farming (for example, see articles published in the Hawaiian Planters’ Record prior to the 1930s when chemical fertilizer use started to expand rapidly).

There is little doubt that with proper economies of scale that there are still opportunities for growing fruit crops such as banana, pineapple, mango, avocados, specialty fruits, etc. for local consumption however there are immense risks as well. There is also a solid export market for sweet potatoes grown along the Hilo-Hamakua Coast of the Island of Hawai‘i. While there is a need to grow sweet potato in rotations to minimize disease and pest problems the superior soil physical properties of the Hydrudand soils in the region are ideal for good yields and quality with proper soil fertility management.

The Replacement Carbohydrate Issue and Food Security

It is well known from experts in multiple disciplines that no island society/nation state is secure in the event of an isolation crisis such as “the boats stop coming scenario” unless the islands are producing about 70% of their staple carbohydrates at the time they are cut off.

Continued next page
Dean’s Corner continued...

Given it is highly unlikely that Hawai‘i is going to start producing food grain crops like rice again some people are advocating for local dietary replacement with breadfruit and root crops such as sweet potato, taro, cassava, etc. Changing consumer preferences will be a long hard slog. Furthermore, the price points for breadfruit and root crop-derived flours are likely to be prohibitive, let alone the production scale to capitalize a processing operation.

Indeed value-added product development has been talked about for decades as a means to increase the proportion of local crop production that is not discarded and as a means to increase income of farmer entrepreneurs. While we should continue to explore the feasibility of value-added options the production scale and consistency of supply often becomes an issue with respect to attracting meaningful investment in processing facilities.

Research and Education for Hawaii’s Agriculture

Farmers often tell us that they are concerned that other places in the world have made dramatic advances in production optimization and precision agriculture technologies. They also tell us that we need to better ensure that a higher percentage of college graduates are really farm ready in terms of relevant skill sets and have the desire and required work ethic to make it in farming. We can do better however we need support.

There is no doubt that the University of Hawai‘i System, the Hawai‘i Department of Agriculture (HDOA), and the Pacific Basin Agricultural Research Center (PBARC) of USDA have funding limitations and other challenges that impact the capacity of their agriculture programs. People need to recognize that the volatile “boom-and-bust” research spending cycles dependent nearly entirely on grants and donors is highly inefficient and tends to be counterproductive because they interfere with the planning, conduct, timely and flexible responses during crises, and overall efficacy of research (i.e. no long-term studies and less than optimal coordination).

Furthermore, states that rely too heavily on external funding for agricultural research risk having their research agendas diverted from local priorities. In this case salaried employees are inefficiently utilized and the morale of both the staff and the local clientele can be negatively impacted.

The governments and private sector of China, India, and Brazil have increasingly recognized the need for long-term investment in agriculture and now account for nearly half the research and development investment in this sector and most of the tropical/subtropical agricultural work. In order to compete and deal with environmental challenges (including new crop pests and diseases driven in part by climate change) Hawai‘i farmers need far greater investment in locally relevant agricultural science and technology.

While Hawaii’s agriculture no longer has the influence it did during the sugarcane and pineapple plantation era we can no longer retreat and behave like investment in local agriculture is rather futile. Creativity, innovation, and flexibility are key to capture opportunities and address current needs and future challenges. The University of Florida’s Institute of Food and Agricultural Science (IFAS) and their College of Agriculture and Life Sciences (CALS) just received significant funding from the Florida Legislature after much pleading by stakeholders (farmers, researchers, educators, students, food activists, etc.) to improve their technical capacity in subtropical agricultural teaching, research, and extension in an interdisciplinary format. The funds included allocations to renovate facilities/labs and hire some pre-eminent globally recognized scholars in areas deemed strategic for near-term revitalization of Florida agriculture, and a host of early career PhDs with demonstrated potential. While there are no guarantees in terms of outcomes this is refreshing development when so many states seem to be driving public university programmatic and hiring priorities in line with potential tuition revenue and grant dollars. In the present era the ability of agricultural science to attract high enrollments similar to many of the social science disciplines is unrealistic however the university agricultural programs need to change as was recently detailed by agronomist and nature journalist Joel Bourne, Jr. in his 2015 book entitled The End of Plenty: The Race to Feed a Crowded World. Bourne indicates that too many agricultural programs overly emphasize reductionist biology, wear chemical blinders, and are either unwilling or unable to provide students with sound comparative sustainability analysis of various agricultural production systems. This leads to students changing majors or graduating bored with degrees they no longer believe in. Furthermore, similar to the health science areas there is no way around the fact that there are greater inherent costs in offering quality agricultural programs. Societal good and longer term consequences somehow need to be better factored into the decision making processes with respect to agriculture. Growth in agritourism can improve awareness of the food system.

Agriculture Graduates – Beyond the Romance and Rhetoric

It is easy to forget that many of our successful farmers in Hawai‘i had other careers, eventually dabbled in farming, and then moved to full time farming.

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First identified in Hawai‘i, North Kona specifically, in 1988, with consequential studies conducted in the early 1990’s. Initial studies determined the Tropical Nut Borer (TNB) only affecting Western Hawai‘i island and with no other reports from Maui, Oahu, or Kauai. Within just a few years TNB was found on all islands throughout the state, creating a significant threshold on Macadamia Nut production and proceeds. University of Hawai‘i studies conducted in the 1990’s suggested a larger impact on orchards within dryer climates versus consistently wetter areas.

TNB’s ability to fly accompanied with their small size, adult is approx. 1mm, allowing mild winds to assist in disbursement across larger areas. However, the rapid spread of TNB was probably aided by the purchasing of unshelled nuts from infested areas. In addition, the benefits of using husks as fertilizer resulted in some growers buying husks from processors or husking plants and inadvertently spreading infested husks in their orchards. From the distribution and damage experienced in the drier infested areas, it is clear that TNB will continue to be a serious pest of macadamia. The damage from TNB is considered substantial, while its life cycle adapts well to established macadamia production practices.

The life cycle of TNB begins as deposited oblong eggs within the macadamia nut fruit husk or kernel measuring 0.03 inches long by 0.01 inches wide. They have an opaque coloration and have within a week of being laid. 2 larval stages follow hatching, where they grow and eat through the surrounding area which they were laid, husk or kernel.

Three to four weeks later the beetles enter their pupal stage where they rest and grow to 0.04 to 0.07 inches, depending on sex-females tend to be larger. This stage lasts approximately one week. After its transformation, the adult beetle, brownish in color, is capable of laying eggs. Studies have found that eggs average about one to eight, male to female respectfully, which can easily decimate an orchard in a short period.

No single method of TNB control has been determined work in all situations; therefore, an IPM program requires the use of several methods and their usefulness depends on farm size and the economics of the operation. For these methods to be most effective, they need to be undertaken while considering several key factors:

1. TNB reproduces primarily within nuts that have been on the ground for more than two to three weeks.

2. TNB can fly/ drift more than 200 yards away from an infested area into a new area within three to four weeks.

3. An infected nut husk can shelter in excess of 100 beetles.

Remember, TNB reproduction and damage continues while nuts are within the harvest bags. Damaged nuts should not be left in the orchard and should be removed and destroyed by burning, composting, burying, or transporting them to the dump. Finally, do not buy raw husk for composting around your home or orchard.

Happy gardening… www.ctahr.hawaii.edu
Guizhou Academy continued...

They use water to dissolve bioactive compounds and deliver to goats as a supplemental drinking. The herd was in a remote mountain village and is one of the most well cared goat herds that I have ever seen around the world. Another herd, leveraging unique browsing ability of goats, is able to achieve an excellent productive performance without grain supplementation. I saw goats, the only ruminant to climb the trees, utilized their browsing skills with mobile upper lip, prehensile tongue and agile front legs to acquire the most nutritious part of plants. During a trip across the mountainous terrain, Dr. Lu and the group reached a mountaintop that afforded them to witness the difference goats could make in maintaining the diversity of plant species. In contrast to the adjacent area that is dominant by certain weed species without goats, the area browsed and grazed by goats has a distinct even growth among plant species. Dr. Lu also spent time reviewing research progress with Professor Xu and graduate students at Sechuan Agricultural University.

Dean’s Corner continued...

Society needs to get over the notion that a substantial number of our agricultural graduates are going to go straight into farming (unless their families already have the resources to farm or they can partner with an existing farm) and grow the diversified crops that have been the post plantation era mainstays (sweet potato, papaya, coffee, etc.) or venture into new crops. It is rare to find an entrepreneurial agriculture student who plans to lease land and take on major start-up debt to farm straight out of college. A few do it however it is not ever on the radar screen for most. In a large part it comes down to the risks and workload versus the rewards (including lifestyle) and most will opt for more immediately stable income options and regular work days than being a potentially high stress beginning farmer. The factors influencing economically viable farming in Hawaiʻi are multifaceted and best discussed by agricultural economists, agricultural policy, and rural development experts. Their analyses need to be taken into consideration as well as the viewpoints of the concerned stakeholders.

CAFNRM’s Dr. Yqing Li continued…

Dr. Li’s contribution to the design of the Sanming facilities and continued research provided an incredible opportunity for visiting students to observe long-term experimental plots and field studies, be exposed to laboratory equipment and procedures not commonly available to people within the UH system, and even run a few analyses based upon their own researched hypothesis. The students were also able to learn about and share cultural experiences and perspectives with the students and hosts at the university, and view important ecological and historical sites. The summer experience was intense, but highly fulfilling and incredibly valuable, and the students are excited for future possibilities in collaboration and creating a larger knowledge-sharing base. This opportunity is highly recommended to other students who are studying anything within or related to tropical hydrology, forest ecosystems, geology, wetlands, soil microbiology, sustainable forestry, climate change, and conservation.
"Sustainability" is a property of social and biological systems that can remain active and functioning for long periods of time without depleting their resources or causing damage to their surroundings.

This concept has become more widely recognized in recent times. A big landmark was "The Limits to Growth", a report on simulations of global population, environment and resources from the early 1970's showing a serious collapse of human population and standard of living, unless measures like a reduction in fertility rate and better care of the environment were adopted. In the late 1980's "Our Common Future" (also known as the Brundtland Report, produced by the United Nations) discussed development and environment as closely related issues, and presented a blueprint for sustainable development. At present time in time credible threats exist to our way of life: climate change, rising ocean levels, species extinctions, mercury and pesticides everywhere, and the foreseeable depletion of fossil fuels and quite a few rare minerals used in technological applications.

But in addition to these global problems, there are issues and situations of local concern. We live in a very isolated island with great challenges and opportunities. Among the first, very few nonrenewable resources (we have no fossil fuels), large transportation costs and the possibility of many natural disasters (earthquakes, tsunamis, hurricanes, droughts...) Among the latter, lots of surface to raise crops and the possibility of wind, solar, ocean-based and geothermal energy.

It is with the latter motivation that I was asked to develop the curriculum for an Energy Science certificate. Our state wants to switch entirely to renewable energy generation by 2045. UH campuses are under pressure to become more energy efficient and conduct energy audits in a much shorter time frame.

As part of energy curriculum development, I spent last Spring Break at the Arizona State University campus, as we have a potential partner there. That campus has both an Institute and a School of Sustainability - the former focusing on research, and the second on teaching.

During that week I met with numerous faculty members and administrators and visited some of their lab facilities. ASU is a huge campus, both in terms of physical space and number of students (around 80 thousand). There is strength in numbers: the School has faculty with an appointment in sustainability, but also affiliate faculty from engineering, business, law, geography and the biosciences that gives it a very diverse flavor. The same can be said for the Institute. During my week at ASU I was able to visit one of the largest algae research facilities in the country. I learned that extracting energy from the sun using algae is not economically viable, but if the algae are used for something additional (such as producing medicinal compounds) the situation is more attractive. I also visited a lab where they are using bacteria to extract electrical energy out of waste.

On the curricular side, I talked to the people who are teaching similar courses to those we are starting to offer at UH Hilo. I gained many insights on how to conduct the courses and what material to include. I did find out they do not have a dedicated Energy Lab course as we are planning - making it both a challenge and an opportunity for us.

I came from ASU with a renewed sense of confidence in the future of our own program, and full of ideas and enthusiasm. Hopefully some of you will decide to take our courses (they will be listed under the ENGR alpha).
For a solution to be truly sustainable, it must have a positive return to environment and society. This semester, Professor Norman Arancon has introduced a course that is structured and provided opportunity to do just that. Professor Arancon has designed his course, Ag 294 (Agricultural Waste Management: Composting and Vermicomposting) as a co-curricular organization, to take lead on a pilot waste management program on our UH Hilo Campus.

The pilot program was first introduced in 2009 by Ag Club, led by Jesse Potter. It has generated a lot of support and interest from the succeeding students in Ag Club and UHHSA. Last semester the sustainability committee of UHHSA took the lead in collecting post-consumer food wastes from the UH Hilo dining hall and composting these resource into valuable soil amendments to support the gardens around the campus. This semester, we are hoping to bring the program to the next level: Establishing an efficient sustainable system to manage the organic waste on our campus that can be adopted each semester at no additional cost. Professor Arancon’s class, composed of 15 students, is currently focused on maintaining the compost and vermicompost sites by the Agriculture Building along with collecting organic waste from the newly introduced collection stations around campus. With the collaboration between Professor Arancon’s students, the support of the UH Hilo’s Sustainability Committee chair, Dr. Ryan Perroy, and the approval and assistance from Kolin Kettleson in auxiliary services, a total of six collection stations have been integrated on campus where all students and faculty can participate in sustainable efforts; 1 Station in UCB, 3 Stations in Campus Plaza, and 3 stations on the library lanai. The stations include 4 bins: Hi-5, Trash, Compost and Paper Waste. The blue recycle bins (Hi-5) are maintained by Professor Lorna Tsutsumi and her crew. Professor Arancon’s students collect the compost material twice a week and add it to the composting sites accordingly while maintaining the temperature and nutrient content at favorable levels. The cooperation and participation between faculty and students has allowed this pilot program to begin smooth sailing. Any students interested in learning more about the project or want to get involved, participation throughout the entire Agriculture department and campus is encouraged and valued. Stop by CAB 201 Tuesday’s and Thursday’s at 12:00pm to learn more or email Alexis Stubbs (alexis33@hawaii.edu) for more information and for volunteer opportunities.
SNAP SHOTS: “A photograph is worth a thousand words”. This section features some of faculty, staff and students of CAFNRM in the classroom, laboratory and field.