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## EAGLE FEATHER RESEARCH NEWSLETTER

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Welcome, Willkommen, Bienvenue, Bienvenidos, Benvenuto. We start with the question of millions of electronic gadgets and their connection to the energy drain around the globe. In 1980 there was an average of three consumer electronic products in every household. Today, there is an average of 25 electronic products in every household. It affects everyone, from laptop-loving children to electronic fences for Fido, to energy hogs flat panel TV's. The proliferation of personal computers, iPods, cell phones, game consoles etc. amounts to the fastest growing source of power demand in the world. While consumer electronics represent 15 percent of household power demand, it is expected to triple over the next two decades making it more difficult to tackle the greenhouse emissions responsible for global warming. Satisfying this demand will require the equivalent of 500 coal-fired power plants or 230 nuclear plants according to the International Energy Agency. The only solution might be to have mandatory efficiency rules regarding the amount of power each device can use. We do have efficiency standards for refrigerators and washers which have cut energy consumption by nearly 50%. However, applying these standards to televisions and game consoles have been repeatedly derailed by lobbyists representing the manufacturers. Part of the problem centers around the fact that they cannot be entirely turned off; even when not in use they draw electricity while they await a signal from a remote control or wait to record a TV program. One immediate solution is to plug your electronic devices into smart power strips. The strips turn off when the electronics are not in use, cutting power consumption to zero. Another problem is that many products require large amounts of power to run. Noah Horowitz at the Natural Resources Defense Council calculates that the nation's gaming consoles like Xbox 360 from Microsoft and the Sony PlayStation 3 use the same amount of electricity each year as San Diego, the ninth largest city in the country. Let us begin with the smart power strips with your electronic devices while we wait for new standards for the rest of the power eating appliances in our households.

**Solutions for a Hungry World:** By 2050, the challenge will be to grow 50% more food to feed 9 billion people with less and less land. Scientists offer eight possible ways to

accomplish this challenge: (1) Farm the Desert, (2) Food growth with precision, (3) Genetic engineering, (4) Replacement of fertilizers, (5) Remap the Continents, (6) Use of Robotic labor, (7) Soil renewal and (8) the production of super crops.

**Farm the Desert.** *Fresh water use:* 70% of freshwater is used for agriculture. *Solution:* Greenhouses near coasts turn plentiful seawater into freshwater for crops without expensive desalinization plants. *Potential:* Farmers could grow cash crops like lettuce and tomatoes in the desert. *ETA:* Currently there are three pilot projects with new and larger full-scale projects in the near future (Tenerife, the Canary Islands; Abu Dhabi, the United Arab Emirates and Oman use prevailing winds, fans and simple evaporators to convert seawater in fresh water for a little as \$5.00 a square foot). The projected Sahara Forest Project will add a “concentrating solar power” plant to the greenhouse concept where extra freshwater could then be used to run the facility (the sun heats water in pipes to make steam, which drives generators) and to clean the huge arrays of mirrors.

**Growth with Precision.** *Fertilizer use:* 300 to 500 pounds per acre at a cost of 40 to 80 cents per pound. *Solution:* Networked soil sensors signal how much fertilizer and water are needed and when. *Potential:* Slash the amount of resources required for farming. *ETA:* 5 years to commercialization. GPS steered tractors will apply fertilizer and water to seeds with sub-inch accuracy. Year around sensors measure moisture, temperature and nutrient data and transmit information wirelessly back to a central computer. These provide clues to how nitrogen and carbon are cycling through soil. Cost: 4-6 sensors per acre between \$20 and \$30. Savings on water and fertilizer: \$150 per acre for each crop.

**Rebuild Rice:** *Dependence on Rice:* About 50% of the world’s population. *Solution:* Genetically engineered rice to change its photosynthesis for more growth in any conditions. *Potential:* Increase rice yields by 50% per year and transform other plants as well. *ETA:* As soon as 10 years. John Sheehy, head of the Rice Research Institute in Manila (Asia’s largest non-profit agricultural research center) is altering the way rice uses the sun’s energy to make it grow faster. Current photosynthesis processes produce what are called C3 plants. The new C4 plant builds tissue more efficiently in warmer and drier climates creating carbohydrates that require less CO2. That reduces the amount of time the plants need to keep their leaf pores open to soak up the CO2, so they lose less water to evaporation. This C4 capability has evolved many times in the past, so the plan is simply to mimic nature. Determining which genes regulate C4 anatomy is what is at stake. Once the code is cracked, wheat grown in sub-Saharan Africa could become a reality.

**Replace Fertilizer:** *Global greenhouse gas emissions:* 1.2% caused by the production of chemical fertilizers. *Solution:* Seeding fields with microbes that pull nitrogen from the air. *Potential:* Increase yields while leaving the soil healthier than before. *ETA:* There are already small quantities available. While chemical fertilizers have increased crop yields, it has posed a health problem. Now the strategy is to replace fertilizers altogether with microbes. Professor C.A. Reddy of MSU assembled a cocktail of 300 naturally occurring soil microbes that reduce the need for phosphorus and nitrogen fertilizers while protecting plants against pathogens and boosting yields in

virtually every type of crop. Tomato plants fed with microbes yielded 90% more fruit with this liquid soil called Bio-Soil Enhancers. These microbes are self sustaining, unlike traditional fertilizers which need to be replaced each year.

**Re-Map A: Continent:** *Deep Data and New Mapping:* charting information like irrigated areas and crop distribution in view of increase in per-capita food yields in sub-Saharan Africa over the past 40 years. *Solution:* Gather extensive data on land use to better target new farming technologies. *Potential:* African farmers will increase yields enough to feed a local population expected to increase to double by 2050. *ETA:* 2010. *Harvest Choice* recently received 4.7 million from the Bill and Melinda Gates Foundation to gather and merge more data than ever before. Additionally, NASA has teamed up with the U.S. Department of Agriculture to use its Aqua Satellite to monitor soil moisture around the globe. The USDA's Foreign Agriculture Service is moreover, using the data to help form more accurate crop forecasts not only for the U.S. but for developing countries.

**Use Robot Labor:** *Value of specialty crop industry:* \$55 billion. *Problem:* there are a declining number of available human hands to harvest. *Solution:* Mechanized farmers for monitoring, pruning, thinning and even picking produce. *Potential:* Domestically grown fruits and veggies that everyone can afford. *ETA:* As soon as two years. Recently, the USDA awarded \$28 million to Sanjiv Singh of Carnegie Mellon University and other researchers around the country in part to build automated farming systems that will improve fruit quality, shore up worker shortages and keep American farmers solvent. Currently, they are autonomous four wheelers that rumble through apple orchards, using sensors to scan for things like fungus and growth rates. Separate sensors in the ground monitor soil moisture, humidity and light levels. The idea is to micromanage every plant from a central station and dispatch robots to deal with pest invasions or soil imbalances before fruit starts dying. But can they pick the fruit efficiently? Currently, these machines lag behind their human counterparts. Nonetheless, the goal is to use scouting robots with multiple stereo cameras that locate and size the fruit in the trees. The "bots" beam info to robotic fruit pickers with long harvesting arms that gently pluck the fruit. The end is to have machines that allow fewer people to do more work—scissor lifts for better access to treetops, automated pruning devices, robots that stack and transport boxes and finally a sensor network to keep it all in synchronization.

**Resurrect the Soil.** *Amount of degraded land by humans:* 25%. *Solution:* Add *biochar*, a form of charcoal that provides plants with vital nutrients while also sequestering carbon. *Potential:* Turn vast swaths of un-farmable land arable again, while locking away tons of carbon dioxide. *ETA:* Available now. Pre-Columbian civilizations had this biotechnology long before Europeans came to the Americas. They created rich, dark dirt called today terra preta. It is made from wastes and not rainforests and it makes farming more sustainable and also makes agricultural fields into vaults for storing carbon. Biochar attracts microorganisms that help plants access nutrients in the soil, and it enables the ground to hold more water. More important, it locks the carbon in the biomass rather than letting it escape into the air.

**Make Supercrops:** *Proportion of malnourished people in Africa:* 25%. *Solution:* Engineer the cassava into the perfect crop. *Potential:* An African made plant with 10

times the nutrients of the current cassava. *ETA*: 2015. As a staple, 250 million people rely on Cassava root, a cheap root that grows even in the worst conditions. The problem is one of nutrients and shelf life. It is deficient in iron, zinc, vitamin A and vitamin E. It also rots in two days. The objective is to make a power plant. The Donald Danforth Plant Science Center in St. Louis is doing just that; it is a \$12 million effort to create Bio Cassava Plus that has more nutrients, longer shelf life, extra virus resistance and no cyanide producing toxins in the root. Latest progress reveals the production of individual strains with four times the protein, 10 times the vitamin E and 8 times more zinc. Next step: stack genes together in a single plant, using the varieties that Kenyan and Nigerian farmers prefer. The first-ever field trial of a transgenic crop in Africa is underway.

**FAQ:** *Why do grocery-store tomatoes taste like cardboard?*

- Part of the problem is transportation and storage. To keep them from rotting farmers pick fruit prematurely for shipping and distribution hubs treat them with ethylene gas to induce the final ripening closer to your store shelf. This same gas is used on bananas, citrus fruit and honeydew melons. When picked early, these do not produce the same amount of compounds that contribute to flavor, such as when less starch is converted to sugar.

*If I can afford only a few organic produce, which should I buy?*

- According to the Environmental Working Group, a nonprofit public-health advocacy organization, if you eat the conventional “dirty dozen” of fruits and vegetables you will ingest up to 10 different pesticides (peaches, pears, apples, grapes, nectarines, strawberries, cherries, bell peppers, celery, lettuce, carrots, and kale). Safer non-organic bets are onions, avocados and sweet corn which the lowest levels of pesticide residue.

*Will Spinach kill me?*

- All produce, conventional or organic is susceptible to E coli and salmonella via contaminated water or improper use of manure. *Future technology*: nanobiosensors that bond to salmonella bacteria causing dye molecules to fluoresce under a special light.
- **Did You Know....?** The Rough Riders and Teddy Roosevelt never charged on horseback up San Juan Hill. Actually their horses were mistakenly left in Florida so any fighting was done on foot. The fact is that out of any army of 16,000, the Rough Riders numbered just a few hundred and most likely went up Kettle Hill as Roosevelt alluded to soon after. It was Roosevelt that years later talked about San Juan Hill which led to the confusion.

**Happy and Insightful Reading:**

**Arnoldo Carlos Vento, Ph.D**