



[XML](#) [RSS](#) ISIS members area [log out](#)

ISIS has a new office. Please see our [contact](#) details

ISIS Press Release 02/03/09

Science of the Organism & Sustainable Systems

Implications for Agricultural Policies

Views and goods advertised are not necessarily endorsed by Science in Society or the Inst. of Science in Society.

Ads by Google

[Learn Biblical Hebrew](#)
Online Biblical Hebrew lessons. Understand the Bible completely.
www.ClassicalHebrew.com

[Laboratory Automation](#)
Bespoke solutions for non standard laboratory automation.
www.astechprojects.com

[Science Business Course](#)
Executive Course Scientifics 4400€ IDEC-Universitat Pompeu Fabra
www.idec.upf.edu/cmliciz

[Actuarial Salaries Survey](#)
D.W. Simpson & Company, Inc. See What Others Are Being Paid Now
www.actuaryjobs.com

Ads by Google

[Laboratory Consultants](#)
University, Industry & Government Research Facilities Design
www.rfd.com

[Shadow Drive 2](#)
Forensic write protection to view a suspect's system on site
www.mh-Service.de/en/f

Dr. Mae-Wan Ho calls for a shift away from the obsolete mechanistic science that has helped create the current food, fuel, and financial crisis in the midst of climate change. The new science of the organism re-establishes our connection with nature and with indigenous knowledge systems worldwide. Europe's agricultural policies must rise to the challenge, to support and promote organic, localised agriculture and food and energy systems that offers the most effective way out of the current crisis, to deliver health, wealth and happiness to the world's nations.

Briefing for "The Science of Sustainable Agriculture, An Innovative Paradigm" European Agricultural Policy Conference, 3 March 2009, European Parliament, Brussels

From mechanism to organism

The European Enlightenment was responsible for many good things. It was the age of reason over received wisdom [1]. It transferred the power of creation from God to nature, which we can understand by scientific enquiry. It also gave us a powerful view of the world as machine [2] that brought about the industrial revolution; and with it, the enclosure of the commons, capitalism, imperialism, colonialism, world wars, and an industrial, mechanised, chemical [Agriculture without Farmers](#). (*Sis* 27) [3]. Graham Harvey's excellent book [4] will tell you how it happened, and more importantly, how it could be reversed.

This year is the 200 th anniversary of Darwin 's birth, and the 150 th anniversary of the *Origin of Species* . Darwin and Victorian England gave us the idea that competition of one against all, and all against nature is the way to progress. Add Darwinism to Adam Smith's *The Wealth of Nations* (1776), and we get the free market neo-liberal economics that has dominated the world for 150 years [5] (see [Genetic Engineering: Dream or Nightmare?](#)).

That's essentially how the world has been brought to its knees. We have a food, fuel, and financial crisis in the midst of climate change, from decades of ruthless over-exploitation of planet and people.

The mechanistic model has had its day. In science, it was becoming obsolete soon after the turn of the past century with the emergence of the science of the organism. I pick out three books that have influenced me the most. The authors were all inspired by the new physics of relativity, and especially quantum theory. Alfred North Whitehead's eloquent critique of the static, flat, and colourless Newtonian Universe in *Science and the Modern World* [6] is all of a piece with Henri Bergson's insistence, in *Time and Freewill* [7], that time is multidimensional and heterogeneous, giving unique qualities to our innermost experiences. Whitehead argued that we can never really understand nature except as an organism embedded *within* the superorganism of nature herself. Erwin Schrödinger struggled against the Copenhagen interpretation of quantum theory, which insists that nothing can be said about the world in which we live [8] (see [Life & the Universe After the Copenhagen Interpretation](#) , *Sis* 34). His book, *What is Life?* [9], is well known for having predicted the genetic material DNA. But that's only the half of it. The other half predicted the molecular coherence of organisms; which we discovered in my laboratory in 1992.



Search the ISIS website

Google

Search

[printer friendly version](#)

[Apple iPod nano Third Gen Silver \(4 GB\)](#)

[Amazon](#)

Free Shipping, In Stock



It's the small iPod with one very big idea: Video. Now the world's most popular music player lets you enjoy TV shows, movies, video podcasts and more

Best Deals Search

Best Deals from Name Brand Merchants

[amazon.com](#)

Featured Store

[Amazon \\$149.99](#)

[Amazon \\$149.99](#)

[Chitika | eMiniMalls](#)

Recent Publications

NEW! [The Rainbow and the Worm. The Physics of Organisms](#)

"Probably the Most Important Book for the Coming Scientific Revolution" Now in its Third Edition [Buy Now](#) | [More info](#)

NEW! [Food Futures Now: *Organic *Sustainable *Fossil Fuel Free](#)

How organic agriculture and localised food (and energy) systems can potentially compensate for all greenhouse gas

[Science Signaling by AAAS](#)

Science Signaling Pathway Database now available for pathway analysis.
www.AriadneGenomics.com

[MathType - Download Today](#)

The premier Math authoring tool for MS Word, Web, and more!
www.dessci.com

Living organisms have such a high degree of molecular coherence that they appear as dynamic liquid crystal displays under the polarising microscope geologist use for identifying crystals, as you can see in the pictures on the cover of my book [The Rainbow and the Worm, The Physics of Organisms](#) [10] first published in 1993; now in its 3rd much enlarged edition.

Sustainable circular economy of the organism

One main reason organisms are so coherent is because they use energy and resources in a circular way. They run on a circular economy that minimises waste. In the ideal, an organism accumulates no net entropy (representing waste energy and disorganisation), and even the waste exported is minimum. Think of the circle as the organism. A cycle is perpetual return, it sustains itself. Or think of it as the life-cycle, it regenerates itself.

The key to the sustainable circular economy is that it maximises cooperation and reciprocity. The organism has structured activities spanning all space-time scales, those yielding energy are directly coupled to those requiring it, and the giving and taking can be reversed.

In contrast, the dominant economic model of infinite unsustainable growth that depends on competition has no closed cycle and hence no structures within; it generates a lot of wastes and tends to spiral out of control. Boom and bust are inherent to the model.

Sustainable systems as organisms

It soon occurred to me that all sustainable systems are like organisms [11], an idea developed further with theoretical ecologist Robert Ulanowicz at the University of Maryland [12]. And needless to say, this applies all the more so to sustainable agricultural systems as documented in our definitive report [13] [Food Futures Now: *Organic *Sustainable *Fossil Fuel Free](#), ISIS publication). Organic agriculture and localised food and energy systems can potentially compensate for all greenhouse emissions due to human activities and free us from fossil fuels. This conclusion is based on evidence from scientific analyses, case studies in farmer-led research, and especially farmers' own experiences and innovations that often confound academic scientists wedded to outmoded and obsolete mechanistic theories.

There are numerous highlights in this 180 report. But I shall point to a couple of systems that best demonstrate how farmers work with the circular economy of nature to maximise productivity with the minimum work.

Takeo Furano is one of the first organic farmers I visited. He runs a happy circular economy of ducklings in the rice paddies. As you can see in the diagram he drew, weeds and pests become food for the ducklings (saving hours of weeding), and wastes become nutrients for rice plants, plankton, and fish, while the movement of the ducklings provide mechanical stimulation and aeration for the rice plants to grow big and strong. Every year, Furano gets 7 tonnes of rice, 300 ducks, 4 000 ducklings, countless fish, and enough vegetables for 100 people from his 2 ha farm.

Another example of the circular economy is the dyke-pond system perfected by the peasant farmers of the Pearl River Delta, a system so productive that it supported on average 17 people per ha in its heyday. There are many different dyke-pond systems; the one shown here involves growing mulberry, elephant grass and vegetables and raising pigs and silkworms on the dykes. Mulberry feeds silkworms, and after the cocoons are harvested, the faeces of the silkworms are dumped into the ponds to feed the plankton that feed the fish and water plants, which go to feed the pigs. The pig manure also fertilizes the pond. Typically 5 different species of carp are kept in the ponds to fill the different depths and ecological niche. Elephant grass feeds the grass carp.

Professor George Chan was trained as an environment engineer at Imperial College, London, and had many government posts in the US and Mauritius before he was about to retire and spent 5 years with the Chinese peasants of the Pearl River Delta. He said he learnt as much from them as in Imperial College. From his experience in China, he perfected what he called an Integrated Food and Waste Management System, which I call Dream Farm, or Dream Farm 1, and schematised in a diagram based on his description of it.

The biogas digester for anaerobic digestion is the heart of the system; it reinforces the circular economy and makes it run more efficiently. Livestock manure and waste water, instead of being dumped directly into the fishpond, go into the biogas digester where it is sterilised and converted into biogas - 60 percent or more of methane - that can provide all energy needs for cooking, heating, electricity and processing. The residue is a rich fertilizer for crops or for growing mushrooms. The waste water is still not passed directly into the fish

emissions due to human activities and free us from fossil fuels
[Buy Now](#) | [More info](#)



NEW! The only radical science magazine on earth
Science in Society 41 **OUT NOW!** Order your copy from our [online store](#).



NEW! [GM Science Exposed](#). A

comprehensive dossier containing more than 160 fully referenced articles from the Science in Society archives.
[Buy Now](#) | [More info](#)



GMO Free: Exposing the Hazards of

Biotechnology to Ensure the Integrity of our Food Supply
[Buy Now](#) | [More info](#)

Join the I-SIS mailing list; enter your email address

html asci
[subscribe](#)

pond, but goes through oxidative cleansing in shallow basins with algae which produces oxygen through photosynthesis to oxidize the remaining chemical and biological pollutants. Only then is the water allowed to go into the fishponds. Water from the fish ponds can be used to 'fertilize' crops. Algae can be harvested to feed chicken, ducks and geese. Crops wastes go to raise earthworms or compost, or they could be fed into the biogas digester as well. What remains after the mushroom harvest can be fed to livestock, along with crops, and the livestock manure goes back into the biogas digester to complete the grand cycle. And as you can see this farm is incredibly productive because it relies entirely on internal input, recycling all the wastes and turning wastes into food and energy resources.

You can have floating garden, rice crops on the ponds as well as crops on the dykes, and clean, very happy pigs.

Dream Farm 2 to feed and fuel the world, and mitigate climate change

So, we put everything together in an integrated food and energy Dream Farm 2 operating on the same organic circular economy. It differs from Dream Farm 1 only in the explicit incorporation of renewable energies at small to micro-scale: wind, solar and hydroelectric (where appropriate). This is the ideal Dream Farm 2 for demonstration/education and research purposes, an incubator and showcase for new technologies, information exchange and resource centre for Dream Farms around the world, *all using local resources and biodiversity as much as possible*. The diagram is colour-coded. Pink is for energy, green for agricultural produce, blue is for water conservation and flood control, black is waste in the ordinary sense of the word, which soon gets converted into food and energy resources.

Anaerobic digestion is the core waste-treatment and energy technology in Dream Farm 2 as in Dream Farm 1. With anaerobic digestion of organic wastes, we do not need any bioenergy crops that compromise food security.

Anaerobic digestion is a boon for Third World countries, as it provides a labour-saving smokeless fuel for cooking (much healthier for women and children), a means of generating electricity for lighting that extends social and working hours, and improved sanitation [14] ([Biogas Bonanza for Third World Development](#), *SiS* 27). The Chinese government has been promoting the widespread use of biogas digesters for years to support a burgeoning eco-economy; they provide some of the necessary energy while preventing more than 90 percent of the environmental pollution [15] ([Biogas China](#), *SiS* 32).

In addition to combined heat and power generation that improves the efficiency of energy use by at least 50 percent, biogas methane is by far the cleanest fuel for mobile use [16] ([Organic Waste-Powered Cars](#), *SiS* 30). Biogas methane-powered cars were voted environmental cars of the year in 2005. Existing cars that run on natural gas will run on biogas methane, appropriately cleaned and upgraded. Italy has filling stations for natural gas every 25 km [17] ([The Biogas Economy Arrives](#), *SiS* 40), but it doesn't have biogas methane yet. Sweden has taken to anaerobic digestion for producing energy on a large scale, with small local farmscale digesters comprising 10 percent. It is on course to generate 10 000 GWh/year by 2050. Biogas is most suitable for transport within city areas, and local fleets are already operating in Gothenburg, Linköping, and Stockholm [18].

Since the Food Futures Report was published, I have refined the calculations [19] ([Organic Agriculture and Localized Food & Energy Systems for Mitigating Climate Change](#) (*SiS* 40), with pretty much the same results. If Dream Farm 2 were universally adopted over the world, it would have the potential to mitigate 56.6 percent of greenhouse emissions and 50.5 percent of energy use.

Consuming energy locally at or near the point of production increases energy use efficiency by 60–70 percent, because any 'waste' heat generated (typically about 60 percent of the energy) could be used, and losses due to long distance transfer are minimised. So if we take a modest increase in efficiency half of what is theoretically possible, we reduce fossil energy use by another 30 percent, and hence save a further 17 percent of ghg emissions.

Thus, it would not be surprising if fossil energies could be eliminated altogether.

A combination of solar, wind and micro-hydroelectric with biogas would provide well above the energy needs on the farm, and the excess energy could be fed into the grid system supplying local homes and businesses.

We are helping to set up Dream Farm 2s around the world, and there has been a tremendous amount of interest. Closest to home is an Urban Dream Farm 2 proposed by Alex Smith, who owns an organic food factory next to the new Eurostar terminal in London. Alex has been elected a London Leader for 2009, and wants to make his mark by establishing an Urban Dream Farm 2. Food

wastes will be treated by anaerobic digestion to generate energy, and the residue used to fertilize the organic gardens and plots around the area.

Some key lessons of circular economy

Some key lessons of circular economy are elaborated in the final chapter of our Food Futures Report [13].

- Sustainable development is possible, and *not* a contradiction in terms, as some critics of the dominant model claim. By incorporating more and more cooperating life cycles, more biomass is produced to support more life, more business; more people.
- Reciprocal symbiotic relationships are the key to the circular economy, and that is dependent on biodiversity, the more diverse the more productive, exploding the myth that there is a constant carrying capacity to a piece of land
- It makes explicit why an unregulated financial market is toxic to the real economy.

The economic system is embedded in and dependent on the ecosystem. If you have a financial market that creates paper money out of nothing several times over, this will go to fuel conspicuous consumption and exploitation of the earth's resources, well beyond what it can sustain. Money in an economic system is often compared to energy in the living system. When money ceases to flow, the economic system collapses, just as the living system cannot function without energy flow. This analogy holds so long as the financial market is accountable to the real economy that trades in goods and services, but breaks down completely with the proliferations of the unregulated financial sector [20] ([Financing Poverty](#), *SiS* 40). All money is not equal, that created in the unregulated financial sector is not energy as much as pure entropy, the toxic dissipation that ultimately kills the system. In healthy systems, money, like energy, flows symmetrically in fair exchange based on real values of goods and services, so little entropy or waste is generated.

Contemporary Western science *is* shifting away from mechanical reductionism towards an organic, holistic perspective that has deep affinities with indigenous knowledge systems across the world [21], as so clearly seen in agriculture.

European agricultural policies should be promoting organic, localised food and agricultural systems, and supporting appropriate research that combines the best of organic science and indigenous local knowledge, making sure that scientists and farmers work in equal partnership (more details in [22] [Towards a Convention on Knowledge](#), ISIS publication).

And most important of all, Europe should firmly reject genetically modified crops, and we already presented fully [The Case for A GM - Free Sustainable World](#) in 2003[23] (ISIS publication). Now six years later, the evidence is even more compelling. We should ban environmental releases of GMOs decisively now. Genetic modification was inspired by the old genetic determinist paradigm, already superseded by the new genetics of the fluid genome [24] ([Living with the Fluid Genome](#), ISIS publication) almost as soon as it began in the late 1970s. The fluid genome makes genetic modification dangerous and definitely not the way to sustainability [25, 26] ([GM is Dangerous and Futile](#), [GM is Not the Way to Sustainability](#), *SiS* 40). We cannot trust the regulators to protect us, as they are doing their best to ignore the damning evidence on safety, corrupting science, and even helping to promote GMOs [27] ([GM Food Nightmare Unfolding in the Regulatory Sham](#), ISIS scientific publication).

. Whenever truly independent scientists carry out feeding trials with GMOs, they find sick or dead animals. The latest, a study commissioned by the Austrian government, shows that [28] [GM Maize Reduces Fertility & Deregulates Genes in Mice](#) (*SiS* 41). At the same time, geneticists are documenting how toxic substances affect not just the individuals exposed, but also their children and children's children [29] ([Epigenetic Inheritance - What Genes Remember](#), *SiS* 41), basically because the substances determine how certain genes are expressed, and the environmental effects become inherited [30] ([Epigenetic Toxicology](#), *SiS* 41). That's why risk assessment of GMOs and other xenobiotics have to be carried out over three or four generations. Decades of sequencing and dissecting the human genome have confirmed that the real causes of ill health are environmental and social [31] ([From Genomics to Epigenomics](#), *SiS* 41). It is not the genetic messages encoded in genomic DNA, but environmentally induced epigenetic modifications that overwhelmingly determine people's health and wellbeing. Early nutrition and parental care play a large role [32] ([Caring Mothers Strike Fatal Blow against Genetic Determinism](#), *SiS* 41) in an individual's physical and mental health.

Europe's agricultural policies must rise to the challenge, to support and promote organic, localised and biodiverse agriculture that is the most effective way to deliver health, wealth, and happiness to the world's nations.

References

1. Enlightenment, *Encyclopaedia Britannica* , vol 8, pp. 599-602, 1964.
2. Mechanism, Wikipedia. 3 February, 2009, [http://en.wikipedia.org/wiki/Mechanism_\(philosophy\)](http://en.wikipedia.org/wiki/Mechanism_(philosophy))
3. Gala R. Agriculture without farmers, In Food Futures Now, [Science in Society 27](#), 30-32, 2005.
4. Harvey G. *The Carbon Fields* , Grass Roots, Somerset , 2008.
5. Ho MW. *Genetic Engineering Dream of Nightmare? The Brave New World of Bad Science and Big Business*, Third World Network, Gateway Books, MacMillan, Continuum, Penang, Malaysia, Bath, UK, Dublin, Ireland, New York, USA, 1998, 1999, 2007 (reprint with extended Introduction). <http://www.i-sis.org.uk/genet.php>
6. Whitehead AN. *Science and the Modern World*, Penguin Books, Harmondsworth, 1925.
7. Bergson H. *Time and Free Will. An Essay on the Immediate Data of Consciousness* (F.L. Pogson, trans.), George Allen & Unwin, Ltd., New York , 1916.
8. Ho MW. Life & the universe after the Copenhagen Interpretation. [Science in Society 34](#), 332-33, 2007.
9. Schrödinger E. *What is Life?* Cambridge University Press, Cambridge 1944.
10. Ho MW. *The Rainbow and the Worm, the Physics of Organisms* , World Scientific , Singapore , 1993, 2 nd ed. 1998, reprinted 1999, 20021, 2003, 2005, 2006; 3 rd ed. 2008. <http://www.i-sis.org.uk/rnbwrm.php>
11. Ho MW. On the nature of sustainable economic systems. *World Futures* 1997, 51, 199-221. <http://www.i-sis.org.uk/onlinestore/papers1.php#section3>
12. Ho MW and Ulanowicz R. sustainable systems as organisms? *BioSystems* 2005, 82, 39-51. <http://www.i-sis.org.uk/onlinestore/papers1.php#section3>
13. Ho MW, Burcher S, Lim LC, et al. *Food Futures Now, Organic, Sustainable, Fossil Fuel Free* , ISIS TWN, London , 2008. <http://www.i-sis.org.uk/foodFutures.php>
14. Ho MW. Biogas bonanza for Third World Development. [Science in Society 27](#) , 29, 2005.
15. Li K-M and Ho MW. Biogas China . [Science in Society 32](#) , 34-37, 2006.
16. Ho MW. Organic waste-powered cars. [Science in Society 30](#) , 38-39, 2006.
17. Ho MW. The biogas economy arrives. [Science in Society 40](#) , 16-18, 2008.
18. Lindberg S. Developing New Markets in Scandinavia, Defra Workshop, Methane to Markets, 29-30 November 2006, Kindersley Centre, Berkshire, http://www.methanetomarkets.org/events/2006/agriculture/ag_nov2906.htm
19. Ho MW. Organic agriculture & localised food and energy systems for mitigating climate change. [Science in Society 40](#) , 24-28, 2008.
20. Ho MW and Saunders PT. Financing poverty, From the Editors, [Science in Society 40](#) , 2-3, 2008.
21. Ho MW. Towards an indigenous Western science: causality in the universe of coherent space-time structures. In *Reassessing the Metaphysical Foundations of Science* (W. Harman, ed.), Noetic Sciences Institute, 1994.
22. Ho MW, Novotny E, Webber P, Daniels EE et al. *Towards a Convention on Knowledge* , ISIS, London , 2002. <http://www.i-sis.org.uk/conventiononknowledge.php>
23. Science Panel Report, Institute of Science in Society and Third World Network, London and Penang, 2003; republished *GM-Free, Exposing the Hazards of Biotechnology to Ensure the Integrity of Our Food Supply* , Vitalhealth Publishing, Ridgefield, Ct., 2004 (both available from ISIS online bookstore <http://www.i-sis.org.uk/onlinestore/books.php#1>)
24. Ho MW. *Living with the Fluid Genome* , ISIS TWN, London , 2003.
25. Ho MW. GM is dangerous and futile. *Science in Society 40* (in press).
26. Saunders PT. GM is not the way to sustainability. *Science in Society 40* (in press).
27. Ho MW, Cummins J and Saunders PT. GM food nightmare unfolding in the regulatory sham. *Microbial Ecology in Health and Disease* 2007, *Disease* 2007, 19, 66-77.
28. Ho MW. GM maize reduces fertility & regulates genes in mice. [Science in Society 41](#) , 40-41, 2009.
29. Ho WM. Epigenetic inheritance, "what genes remember". [Science in Society](#)

- [41](#), 4-5, 2009
30. Ho MW. Epigenetic toxicology. [Science in Society 41](#), 12-15, 2009.
31. Ho MW. From genomics to epigenomics. [Science in Society 41](#), 10-12, 2009.



[Apple iPod nano Third Gen Silver \(4 GB, MA978LL/A\)](#)

[Amazon](#)

Free Shipping, In Stock

Description	Best Deals	Search	Chitika eMiniMalls
It's the small iPod with one very big idea: Video. Now the world's most popular music player lets you enjoy TV shows, movies, video podcasts, and more. The larger, brighter display means amazing picture...			

The Institute of Science in Society, The Old House 39-41 North Road, London N7 9DP
 telephone: **[44 20 7700 5948]** **[44 20 8452 2729]**

[Contact the Institute of Science in Society](#)

MATERIAL ON THIS SITE MAY NOT BE REPRODUCED IN ANY FORM WITHOUT EXPLICIT PERMISSION. FOR PERMISSION, PLEASE CONTACT enquiries@i-sis.org.uk