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Aquaponics & Landfill Methane Use: These Fetid Miasmata Smell Like Profitable Conservation

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*by Blake M. Mensing**

On the surface, aquaponics[1] (a portmanteau word of aquaculture and hydroponics)[2] and the use of landfill methane for energy[3] have very little in common. However, both utilize waste to power another system while reducing the net amount of waste generated.[4] Reciprocating or symbiotic technologies are a beneficial alternative to traditional technologies because they reduce waste and mimic the closed ecological systems that have garnered the attention of some of the world's greatest scientific minds and some of the world's youngest.[5] This article outlines the basic processes involved in aquaponics and landfill methane utilization and then proposes that more synergistic systems should be developed and then implemented on a larger scale to minimize total human waste output.

Aquaponics combines fish farming and soilless vegetable production to help to eliminate some of the major shortcomings of each process.[6] The result of this conglomeration is that the only input required is fish food.[7] Water conservation is a particularly desirable benefit of combining hydroponics and aquaculture.[8] The fish produce an effluent rich in plant nutrients, but toxic to the fish in high quantities, so the water is filtered by the roots of the plants and then pumped back to the tanks.[9] Leafy vegetables and spice plants seem to be able to utilize the nitrogen-rich tank water most efficiently and the crop helps to augment the profits of a fish farmer by producing another saleable good and reducing the costs of filtering the tank water.[10] Another possible benefit of aquaponics is that the harvested fish relieve some of the strain on the world's fishstock.[11] When properly monitored, both the fish stock and the hydroponic vegetable crop thrive.[12]

Methane is widely recognized as one of the six major greenhouse gases that are accumulating in the Earth's upper atmosphere and are contributing to the steady uptick in global average mean temperatures.[13] In the United States, landfills accounted for twenty-three percent of total methane emissions in 2006.[14] The impact of methane is more than twenty-five times greater than carbon dioxide, though fortunately its atmospheric concentration is much lower.[15] One method of reducing methane emissions is to capture and convert the gaseous effluvium from landfills into usable fuel for electricity generation.[16] As the garbage in a landfill breaks down, many different gases are released.[17] The gaseous mixture is made of approximately fifty percent methane, which can be separated from the remaining gases and used for the generation of electricity.[18] The capture and use of methane from landfills not only reduces the total amount of biomethane generated, but also prevents the release of some carbon dioxide that would be produced through traditional coal-fired power plants.[19]

Aquaponics is a sustainable practice because the waste of one system is used to fuel another symbiotic system and the only input is the fish food.[20] As long as the fish food used is produced in a sustainable manner, then the pitfalls associated with traditional aquaculture are more easily avoided.[21] Similarly, landfill methane capture for energy production is an efficient utilization of a gas that would otherwise be emitted into the atmosphere without being put to use.[22] Aquaponic farms could and should be placed near landfills to have their electricity needs met from the methane generated during landfill decomposition, further reducing total wastes by minimizing the costs of transmitting electricity. In order to further the progress towards sustainable development, scientists and engineers need to train their eyes on systems that use wastes so as to reduce the net impact of human consumption on the environment. The philosophy behind both aquaponics and landfill methane capture is based on reducing the net wastes generated by humans through the utilization of system outputs. When profit maximization and waste reduction collide, both business and the environment benefit.

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While neither system is perfect, their underlying foundations are a step in the right direction. Human production processes should be evaluated in light of the success of aquaponics and landfill methane capture because it is likely that the examination will uncover other wastes that have been overlooked as possible inputs. In the instances where a pair of systems could form a symbiotic relationship, humanity should take advantage of that symbiosis to help to reduce our enormous ecological footprint. If clean technology can include a profitable use for fish excrement and the gas gathered from festering garbage, then the scientific and business communities surely have many more ecologically sound profit avenues to explore.

Endnotes: Aquaponics & Landfill Methane Use *continued on page 59*

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[1] *See generally* Aquaponics.com, Information—Aquaponics Overview, http://www.aquaponics.com/InfoAquaponics.htm (last visited Mar. 25, 2009) [hereinafter Overview] (noting that aquaponics is in its commercial infancy despite the existence of fish farming and soilless plant culture in combination for thousands of years).

[2] *See* PracticalEnvironmentalist.com, What the Heck is Aquaponics?, http://www.practicalenvironmentalist.com/gardening/what-the-heck-is-aquaponics.htm (last visited Apr. 3, 2009).

[3] *See* Department of Energy, Landfill Gas to Energy for Federal Facilities: Fact Sheet, *available at* http://www.epa.gov/lmop/res/pdf/bio-alt.pdf (last visited Mar. 25, 2009) (placing the birth of landfill gas capture for energy use in the late 1970s).

[4] *See generally* Overview, *supra* note 1 (describing how the problem of removing nutrient rich water from an aquaculture system satisfies the need for nutrient rich water in a hydroponic system); Energy Information Administration, Landfill Gas, http://www.eia.doe.gov/cneaf/solar.renewables/page/landfillgas/landfillgas.html (last visited Apr. 3, 2009) (providing official energy statistics compiled by the U.S. Government and stating that the landfill methane that is captured and burned for fuel is prevented from leaching into the atmosphere).

[5] *E.g.*, Eco-sphere.com, The Inside Story, http://www.eco-sphere.com/aboutecosphere.htm (last visited Mar. 25, 2009) (advertising a closed, interdependent ecological system as an educational tool for young people; the system was first developed by NASA scientists as they attempted to create self-contained communities for astronauts).

[6] Steve Diver, National Sustainable Agriculture Information Service, Aquaponics: Integration of Hydroponics with Aquaculture 1-2 (2000), *available at* http://www.attra.org/attra-pub/PDF/aquaponic.pdf (enumerating the benefits of aquaculture's use of wastes to fertilize plants situated above fish tanks).

[7] *See id.* at 1 (pointing out that "[g]reenhouse growers view aquaponics as a way to introduce organic hydroponic produce into the marketplace, since the only fertility input is fish feed and all of the nutrients pass through a biological process").

[8] *See* What the Heck is Aquaponics?, *supra* note 2 (distinguishing deep water aquaponics from reciprocating aquaponics by describing the differing plant placement and comparing aquaponics to conventional agriculture and concluding that ". . . aquaponics is a huge water saver.").

[9] *E.g.*, Overview, *supra* note 1 (proffering that a miniature ecosystem is created that benefits both the fish and the plants).

[10] Center for Innovative Food Technology, Alternative AG Ventures – Aquaponics 1, *available at* http://www.eisc.org/attach/aquaponics.pdf (articulating that farmers can profit from their hydroponic vegetables grown on less than one acre of land).

[11] *See* Rosamond L. Naylor et al., *Effect of Aquaculture on World Fish Supplies*, 405 Nature 1017, 1018 (2000) [hereinafter *Effect of Aquaculture*] (presenting the pros and cons of fish farming and noting that tilapia can displace the catches of some wild species such as cod, hake, haddock, and pollock).

[12] Overview, *supra* note 1.

[13] *See* UN Framework Convention on Climate Change, GHG Data from UNFCCC, http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php (last visited Apr. 3, 2009).

[14] Environmental Protection Agency, Landfill Methane Outreach Program, http://www.epa.gov/lmop/overview.htm (last visited Apr. 3, 2009) [hereinafter LMOP] (asserting that there are over 500 landfills that are good candidates for methane capture and energy use).

[15] *See* ScienceDaily.com, *Greenhouse Gases, Carbon Dioxide and Methane, Rise Sharply In 2007* (Apr. 24, 2008), *available at* http://www.sciencedaily.com/releases/2008/04/080423181652.htm.

[16] *See, e.g.*, GHGonline.org, Sources of Methane – Landfill, http://www.ghgonline.org/methanelandfill.htm (last visited Apr. 3, 2009) (observing that up to fifty percent of landfill methane emissions can be reduced through methane recovery systems, including methane capture for energy production).

[17] *See* LMOP, *supra* note 14 (clarifying that a small amount of non-methane organic compounds are released in the decomposition process).

[18] *Id.*

[19] *E.g.*, Chicago Climate Exchange, Landfill Methane Emissions Offsets, http://www.chicagoclimatex.com/content.jsf?id=222 (last visited Apr. 3, 2009) (recognizing the offset potential of "[m]ethane collection projects that include electricity generation," which may qualify "based on displaced emissions").

[20] *See, e.g.*, Diver, *supra* note 6, at 1 (lauding the benefits of aquaculture in large part because of the symbiotic use of fish effluent and the bio-filtration that the plant roots perform).

[21] *See Effect of Aquaculture*, *supra* note 11, at 1019 (warning that tilapia fish feeds often exceed the percentage requirement for the level of fish meal used and that fish meal is produced from wild caught fish).

[22] *See* LMOP, *supra* note 14.