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ZERI: A Philosophy and Methodology to Reinvent the World¹

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Many Friends have become increasingly concerned that our current economic system is not sustainable. Clearly, a perpetual growth economy is not possible within the limits of Earth's biosphere. As one who has long carried this concern, I was captured some years ago by the inspiring model of Gaviotas, a sustainable community in Colombia. When circumstances provided an extraordinary opportunity to visit the community in June 2005, the dynamic Gunter Pauli turned out to be our guide. Gunter's work with Zero Emissions Research and Initiatives (ZERI), provides a shining light—an example of an entirely different way to do business.

Turning Waste into Revenue for the Poor

Gunter Pauli founded ZERI on the idea that principles of the natural world can be applied to human manufacturing and waste removal practices, transforming those wastes from an expensive and sometimes toxic nuisance into a benign and revenue-producing resource. Since its founding in 1994, ZERI has put into practice more than 80 demonstration projects worldwide that turn waste into jobs for the impoverished.

Born in Belgium and fluent in seven languages, Gunter Pauli is a man of vision, passion, and literally bursting with remarkable energy. In his twenties, determined to get earth friendly detergents onto mainline supermarket shelves, he founded Ecover, which manufactures eco-detergents from tropical vegetable oils in a facility that was an early model of green design.

Yet, in the midst of this financial success, he says he “hit a brick wall” when he realized that although his “green” cleaning products were certainly much less environmentally damaging than traditional cleaning products, he was actually utilizing less than 5% of the total plant material from which they were derived. The rest—95%—was being discarded as waste. With that came the realization that he needed to take responsibility for the massive amounts of waste his production process was creating.

ZERI Founded in 1994 on Five Design Principles

By the age of 38, Gunter had figured out a way to become a part of the solution. At the United Nations University in Tokyo, in 1994, he founded ZERI to demonstrate that there is another way for humans to interact with the earth's natural resources. Inspired by the work of Lynn Margulis and the harmonious and interdependent relationships among the five kingdoms of nature (plant, animal, fungus, algae, and bacteria), Pauli identified what he calls the “five design principles”:

- 1) Whatever is waste for one species is a nutrient or food for another species belonging to another kingdom;
- 2) What is a toxin for one organism, is a nutrient or neutral for another belonging to another kingdom;
- 3) Whenever highly complex ecosystems operate, viruses will become inactive and even disappear without causing harm once passing through at least two other kingdoms;
- 4) The more local and the more diverse a system, the more productive and the more resilient; and
- 5) Whenever species of five different kingdoms live and interact in an autopoietic system, they can integrate and separate all matter at ambient temperature and pressure.

In its first four years, ZERI established teams in Japan, South Pacific, Latin America, and Africa. Using the five design principles, the teams created pilot projects where waste was put to productive use and/or where the combination of kingdoms was creating a synergy that led to much greater production.

Manizales, Colombia

Coffee Waste Provides Jobs for Abused Women

The morning ritual of pouring boiling water through finely ground roasted coffee beans, results in a rich, dark liquid that starts the day for untold millions. Yet, how many realize that liquid we sip represents a mere 0.2 % of the original coffee berries harvested on our behalf? The remaining 98% is currently discarded as waste.

In Manizales, Colombia, we visited a ZERI demonstration project that provides an income for formerly abused women who use a small portion of one coffee facility's waste—shredded hulls of the coffee berries from which the beans are extracted and the residue of the instant coffee manufacturing process—to grow economically prized oyster mushrooms (*Pleurotus*).

The women mix the waste with water in a huge vat, heat the slurry, drain and cool it, then stuff the resulting substrate into plastic bags, which they inject with spores of the oyster mushroom through the sides of the bags. After several weeks in darkness, the mushrooms grow out through the holes in the plastic and are easily harvested. The bags are then returned to darkness for another two additional growing cycles, until the lignin and cellulose in the substrate is digested by enzymes produced by the mushrooms. The digested substrate is a nutritious feed for chickens and pigs. Thus, formerly discarded waste has been transformed into two revenue streams.

¹This is a deliberate reference to Alan Weisman's book: *Gaviotas: A Village to Reinvent the World*.

Quaker Eco-Bulletin (QEB) is published bi-monthly by Quaker Earthcare Witness (formerly FCUN) as an insert in *BeFriending Creation*.

The vision of **Quaker Earthcare Witness (QEW)** includes integrating into the beliefs and practices of the Society of Friends the Truths that God's Creation is to be held in reverence in its own right, and that human aspirations for peace and justice depend upon restoring the Earth's ecological integrity. As a member organization of Friends Committee on National Legislation, QEW seeks to strengthen Friends' support for FCNL's witness in Washington DC for peace, justice, and an Earth restored.

QEB's purpose is to advance Friends' witness on public and institutional policies that affect the Earth's capacity to support life. QEB articles aim to inform Friends about public and corporate policies that have an impact on society's relationship to Earth, and to provide analysis and critique of societal trends and institutions that threaten the health of the planet.

Friends are invited to contact us about writing an article for **QEB**. Submissions are subject to editing and should:

- Explain why the issue is a Friends' concern.
- Provide accurate, documented background information that reflects the complexity of the issue and is respectful toward other points of view.
- Relate the issue to legislation or corporate policy.
- List what Friends can do.
- Provide references and sources for additional information.

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Montfort Boys Town, Fiji

Beer Waste into Mushrooms, Fish, and Vegetables.

George Chan, an advocate of integrated farming with 40 years of experience, proposed an early ZERI project in Fiji. Sludge from a local brewery was used to create revenue-generating products—mushrooms, pigs, chickens, fish, vegetables, fruit, and fuel for electric power.

The site for his experiment was Montfort Boys Town, a school for disadvantaged boys, who had traditionally raised food and money by farming fish in ponds. ZERI chose Fiji both because it is poor and because its one main industry—sugar—was in decline.

The brewery provides the waste of spent grains for free. Farmers tried using the waste for feed, but it was difficult for animals to digest. Once dried and mixed with rice straw, newspaper, or sawdust, the waste is an excellent substrate for mushrooms, which are grown on shelves in a traditional, one-room thatched hut constructed by the boys. Chan had hoped to use native mushrooms, but as none were readily available when the experiment was launched, he selected three kinds based on the climate and conditions—shiitake (*Lentinus*), oyster (*Pleurotus*), and straw (*Volvariella*), each of which grow well by digesting the spent grain.

In traditional mushroom farms, the digested substrate is dumped on fields, where it can overwhelm planted crops. At Montfort, the boys shovel it into pails and carry it to a nearby wooden shack where, thanks to the work of the mushroom enzymes, it is now nutritious and digestible feed for a second revenue-generating product—chickens and pigs.

Every couple of days, the waste from these animals is flushed with water into a closed concrete and metal drum called a “digester.” Anaerobic bacteria break down the animal waste, giving off methane gas—a third product—which is piped off and collected in bottles. The gas is used to power the school's lights and to steam the mushroom substrate.

The solid waste is further digested as it travels through several compartments where 60% of its biological and chemical oxygen demand is removed. Then the substrate is gravity fed into a series of three algae ponds in which bacteria, plankton, and other micro-scavengers aerobically consume the remaining unwanted parts of the original animal waste. The animal waste has then been converted into algae, which is harvested and used as high quality compost for the vegetable and fruit crops—a fourth product—that grow on the dykes surrounding the fish ponds, as well as for fish food.

Chan's fish ponds—the fifth product—have seven kinds of fish from top feeders to mud carp and scavengers, creating an ecology of its own that eliminates the need for the antibiotics and frequent cleanings needed on traditional fish farms.

In addition to the flowers, strawberries and other vegetables grown around the ponds, additional crops are grown on top of the pond, hydroponically, again providing food, income and experience for the Montfort students.

Due to the success of the project, Montfort Boy's Town has now created a center for sustainable development from its former vocational training school. Its students are steeped in a curriculum of hope, graduating with experience and knowledge of how systems can be designed to create abundance from waste while simultaneously enhancing the environment.

Tsumeb, Namibia

Brewery Moves to Fish Ponds

Impressed by the early results of Chan's work, a commercial brewery in Tsumeb, Namibia, relocated its facilities to farmland that provided space next to the brewery for two fish ponds, a pen for livestock, and a biodigester to process the animal waste. The 3,500 square-meter ponds produced 10 tons of fish per hectare.

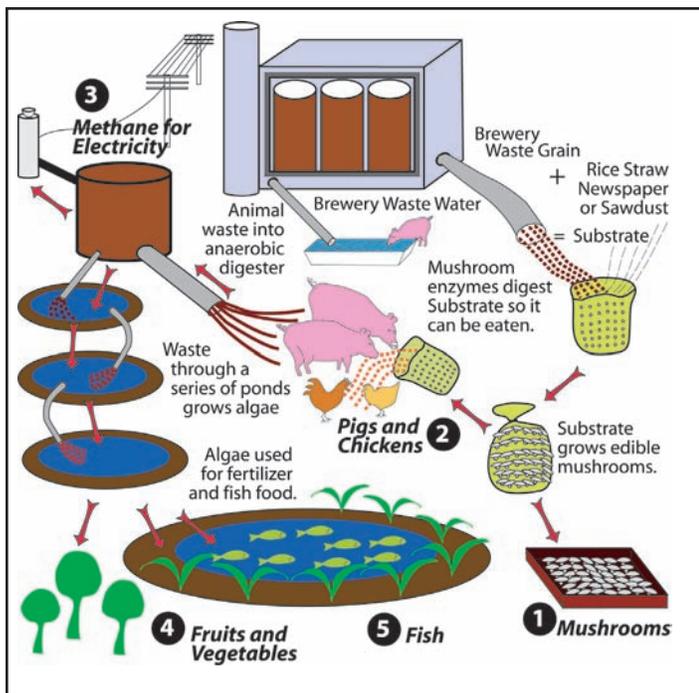


Figure 1. Zero emission cyclical production at Montfort Boys Town, Fiji, where wastes from a brewery are used to make five different products.

Water is not abundant in Namibia, so, normally, there would be little to spare for fish farming. However, breweries discharge large quantities of waste water (typically seven quarts are used to produce one quart of beer), providing ample supply for the ponds.

The methane from the company biodigester provides fuel for cooking and heating for 80% of the town population, which would otherwise come from wood. And the brewery no longer has to pay for the disposal of its spent grain, which is formed into blocks called “beer cakes.” Each 1.8 ton of beer cake now produces one ton of fish. In contrast, when beer cake is used as cattle feed it takes seven tons to produce a ton of beef – due to its poor digestibility for that species. As in Fiji, the fish waste, after it is steam heated using more of the waste methane gas, becomes substrate for mushrooms.

ZERI’s Work in Gaviotas, Colombia

In 1970 the dream of Gaviotas founder, Paolo Lugari, was to build a sustainable community that would provide jobs for the impoverished in the inhospitable, acidic soil of Colombia’s *llanos*. He knew that if he could do it there—on wide expanses of savannah-like country where virtually nothing grew except along the rivers—it could be done anywhere.

By the time Gunter Pauli first visited Gaviotas 1982, the community had developed wind and solar power and had designed a manual pump that enabled them to bring clean drinking water from hundreds of meters below the surface. Paolo had shared the pump technology with indigenous peoples, bringing them a reliable supply of potable water for the first time.

But the dream of a forest had eluded them until Gunter introduced the idea of adding a fungus when planting the Caribbean pine seedlings to form a mycorrhiza, a nitrogen-fixing mat among the roots of the trees, essentially a self-fertilizing system. The trees

flourished and reached maturity in 10 years. Now, the distilled resin from the trees provides Gaviotans with two products—turpentine and colofonia, which is used to make glossy paper coatings and paint pigments. Continual planting increased the forest, which has provided more than the resin. In the shade of the pines more than 250 species of Amazonian rainforest plants have sprouted including fruit trees whose juice is now bottled, and the decomposition of tree and shrub debris has created more than half a foot of top soil and raised the pH from 4.0 to 6.0. By the time I traveled to Gaviotas in June of 2005, a 20,000-acre rainforest surrounded the community.

The Colombian Air Force was so impressed with the jobs created in Gaviotas, that they hired ZERI to assist in creating what Gunter calls “Gaviotas II” and the Air Force calls “The Project for Life.” The Air Force has donated 100,000 acres of military land in the northwest corner of Vichada (close to the Venezuelan border) to be reforested and farmed using Chan’s integrated system to provide home and livelihood for 10,000 people. Their military base at Marandua, will host a Center for Sustainability, where former military personnel and impoverished people from Bogota will be among those to be trained in ZERI’s systems design philosophy.

Upsizing is Pauli’s Answer to Downsizing

In our current economic system, productivity is achieved through downsizing—finding ways to produce more using fewer employees. Raising productivity this way increases wealth for shareholders at the expense of those who lose their jobs.

Further, our utilities and manufacturing processes employ and emit toxic chemicals that are accumulating in our soils, water, and bodies and leading to increases in allergies, cancers, and other illnesses. While businesses in industrialized countries have incrementally improved their environmental performance, their movement is very slow, and even the cleaner production is still very dirty.

“Creating wealth for a few, while perpetuating poverty and misery for many” says Pauli, “is neither ethical nor productive.”² He advocates a different system that he calls, by contrast, “Upsizing.”

Companies that embrace Upsizing, which employs the Zero Emissions Concept and concentrates on optimizing the productivity of the raw materials, can generate more value, more income, and more jobs. At the same time they can eliminate waste from their processes. Called by some the industrial model of the future, UpSizing examines the potentially harmful effects from emissions, effluents, and other by-products and finds ways to re-use them that eliminate adverse impacts. If industries that can utilize one another’s waste products can be geographically clustered, the cost of transporting waste is eliminated, which reduces demands on fossil fuels. By finding productive uses for formerly discarded wastes, UpSizing creates jobs while increasing productivity, which turns old thinking upside down. Of course, natural processes have been using the Upsizing principle all along. Think of a tree, discarding thousands of leaves and excess seeds each year. That could be a real waste problem, except that around that tree live the squirrels, birds, and millions of insects, bacteria and fungi that transform those

²UpSizing, p. 16.

“emissions” into jobs and food.

By the time Pauli described the Namibia project and others in his book, *Upsizing: The Road to Zero Emissions – More Jobs, More Income, and No Pollution*, his work had attracted the attention of Guinness, as well as breweries in Japan and Colombia. Pauli’s newest book, *Out of the Box: ZERI Management Stories*, presents case studies of companies that have tapped ZERI’s consulting advice and transformed their industries via this systems approach. As early as 1998, DuPont USA had made a public commitment to reaching the target of zero waste.

Gunter Pauli chides us for being so oblivious to the problems we have created, calling us “*Homo non sapiens*.” But he sees possibility where others see nuisance and persistently asks why we continue to do things the way we do, especially in light of the planet’s growing population with its soaring demands for food, water, jobs and material goods. For example,

- Why do we utilize only 20% of softwood trees and 30% of hardwoods, when we could produce a number of useful products from the residue that is now incinerated?
- Why would northern forestry experts advise tropical countries to plant pine plantations that mature in 20 years to produce pulp for paper when the waste from their sugar cane harvest could provide equivalent resource on an annual basis?
- Why won’t the sisal industry, whose ropes and fishing nets can no longer compete with fibers made by the petrochemical industry, take advantage of its production residue (98% of the original resource is waste) to produce citric and lactic acid, which can bring 15 times the revenue of its fiber product, and enable it to lower the fiber prices to compete with synthetic fibers?³

Linear vs. Circular or Systems Thinking:

A Call for a New Paradigm

Gunter Pauli contrasts the linear thinking and sense of time of Western societies with the more circular concept of time of Oriental and Pacific (indigenous) cultures. Western thinking, he says, leads us to the desire to accumulate wealth during our lifetime, consuming nature’s wealth in the process. By contrast, the Eastern belief in reincarnation leads to a longer view that may include many lifetimes. Pacific understanding of humans as just one part of the ecosystem generates a more integrated human-earth relationship.

Pauli posits that two commonly held axioms of science are a product of, and have contributed to, our linear thinking and destructive ways.⁴

- 1) Evolution’s “survival of the fittest” axiom is certainly true for the individual within a species, but applied too broadly leads us to forget that all species are interdependent and that their survival depends upon collaboration. Indeed, any species that removes itself from the integrated ecosystem within which it exists, risks

extinction over time and will cause the extinction of others. The abundance of nature is a result of diversity. Pauli proposes we replace survival of the fittest with a new axiom, “evolution through interdependence and cooperation.”

- 2) The Second Law of Thermodynamics states that all things move from a state of order to one of disorder. This is true for linear thinking, where it is believed that all things are born and then die, and all things disintegrate over time. But in natural systems, the death of one thing is food for another. And, as long as our sun continues to burn, and plants continue to convert that solar energy to chemical energy, which other beings can use, the law by which we operate is one of regeneration, not degeneration.

Pauli calls for a new paradigm that reverses our current linear thinking that the universe is a mechanical system made up of many separate parts; that humans are above and outside of nature; and that our life is a competitive struggle for potentially unlimited material progress that can be attained through perpetual growth of our economy and of technology. Along with other ecological thinkers such as Thomas Berry and Joanna Macy, he warns that this current paradigm cannot continue.

Our new paradigm must view the world as an integrated whole, see all as interdependent, and recognize that all humans are totally dependent upon the cyclical processes of nature. This new thinking will naturally lead us to what Berry refers to as “a mutually enhancing human-earth relationship,” and enable us to exchange our industrial growth society for what Macy calls a “life-sustaining society.”

Opportunities with ZERI

- 1) ZERI offers a one-year Masters program in Systems Design in cooperation with Politecnico di Torino in Torino, Italy <systemsdesign.polito.it>.
- 2) ZERI trainings occasionally take place in the U.S. Contact <info@zeri.org>.
- 3) For resources to help make your community a Zero Waste Community, see <crra.com/grc/articles/zwc.html>

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Hollister Knowlton is a member of Chestnut Hill Meeting, active in Philadelphia YM’s Earthcare Working Group and Friends Traveling for Peace, Justice, and an Earth Restored; a member of the Policy Committee of FCNL, and clerk of Quaker Earthcare Witness (formerly Friends Committee on Unity with Nature). She gave up her car and became a vegan in 1994 for environmental, social and animal justice reasons and took early retirement at the end of 2003 to devote her life to furthering ecological sustainability and healing our human-earth relationship.

³ Dr. Keto Mshigeni, “Zero Emissions Projects in Tanzania,” and Francis Nkuba, “The Sisal Industry in Tanzania” both in *Proceedings of the 2nd UN University Congress on Zero Emissions 1997*.

⁴ *Upsizing*, pp 30-34.