2015 IMPACT REPORT Q1

FIRST QUARTER

People, Place, Promise

COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

UNIVERSITY OF HAWAI'I AT MĀNOA

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Zero-Waste

"CTAHR is doing its part to keep the Islands clean and productive by creating and participating in a wide variety of zero-waste and waste-management projects and initiatives."

Ours is a small state composed of small islands. Every acre is precious for its potential: there is little space available for waste disposal, and our delicately balanced ecosystem is highly sensitive to the effects of pollution and environmental degradation. Though this situation prevails throughout the world, the issue is particularly pressing in Hawai'i. CTAHR is doing its part to keep the Islands clean and productive by creating and participating in a wide variety of zero-waste and waste-management projects and initiatives. Ju-Young Kang is educating her fashion students on reducing the staggering amount of clothing and textile waste through more mindful patterning, cutting, and sourcing, while Eunsung Kan has discovered two ways of purifying emerging contaminants from wastewater, improving animal and human health as well as agricultural irrigation. Livestock production and biofuels are important areas with potential: Samir Khanal and his community partner Robert Olivier are testing and refining an ingenious system of waste recuperation that also yields fuel and animal feed, and Rajesh Jha is researching methods of improving the nutrition potential of the biofuel by-products fed to swine.

Aloha,

Maria Gallo

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Dean and Director for Research and Cooperative Extension

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Add Value–Add Larvae

Most people are familiar with vermicomposting, using worms to break down garden and kitchen waste and boost the fertilizer content of the resulting compost. But as Molecular Biosciences and Bioengineering researcher Samir Khanal explains, larvae generate a similar high-quality soil amendment while eating more, and more diverse, waste. And they also create two further products: fuel and feed.

Food scraps, including fats and meat that can't go into ordinary compost, are placed in a BioPod™, an ingeniously designed compost-type bins, to be eaten by black soldier fly grubs. These voracious eaters become very fat, and this fat is a valuable source of fuel. The grubs are heat-dried to reduce moisture content, then pressed for oil. "There's nothing more valuable than a liquid fuel source," avers Robert Olivier, Dr. Khanal's collaborator and BioPod™ creator; it's far more versatile and easy to use than a gas.

Dried larvae can be turned into larval protein meal and oil.

Desirable as it is, the fuel may not be as important as the other end-product, the feed. After dried larvae are pressed, the resulting meal is the perfect blend of protein and fat for feeding chickens and fish. Mr. Olivier is running a trial with 120 chickens on a Maui farm now; final results aren't in, but he confirms, "They love it. And the eggs are phenomenal!" Tilapia and other fish used in aquaponics also thrive on the meal, providing a much-needed solution to the conundrum of trying to promote food sufficiency through aquaponics when feed is largely imported from the Mainland.

Larval farming is potentially a self-perpetuating cycle on both large and small scales. Self sufficiency-oriented homesteaders can use their own scraps to feed their own BioPod™ of larvae, using the pressed oil in oil lamps or oil-fueled heating devices and feeding small flocks of poultry and tanks of fish. But Dr. Khanal and Mr. Olivier envision the citywide implications: Trucks bringing food waste from restaurants and supermarkets to facilities with much huger BioPod™ bins could be powered by larval biodiesel—the oil, amended for consistency and stability. This biodiesel, they calculate, would easily power the machines pressing the dried larvae—and the heat generated by the pressing is just the temperature needed to dehydrate the next batch. And commercial-grade feed, pressed into pellets, could be trucked to feed-supply stores all over the state, again in trucks fueled by larvae. It's an exciting vision…one they're already working to bring to reality.

Samir Khanal, Robert Olivier, and graduate student K.C. Surendra show the products of larval composting.

It's All Fine for the Swine

The new foodie trend of "snout to tail" cooking utilizes all parts of the pig for sustainability and waste reduction as well as gastronomic pleasure. But pigs themselves are masters of resource optimization: they can be fed a dizzying variety of feedstuffs, much of which might otherwise become refuse.

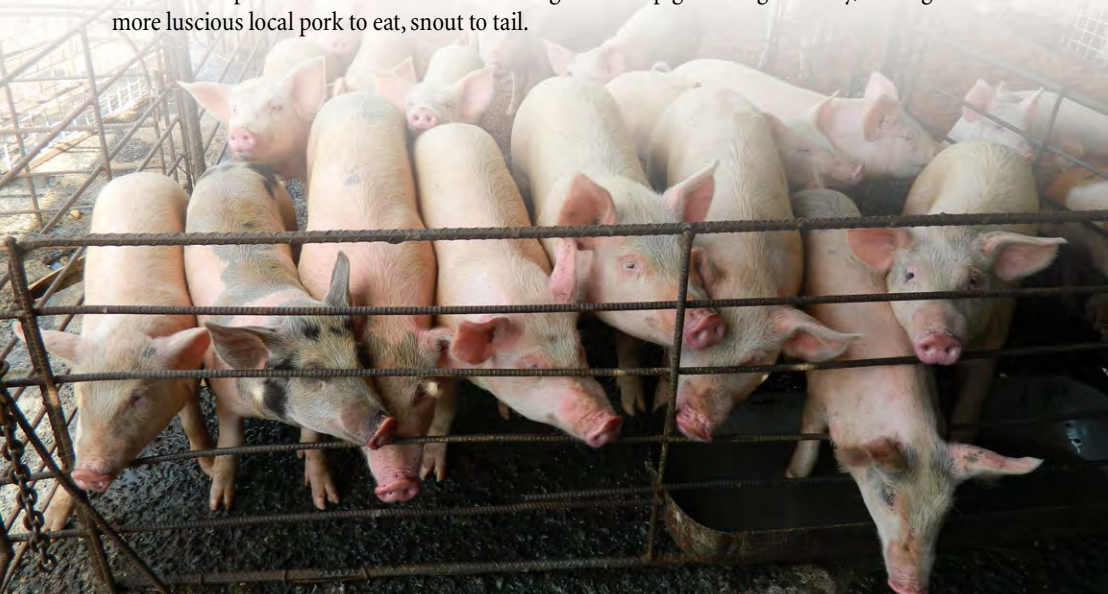
It's this capability that Human Nutrition, Food and Animal Sciences researcher Rajesh Jha is exploring in his research into alternative feeds for swine, developing more cost-effective and sustainable animal production systems. He has successfully evaluated a wide range, including a number of locally produced options. Sweet potato, cassava, and taro show promise, as do okara and macadamia nut cake. All have reasonably high, though different, nutritive values and digestibility, so combinations can be used to formulate diets for various animals.

Macadamia nut cake, a waste product of local oil processing, is a promising swine feed.

The last two also have the advantage of being otherwise waste products. Okara, the soybean pulp remaining after production of soymilk or tofu, is often relegated to the landfill. However, Dr. Jha's lab found it very promising as pig feed due to its high nutritional value and digestibility. Macadamia nut cake, a by-product from macadamia oil processing plants, used to be thrown away as well. However, Dr. Jha shows that it also has high potential as animal feed thanks to its high protein, energy values, and digestibility. Now he is starting a chicken-feeding trial with macadamia nut cake as well.

Dr. Jha not only searches out new potential foods for swine; he works to improve those already in use. A waste product commonly used as swine feed is Distillers Dried Grains with Solubles (DDGS), a corn-derivative by-product of ethanol production. DDGS is fed not only to pigs but to dairy and beef cattle, poultry, and sheep. However, the digestibility of DDGS is quite low; therefore, it can only comprise a relatively small proportion of their diets. A highly competitive grant recently awarded by the National Pork Board is allowing Dr. Jha to research ways to treat DDGS with enzymes to unlock its nutrients and allow it to be used more effectively by the pigs who eat it, leading to a reduction in the cost of their feed and increasing environmental sustainability. Not only this, but he explains that this technique can work to enhance the available nutrition of other feeds, including the local feedstuffs he's testing.

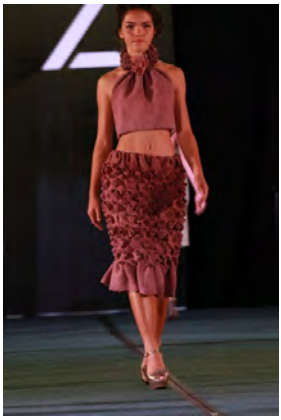
The best part? All this research is bolstering Hawai'i's pig-farming industry, leading to more luscious local pork to eat, snout to tail.



High Style, Low Waste

Dressmaking may not be high on most people's list of waste-generating activities, but in fact, between 15 and 20 percent of each bolt of cloth ends up being discarded when garment pieces are cut out. Between that and clothing that's worn and then discarded, the US throws away up to 21 billion pounds of textile waste a year! But Assistant Professor Ju-Young Kang is leading her fashion design students to challenge these numbers in two ways, both by more sustainably creating garments from whole cloth and by "up-cycling" already-made garments.

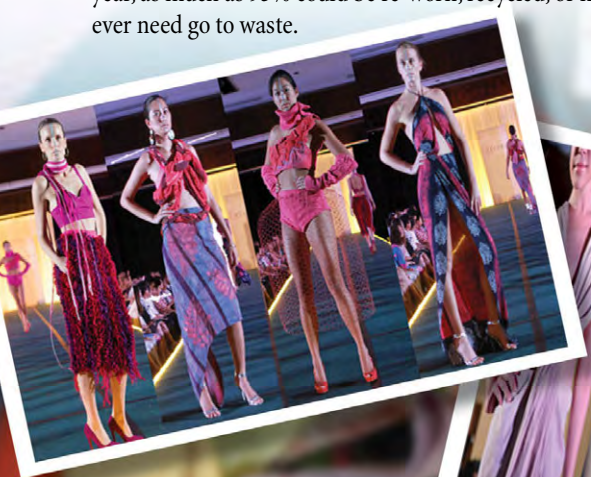
These two pursuits are known as pre- and post-consumer zero-waste design. The first is a sustainable design technique that reduces textile waste at the design's decision, pattern-making, knitting, and draping stages. The technique combines efficiency with aesthetics by more mindfully creating garments, placing the pieces on the fabric to maximize the use of space and using the scraps that are generated as design elements. Constraints can actually unlock creativity, as the designer has to think in new ways to work around them. This is beautifully evident in the 2013 UHM senior fashion show segment showcasing Dr. Kang's students' designs, "Écobilan," which also incorporates natural dyeing techniques using local plants, flowers, vegetables, fruits, and coffee.

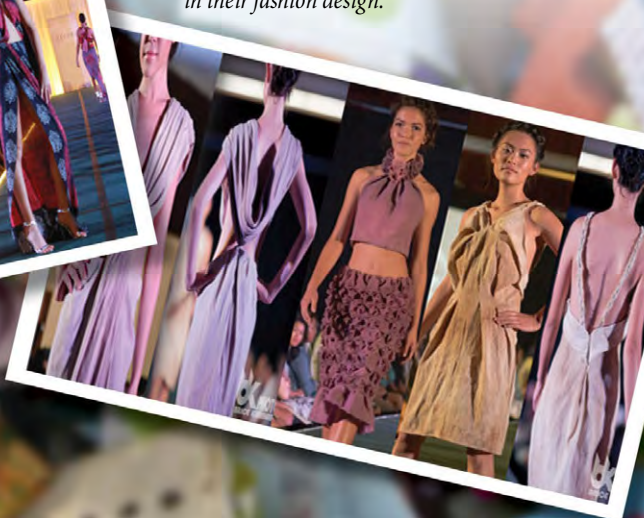


Using waste scraps of cloth as design elements adds interest and sustainability to garments.

The following year, Dr. Kang spearheaded a segment entitled "Reinvented Culture" in the 2014 fashion show, focusing on a "recycle, reuse, and rewear" approach to waste management. The students hit lanai sales and thrift shops for second-hand clothes and other recycled materials, from couture gems to short-lived fad-wear of yesteryear, then recut and resewed their finds into cutting-edge garments of their own.

Dr. Kang and her students are not alone. Due to the increasing consumer awareness of environmental issues specific to textile and apparel production, as well as firms' commitment to putting sustainable practices into production, a growing number of fashion retailers, including Gap, American Apparel, Eileen Fisher, H&M, and Levi Strauss, promote sustainable concepts in their operational practices including material preparation, manufacturing, distribution, and retailing. Designers such as Mark Liu make zero-waste one of their trademarks. Of the thousands of tons of garments/textiles that consumers dispose of every year, as much as 95% could be re-worn, recycled, or not generated in the first place—nothing ever need go to waste.





Students resuse existing textiles (left) or more mindfully create new ones (right) in their fashion design.

Greening Graywater

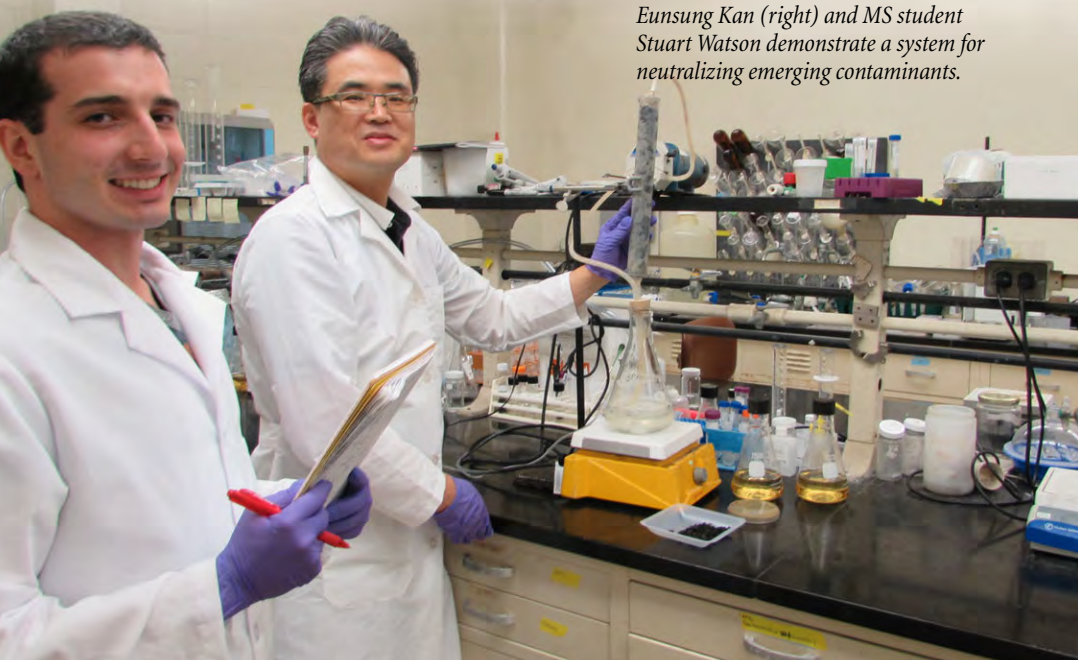
Schoolchildren learn about the natural water cycle: clouds, rain, streams, ocean, evaporation. In the municipal water cycle, water from the tap is used for drinking/cooking, bathing, washing, and irrigation; the resulting "graywater" runs to the sewer, is taken to a wastewater treatment plant, and is purified to be used again.

It's in the purification process that things can get problematic. Assistant Professor Eunsung Kan works with emerging contaminants, adulterants of the water that appear in such small concentrations that they are often ignored—and therefore not removed. But these contaminants, including endocrine disrupters such as BPA, synthetic hormones, antibiotics and pain relievers, and certain chemicals in makeup and sunscreen, can cause a host of problems even in tiny amounts, including a higher incidence of breast, thyroid, and prostate cancers and hormone disruptions. Other problems include drug resistance—and not only in humans. Since the water is also used for irrigation, trace amounts of antibiotic collect and concentrate in the tissues of the plants, leading to pesticide resistance in the pests that eat them—and thus to the need for stronger pesticides.

Biochar made from locally grown greenwaste (left) is used as a substrate for locally collected water-purifying bacteria (right).

Dr. Kan looks at the entire municipal water cycle, but the core of the research in his Bio/Green Engineering Lab in the Department of Molecular Biosciences and Bioengineering is on removing emerging contaminants. He explains that several processes in use pose problems of their own, such as adding extra chemicals to neutralize those already present. His techniques, both cheaper and "greener," include a photocatalytic process and one using specially selected and cultured bacteria.

In the first process, rods of biochar, or biologically active charcoal, are impregnated with titanium oxide and placed in the water. Sunlight excites the titanium oxide, which catalyzes, or breaks down, and neutralizes the trace contaminants. In the second process, a particular strain of bacteria that also breaks down the contaminants is isolated from the soils surrounding UH Mānoa and encouraged to grow in a thick biofilm on the surface of biochar. The ideal system, Dr. Kan explains, combines the techniques: a photocatalytic system can be fitted to any area where wastewater is outflowing, after which the water is directed through a column treated with the bacteria, emerging contaminant free. With their green and sustainable focus, his techniques are contributing to detoxification and agricultural reuse of water.



Eunsung Kan (right) and MS student Stuart Watson demonstrate a system for neutralizing emerging contaminants.