Clustering Maggots, Fish and the Treatment of Diabetic lesions

Executive Summary:

Maggot Farming is a viable business venture on multiple levels. Maggots can process offal and then be used as feed for livestock. They have higher levels of protein than the usual soy based feed. This could greatly reduce the carbon and water footprint of the meat industry. Maggot treatment for wounds is also making a major comeback. It has been found to be especially effective on serious diabetic lesions. Furthermore, maggots are now being utilized to process human waste and can also be processed into sources of proteins, fats and chitin. The clustering of these different applications generates multiple cash flows, making the business resilient. The system is not capital intensive, allowing start up projects to quickly make a turn around.

Key words:

Maggots, feed, overfishing, surgical dressings, resilient businesses, local economic development, multiple cash flows

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Photographs The ZERI Network

Maggot Farming: Feed for Fish and Quails

When I visited The Songhai Center in Porto Novo (Benin), I was impressed with the groundbreaking work of Father Godfrey Nzamujo. In 1985 he had secured a piece of land in the peri-urban area of Porto Novo, in order to realize a dream to improve the livelihoods of Africans. The integrated farm he established is amongst the best I have seen. It was much in line with what I learnt from Prof. George Chan, in Mauritius, who had pioneered Integrated Biosystems by combining animal husbandry, fish farming, biogas production, natural waste water treatment and processing the output into consumer goods of organic quality. The one thing missing on the farm from my checklist of the five kingdoms of nature was Fungi, but this was soon rectified by our colleague from Zimbabwe, Margaret Tagwira, who introduced mushroom cultivation.

Songhai logo © 2006, ZERI

What I wanted to learn from the Father was maggot farming. He had his own slaughterhouse, and all the offal was used to feed the flies and turn their eggs into maggots, which he then fed to quails. He had an abundant supply of quail eggs, some of which were destined for export to Paris. For Father Nzamujo, this was a nice additional earning. He indicated that 90% of the cost of quail farming is the feed. Since he uses his own maggots as feed, it costs him much less to raise them, allowing him to be a competitive seller on the global market. Before my eyes, I saw the unfolding of the concept of *upsizing (or upcycling in German)* which I had just described in my book with the same title.


Songhai maggot farm in Porto Novo © 2006, ZERI

While Father Nzamujo focused on an integrated system, new entrepreneurs emerged focusing on the production of protein from maggots. I first met the South African brothers-Jason and David Drew- in 2010 when they had just decided to sell their holdings in call centers in order to create a new "maggot" business. I visited their test

Maggots at Elsenburg trial farm of AgriProtein © 2010, ZERI

facility located on their farm outside Franschoek (Western Cape, South Africa). Their company- AgriProtein- raised the money and collaborated with Stellenbosch University to convert its Elsenburg facility into a maggot farming test unit. In the US the maggot story has its own champion. Glenn Courtright left the military after 22 years and, after a stint working with biodiesel, turned to maggot farming. His company - EnviroFlight - now manages a 2,000 square meter facility outside Dayton, Ohio. He cracked production and procreation of flies and eggs. His trials demonstrated that he could produce the same amount of protein in ten days, as a pig does in six months, from a stack of five bins of maggots. Glen also got a patent for his "love shack", the place where he breeds and harvests the eggs of solder flies.

Glenn shares the vision of the Drew Brothers from South Africa: that it is time to fundamentally shift the feed business. Every ton of maggots can replace a ton of fish, caught only to feed other fish. Salmon devour three kilograms of sardines to deliver one kilogram of orange flesh. The nutritional value of sardines is higher than that of salmon but marketing has left commoners (like me, until recently) with the impression that sardines are lower in quality. The value of pelagic fish has increased over the past decade 300%; the opportunity to convert scrap food and offal into protein is attractive, from an environmental and a business point of view. Even at the small scale of production today, Glen is able to offer fish feed 16% cheaper than fish meal. He also sells the maggot scrap as high end fertilizer, earning an additional income. The Blue

Economy concept is confirmed both in Africa and in North America: local, better and cheaper.

This new business model offers a distinct feature: people feel better about the product. Everything has become a commodity, and everyone is chasing the lowest price. Merely having good ideas and technology is not enough. One needs to stand out as distinctly different from the nearest competitor. This depends substantially on how people feel about the product. Do they really want to encourage overfishing, or would they rather have food without depleting our fish stocks? Similarly, investors feel differently about the business. If you have multiple revenues, then there is more income and that reduces the risk.

Maggot Farming: Treatment of Diabetic lesions

I have been sharing the story of maggot farming around the world. In 2005 I learned that the National Health Service of the United Kingdom had a special division in Wales named Surgical Materials Testing Laboratory. Dr. Steve Thomas, then the director, had taken charge of a research program to cut the annual cost of surgical dressings, used mostly on Diabetic lesions. Through a chance meeting in 1992 Steve realized that it was time to revive the tradition of maggot treatment for diabetic wounds. The increased ineffectiveness of antibiotics motivated the medical team and it only took 6 months to develop a method before the first patients were treated with sterile maggots. Professor Nicky Cullum of the University of Manchester[1] and her colleagues established that larvae close leg ulcers in 14 days. This solid proof set off a new avenue for creative business developments complementary to those we already knew.

The success and the subsequent demand for maggot treatment surprised everyone. Sales reached a million dollars and, by 2000, larvae production had outgrown the facilities. So the unit was spun off into a private company Zoobiotic Plc. However it took seven years before the larvae treatment (marketed under the brand name LarvE) gained Drug Tariff Status. This certifies it to be effective, allowing treatment costs to be covered by the National Health Service (NHS). The business only faced one German competitor on the European market which they soon acquired, along with a name change to Biomonde. They also successfully patented their unique dressing-Biobag-

[1] Cullum, C., Bland, , Dumville, , Iglesias, , O'Meara, , Soares, , Torgerson, , Nelson, & Worthy. (2009). Larval therapy for leg ulcers Study. *British Medical Journal*, 338

which contains live maggots inside, providing a controlled application of maggots for the ulcer patients, as opposed to having them roam the wounds. When the American Food and Drug Administration (FDA) (finally) approved the same treatment in 2014, Biomonde created their third production unit in Gainesville, Florida (USA). The maggots are now part of the Florida Innovation Square. The market is vast. The United States spent $20 billion on diabetic wound treatment in 2013, and the number of Americans diagnosed with diabetes was projected to increase from 11 million in 2000 to 29 million in 2050.

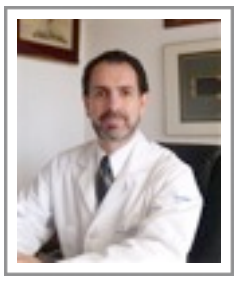
BioBag packages with maggots as wound dressing © 2014, Biomonde

While I followed the project in Wales, I came to know Stephen Brittland from the University of Bradford. He had undertaken research on the effectiveness of extracted maggot saliva, obtained simply by submerging the "animals" in salt water. He teamed up with a gel maker - Advance Gel Technology (AGT) - to produce a topical product with a shelf life. Even though the prospects were good, the combination could not compete with the 48 hours window the BioBag offers. This AGT case described as Case 2 in the first series of The Blue Economy under the subtitle "Nature's Nurses" has lost the competitive game and has given way to a broader portfolio of opportunities.

Maggots and Their Prospects:

This work has inspired many. I talked to entrepreneurs and academics around the world and encouraged them to pursue this new portfolio of business options, not only to deliver better therapy, but also to create new industries, with a proven demand, based on local resources. Dr. Jose Contreras of the General Hospital Dr. Manuel Gea Gonzalez in Mexico City[2] introduced the treatment in 2000; Prof. Luis Figueroa at the Universidad Austral in Chile initiated treatments in 2003; Prof. Hilderman Pedraza Vargas from the National University in Colombia started in 2008 to apply the maggot treatment to land mine victims. While many put their findings in scholarly articles, he chose to post his findings on a public page[3], making the old know-how of the Maya's accessible again.

Dr. Hilderman Pedraza Vargas



Dr. Jose Contreras Ruiz © 2014

The start-up for a small industrial facility hovers between €3 and 10 million. The investment proposals get funded because the business generates multiple cash flows and benefits. This is a key requisite to delivering products of a higher quality at a lower cost, even during the early phase of scaling up the output. The multiple cash flows are not limited to maggot therapy and protein for feed. Various parts of the larvae are pure sources of chitin, oils and lipids. It may be tough to convince any food lovers to go for maggots, but there are examples in the United States that this niche market is ready to be served. AgriProtein (South Africa) has another take on creating value from their know-how. They assist local communities that lack sewage systems to treat human waste through maggot-based systems, creating a sewerage service that pays for itself.

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2 www.cronica.com.mx/notas/2007/290671.html

3 larvaterapia.wix.com/larvaterapia; www.facebook.com/pages/Simbiosis-Larvaterapia/675073695918945

The Gates Foundation supported the initial testing and the results are up for publication in 2015.

With a solid business model to back it, which is not capital intensive, more entrepreneurs are being enticed onto the maggot bandwagon. The City of Leipzig floated the ambitious idea to create a maggot farm that would process 5,000 tons of offal, turning the cost of the shipment of offal and that of incineration into an investment. It would generate at least 1,000 new jobs and reduce the dependency of the pig and poultry farms on imported feed. Unfortunately, the European Food Safety Authority had reservations on a farmed animal eating another farmed animal. The logic of prohibiting it is based on the "mad cow" disease where cows were forced into a kind of cannibalism. Thus the Agency is technically right but the objections were not formulated with a contextual understanding: when a farmed fly is eating the offal of a farmed cow, pig or chicken it is following the wisdom of a natural system. In addition, these reservations stand against the approval of the NHS and the FDA to use maggots for wound therapy.

The Agency realizes that this is not just the feeding of waste from cows to cows. It is now debating (1) what maggots should be allowed to eat and, (2) which animals should be permitted to eat them. Quails, for example, have always thrived on fly larvae. The American FDA is likely to be a pro-active regulator. Apart from the reluctance of

European authorities, there should be few obstacles to prevent this from turning into a global high growth business opportunity.

The hiccups in regulation are not stopping entrepreneurs from moving forward. Apart from the pioneers already mentioned, there is Kees Aarts, who created Protix Biosystems in the Netherlands in 2013 and raised €10 million (protix.eu); Jean-Gabriel Levon, Alexis Angot and Antoine Hubert, who created Ynsect in Paris (ynsect.com) and

raised €5 million; Enterra Feed of Vancouver (enterrafeed.com) which was created, in 2007, as a result of a heated debate on the sustainability of aquaculture feed between Brad Marchant, a serial entrepreneur, and Dr. David Suzuki; and Entologics of Brazil (entologics.com) created by Carlos Muccioli and François Rozwadowski. They realized that maggot farming with endemic Brazilian fly species would bring a fresh portfolio of businesses to the burgeoning feed and food industries that would contrast starkly to soya and its little respect for biodiversity.

Maggots in the future:

So 18 years after I was first exposed to the maggot opportunity a real cluster emerges, combining feed, food, health, biodiversity and job generation, that can take on the traditional production of food based on fishmeal and soy. Perhaps it is worth adding here that maggots contain up to 60% protein, and 25% fats, compared the 35% of protein of the much heralded soy-based feed.

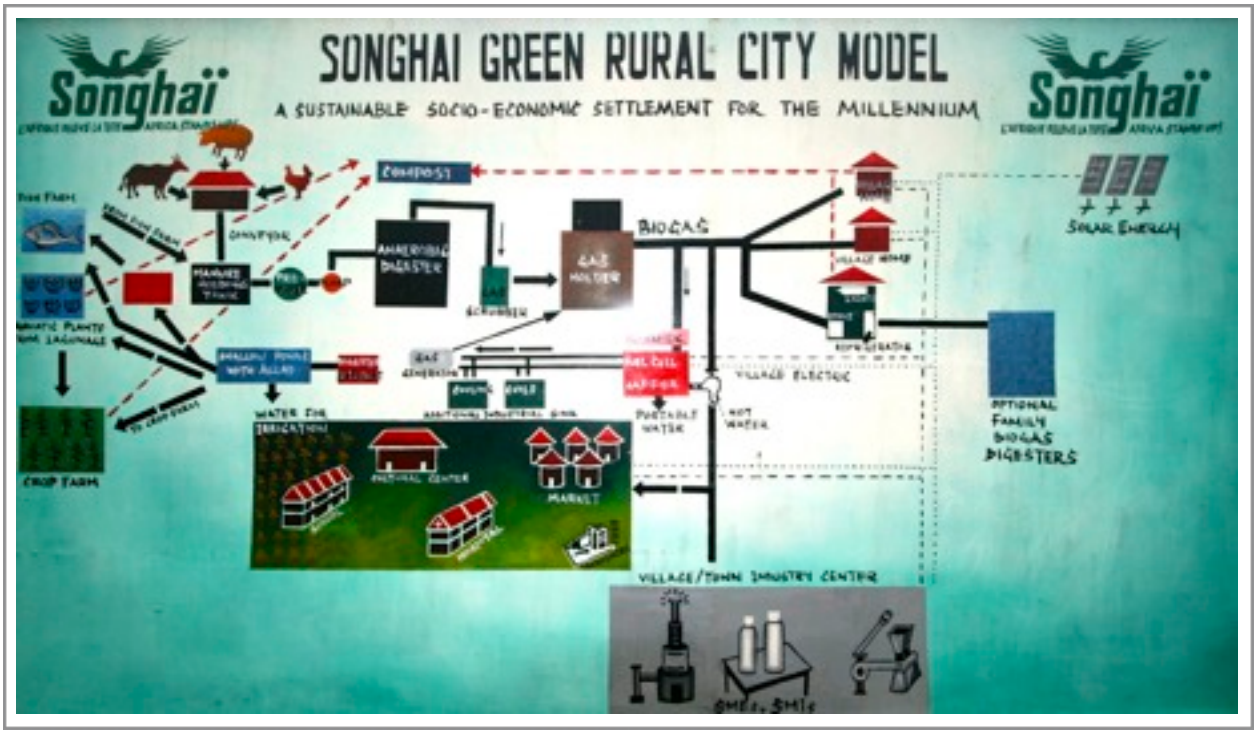
My prognosis is that within one decade the maggot cluster will be firmly established on all continents. The present companies and operations we know of will have increased to at least 500 production corporations, with a combined daily output of approximately 1,000 tons per day on the low side and 5,000 tons on the high side. The production of maggot feed and food will generated at least 250,000 jobs, a downward revision of the estimated 500,000. While the potential is certainly in the order of 5 million, a broad scale implementation will still require a few decades. However, the present amount of capital already committed is just under €50 million, and the number of direct jobs surpassed the 2,500 in 2015. The number of indirect jobs, especially in the medical field with +1,500 medical institutions offering maggot treatment, there are an estimated 6,000 nurses and medical support staff employed offering the "maggot treatment". As we can see, the drive to substitute fish as fish feed, has unexpected consequences, generating a multiple number of jobs in health care. It is here that we see the greatest job growth in the years to come.

A rich new research agenda at universities across the globe will catapult the industry. This is assuming that endemic species are used and businesses resist the old model of predictability through standardization and economies of scale and focus on resilience and multiple revenues. The power of the maggot business is the clustering of all activities. Depending on the time and place, parts can be deployed, and new ones can

be imagined. Investors will need to put up between $500 million and $2 billion in cash for these 500 new corporations to build their capital base and provide the working capital. The advantage is that the turn-around is not only measured in days, the value generated from "nothing" competes with supply chains that are under heavy sustainability stress.

Since the science is right and will get better, I expect regulators to review their original concerns and back-up these highly resource efficient clusters. However, the greatest obstacle I expect will come from the traditional feed suppliers. They will put up a fight since this will decrease sales prices, reducing their margins due to new, fundamentally different competition. The question is how the traditional feed producers will respond to the tremendous story to tell. It is likely that, by 2020-2025, the old guard will have accepted the newcomer and embraced the new business model. This may signal that it is time for the initiation of insect based products and services, further lowering the carbon and water footprint of the animal protein business with a resource efficient production model that can operate in an urban, peri-urban and rural environment.

Graphic: The Integrated Biosystem of the Songhai Center in Porto Novo (Benin)



Translation of the Maggot Case into Gunter's Fables

The Maggot farming story is translated into the fable #50 entitled "Maggot Spit". It is dedicated to Father Godfrey Nzamujo, who inspired the creation of this cluster back in 1996. It is first published in Chinese and English in April 2015 and is available on www.guntersfables.com.

Documentation

Viewers are warned that the images may not be for a broad audience. Caution must be made when viewing the critical condition of the patients at the outset, and the dramatic improvements that unfold. This slideshare is in Spanish only, but the images are self-explanatory.

www.slideshare.net/luafiro/terapia-larva-ly-presentacion-de-pacientes

www.ncbi.nlm.nih.gov/pmc/articles/PMC2771513/