

VJ. HAWAIIAN PACIFIC AGRIC. (2006) Page 3
**The Coming Paradigm Shift: Sustainable Agriculture,
Natural Resources, and the Future**
William W. M. Steiner
CAFNRM, University of Hawai'i-Hilo

A CONTINUING TRADITION

As the new Dean of the College of Agriculture, Forestry and Natural Resource Management, may I welcome you the reader to the reinstatement of the CAFNRM publication, Pacific Agriculture. After a hiatus of many months as we sought a new editor, we are happy to be bringing this publication to you once again, thanks to the care and vision of our new editor, Lorna Tsutsumi. Previously, this journal played an important part in disseminating quality information to the growers, ranchers and farmers in the central Pacific area and around the Pacific Rim. We wish to continue the tradition established in the past and seek our reader's input and help to make this journal even more important. Reinstatement of publication comes at a time when challenges face the region that did not exist a decade ago. These are related to threats brought on by global climate warming, shortages in fuel supplies that are driving energy prices upward and potential economic impacts brought on by mismatches in trade agreements, limited resources, the failure to recognize the value of culturally-based economies, and dependence on ephemeral income bases that are in turn dependent on the price of oil.

WHAT ARE THE NEW CHALLENGES TO INSULAR RESOURCES?

Probably the most immediate threat to island survival is an over-reliance on foreign energy sources. The impacts are immediate, as we have witnessed in the past five years. Although we intuitively but sometimes explicitly have been warned that oil shortages would some day catch up with the United States' ravenous appetite (we consume 25% of the world's production and import 60% of our current need), nothing substantial has been done to avert the problem (e.g. what do we have to show for the \$millions spent to develop alternative energy sources, and indeed what has happened to these programs?!).

But the time appears now to be upon us. The US Geological Survey, the International Energy Institute, The Association for the Study of Peak Oil (ASPO) among others have produced statistics that clearly demonstrate we have reached or are about to reach peak oil production which is that point at which oil production and discovery is below replacement values as we use the resource up. For example, a recent review on oil reserves edited by Chris Skrebowski (Oil and Gas Journal) shows reserves declining 4-6%/year worldwide; the eight largest producers are all declining including Saudi Arabia (by far the largest) and 32 of the smaller producers such as Indonesia are as well. The United States peaked in 1970. About 80% of oil is produced from fields discovered prior to 1970 and no major discoveries have been made since the 1960s. In

fact, PEMEX of Mexico recently stated their reserves were over estimated by as much as 30%, and the new highly touted fields in the Caspian Sea have seen 3 major oil producers bail out of the association to produce oil there in the past year, suggesting all is not as it seems.

Estimates clearly show that new drilling is no longer recognizing new, large oil reserves. They demonstrate that the depth at which oil is being found has almost doubled over the past twenty years mostly because shallower wells do not prove productive. They show that we are seeking oil now in difficult to reach places not previously exploited because of their remoteness (e.g. 10,000 feet below the sea in the Gulf of Mexico). And, new energy consumers representing over half the world's population in India and China are coming on line, consuming more and more of the worlds existing oil resources and having the potential, as their industries enter the competition of the world market, to displace the United States as the primary consumer. Oil use in China, now the second largest consumer behind the United States, jumped 17% from 2004 to 2005 and is expected to double by 2020 while India will increase its use 30% by 2010. Today the world produces 80 million barrels of oil a day and by 2035 (30 years away!) we will need 160 mbg/d.

Clearly, a crisis in sustainability is coming and the only question is when will it arrive? The IEA World Energy Outlook (2005) predicts 2030 as the peak oil year summed across all fields while ASPO predicts 2008-2010 (ASPO assumes we can not trust estimates by Middle Eastern countries because even while the claiming huge reserves for fields like the Ghewar reserve in Saudi Arabia, we now know declining oil production was occurring there, and because OPEC countries have never reported draw down of their reserves). The Peak Oil Netherlands Foundation (PONL: 2005 "World Oil Production and Peaking Outlook", Stichting Peakoil-Nederland)) has produced a table summarizing estimates by various experts (Table 1 modified from the original). PONL believes that by 2020 we can expect demand for oil to not be met, that competition for oil reserves will heat up resulting in higher conflict in countries with large reserves, that most governments have not even begun to face the problem yet and likely will not for the next 5 – 10 years and that oil shortages will change society as we know it.

Table 1: Projected years of peak oil by various experts in the field averaged within group. The numbers in parentheses refer to the number of experts, companies, firms, groups, etc. estimating.

AVERAGED SOURCE	YEAR	COMMENT
Individual Experts (12)	2011	highest and lowest projections removed
Oil Companies (4)	2022	BP removed for lack of projection
Governments (2)	2030	Only France and Netherlands have projected
Oil Analyst Firms (4)	2021	
Energy Advisory Groups (6)	2024	
Automobile Companies (2)	2012	Volvo and Ford have made projections

THE IMPACT ON INSULAR ECONOMIES

Hawaii can serve as an example of how insular economies might be impacted as oil prices continue to climb over the next decade. We recently have seen some measure of this in impacts on food, housing, tourism, and agricultural activity. But we can also expect to see secondary effects with respect to effective utilization of limited island forests, the failure to protect natural resources, effective use of agricultural lands already being taken out of production to develop new housing tracts, and importance of cultural environments. For one thing, we the consumer will be expected to offset the increasing costs of food, housing and transportation as oil prices ramp upward over the next two decades. Virtually everything we consume from what we eat, wear and play with to what we use to conduct our daily business and the tools we need to do so will rise in cost. At some point, our island economies will not be able to handle this cost any longer. That is the point at which collapse will come unless governing bodies find ways to institute supporting subsidies, unlikely to happen since the impact of increased energy costs will not be isolated.

WHAT CAN WE DO TO MEET THESE NEW CHALLENGES?

What is certain is that we can expect to see serious paradigm shifts in the way we conduct our day- to-day activities in our island states, territories and nations. No longer will we have access to inexpensive energy to move ourselves and our goods. No longer can we rely on our beautiful island environments to attract dollars through tourism (one estimate I have seen suggests that when oil reaches \$100/barrel, the cost of an economy roundtrip air ticket to Hawaii will exceed \$5,100 effectively reducing travel to vacation in Hawaii by 80%). Hawaii imports more than 80% of its food and more than 90% of its wood products; the impact on food and housing will be dramatic and felt by all. Perhaps the good side of this might be a return of productive land to agriculture since the businesses based on tourism will no longer be viable. In other words, jobs will disappear as the economy also passes through the paradigm shift causing people to move back to the mainland in search for broader based economies that can supply satisfactory and more self-sufficient jobs.

This is where sustainable agriculture enters the picture. Universities and Colleges throughout the Pacific basin which have agriculture and natural resource focal studies will now have renewed meaning and purpose. Those that do not will soon see shifts toward programs that will build sustainability into local food production systems. Chain food stores (Safeway, Foodland, etc.) will either have to begin purchasing locally or will withdraw there business efforts and consolidate in mainland areas where transportation costs do not drive customer base charges. This means the future will look very strong for the small farmer because production costs that are energy dependent will not be economically favorable.

In this kind of environment, the small farmer will flourish as will diversified farming. This means there are a number of challenges facing us in the not to distant future to enable

us to shift to sustainable practices. Shipping agriculture products overseas will no longer be a viable exercise, commodity driven pricing will become a thing of the past since reliance on local production systems is likely to grow. Developing local markets will be important for small farmers, as will support systems to reduce impacts of pests and increase production on small agriculture lots. The local market will drive food prices, not overseas demand. Because it takes energy to refrigerate perishable goods as well as transport it, economies of scale will be reduced in value because pricing will not be able to make up for the cost involved. Engineers and island planners will be faced with developing low-cost, intra and inter-island transportation systems. Effective systems might even bring some support to long distance shipping (one envisions the return of sail power). Perhaps we will see a return to natural-powered systems such as wind driven ships that only use oil based energy within harbors to locate and dock. Inexpensive electrical systems not derived from oil will be all important. These kinds of changes indicate that development of crops that deliver green-based energy will grow in importance, as will design and development of production facilities to deliver that energy to the consumer. Again, major roles for agriculture and forestry can be seen here. And we should not play down our natural resource communities on each Pacific island.

Pacific island cultures developed in balance with what was available to them for energy, fiber, food and shelter. Traditionally, this is how all native cultures developed, whether island based or not. Now, natural resources in terms of plants, streams, fish, even stone becomes all important again; here are the roots of a culture's ability to sustain its health measured in terms of the physical or in terms of the spirit. Indeed, in trying times, the spiritual becomes even more important. The interpretation here is that an island's ability to preserve what remains of the natural, as the population returns to reliance on what is available to survive, will bring a resurgence in laws that protect, conserve and better utilize the natural.

Today some politicians are visionary enough to see this value, but dependence on tourism and the large corporate interests that derive incomes from moving and supporting paying customers in insular-based recreational areas still dominate law and decision making in our political systems. This to will be caught in the coming paradigm shift.

SPECIFIC NEEDS OF INSULAR AGRICULTURE AND NATURAL RESOURCES

To develop a complete vision of how to respond adequately to changing energy supplies, agriculture and natural resource schools need to examine closely how they see their support role. Some mainland institutes have begun to do this but have based development of their programs mostly on a general need to conserve fertility and richness of land and nature. These systems are based in the environmental awareness movement of the 1960s-1970s and not necessarily out of a recognition that oil costs would soar as production lagged. Nevertheless, they still are well situated to make strong contributions.

Insular environments, however, differ in several ways that will call for different sustainable approaches. First, they are small and have lived and continue to do so in worlds that are clearly bounded and demarcated by ocean. This means there are limited alternatives to bring in alternative income and sales must by definition be local.

Second, local economies are usually reliant on a single source of income for island economies (e.g., sugar cane in the late 1800s, pineapple in the mid 1950s, tourism in the past 30 years). Militarism in the Hawaiian Islands has had its up-and-down contribution to the local economy. Only tourism has survived relatively intact over the past few decades (other than a serious downturn after September 11, 2001) and indeed only tourism has grown recently with the exception of two wars that have sent bursts of military-based economic activity toward the islands. But a decrease in oil supplies and increase in expense of energy will eventually drive tourism to historic lows leaving military activity (which might not decline if oil shortages drive wars in a competition for the limited resources as some have predicted) to return Hawaii to a single economic driver. These will be times of economic adjustment for Hawaii. Thus, diversified agriculture will have a gap to step into but it must be well based in sustainable production methods.

Finally, most islands suffer from poor soil infrastructure, often consisting of a thin layer of soil over lava or limestone underlay. This means fertilizer and soil enhancement must often accompany even simple production plans. Several things can be done to begin moving in the direction of sustainability before an estimated 20 year time window to adjust begins to close. First, we must look closely at how basics such as eggs, milk, meat and fish, and starch based foods are produced. This is no small job since our fisheries are already depleted due to lack of coherent and strict political controls and will.

On the Big Island of Hawaii in the Hawaiian chain alone, four of five dairies have closed in the past decade because the cost of producing milk from cows developed in grain-fed midwestern environments was prohibitive since grain had to be shipped in to maintain production levels (strict legal controls on the quality of milk has not helped but should be questioned in the desire to use mainland style production systems). In this latter case, it would be useful to return control of the quality desired by the consumer to the consumer. Further, it would be desirable to begin a program to examine milk production on cows more attuned to semitropical and tropical environments and select for high production on grass systems rather than on grain fed systems.

Simultaneously, it would be useful to select for grass types that would be high in nourishment and protein to enhance milk production. This calls for integrated planning and selection regimes to develop true island-based milk production systems that could return a profit to the dairy industry. This type of integration would benefit beef production as well. Matching beef and milk gain to high-yield strains of grass would break the dependence on grain that holds sway over Hawaiian production systems.

The same holds true for egg production which has seen many egg farms in Hawaii fail over the past decade. I have worked in large egg-laying systems where enclosed hens were fed high energy feed to maximize egg production, basically burning the hens out after about 18 months. There is room on islands to develop range-fed chicken production systems without dependence on high energy grain feeds enabling maintenance of egg layers over longer life spans, reducing the need to turn production layers over on an annual basis to maintain high egg production. Indeed, once cheap mainland eggs are no longer shipped in to compete with local farmers, this industry might see resurgence in Hawaii and could become one of the staples of a diversified agriculture production system. Chickens play a huge role in reducing plant pests in gardens and during the halcyon days (1920s to late 1950s) of diversified small farm systems in the Midwest, every farm had its chicken coop with extra eggs sold or traded to neighbors. The Amish in fact still farm this way, producing acre gardens for their own use and cash crops of corn, beans, forage, milk etc with chickens providing a side meat, pest control and eggs.

A resurgence of canning and freezing of home-grown products might be expected as sustainable practices rise in use. This suggests growth of cottage industries associated with preserving food for storage similar as was seen or existed prior to about 1970. But these are not the only areas in which sustainable practices will play a role. Currently in Hilo, offal from slaughter houses is sent to the City dump. Green waste generated by homes and the city and county are sent there as well but some is recycled into compost.

CAFNR is working to develop integrated projects that will recycle offal, green waste, and animal waste into efficient and effective compost systems. These will have to comply with EPA and state Department of Health regulations but hold much promise for handling of potentially useful products that are only dumped today. Developing compost systems that can be turned over to private developers and marketers not only creates a business, it creates a product that will replace chemical fertilizers that are oil based and must be shipped in over ocean distances. As pointed out, fertilizers are important in enhancing the often poor soils of tropical and semi-tropical islands. If coupled with operation of a feed mill and biofuel production, even more opportunities may come to mind. Currently, the USDA is providing grant funds for research into these type of integrated projects indicating the Federal government sees value in these approaches as well.

Forestry programs will also play important sustainable roles. Although one role might be traditional in terms of enhancing timber production, certainly local species will need to be grown (especially if endangered) if not outright preserved to return ecosystems to their important role as arbiters for sustainable cultures. But some lands will need to be set aside to examine pulp, fiber and wood production from exotic woods since again it might be prohibitive to import these. This will call for research into landscape preservation and use, types of co-existing trees that might be planted, ecosystem enhancement and development of co-existing (exotic plus native trees) mixed forests, what trees to use for pulp and fiber that are fast growing that won't over run native forests, etc. A serious examination of this balancing act must take place to find the most

efficient and productive species in any given environment. Indeed, new crops for fiber production might be necessary in Hawaii and Guam to sustain local garment industries. Hemp should be considered here since it has multiple uses but because of its similarities to *Cannabis sativa* will require legal action to change its growing status.

Finally, horticulture systems and biofuel systems deserve a close inspection and increased research efforts. Horticulture, especially where fresh water is scarce, could be a real life saver on some Pacific neighbor islands to the West and so hydroponic systems will prove especially valuable. We must begin, then, new studies to ensure their efficiency and integration into home systems that rely on alternative energy such as wood gas generation (SERI 1972). Clean and fresh water will also be a problem in the future, so finding ways to grow crops in controlled environments might not only be an efficient use of water, but might also provide islanders with a “greenhouse in every backyard” consistent with the victory garden approach of the second world war where the public was expected to produce their own food to help with the war effort and make more food available for soldiers overseas. In a sense, we will be fighting a new war, one bent on surviving as the paradigm shift in energy occurs and impacts the world as we know it.

New studies into the nature and quality of palm nut oils for energy production (Milne, 1980), or methane generation from composting systems, or alcohol production from starch based crops, or even investigation of oil-producing plants such as those the U.S. Army studied in World War II might prove useful and provide new crops for agriculturalists to consider although the impact on global climate change will bear scrutiny. And of course, wood gas generation, where gas is produced from combustion of wood or other burnable products, will deserve a close look. All-in-all, we can expect reliance on petroleum based energy systems to decline, and it will be up to us to determine how we go about replacing that energy source.

LITERATURE CITED

Milne, Tom. 1980. Tree crops for energy co-production on farms. Publ. By SERI. 260 pp. Sustainable Energy Research Institute. Encyclopedia of biomass thermal conversion: pyrolysis, gasification and combustion principles and technology. 420 pp.