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Agararian studies at Yale lecture by Thomas Harttung

Sustainable food systems for the 21st century

We are at a unique point in history.

The communications revolution that we have experienced over the last decade or two is allowing individual citizens to participate in global conversations at an unprecedented scale.

They are sharing information, stories, culture, jokes, games, secrets (sic) and they will be sharing food choices in the future.

This may come across as a hopelessly nadve proposal, but I will try to substantiate it in the following.

Six years ago we left the 20th century behind. A century that saw the breakdown of the Imperial World Order after WW1 and the establishment of industrial agriculture on a global scale in the aftermath of WW2.

Many scientists will claim that we also experienced the Green Revolution and the introduction of biotech plant breeding as crucial moments in human development.

My claim is the the key issue at stake in the 20th century was the dislocation of food production from human communities.

Agricultural products became commodities - and even highly processed food products became globally branded. We are in the US today - the home, if not the birthplace, of the hamburger and the coke - but examples abound.

This Dislocation happened not as a result of market forces alone -as many would like to think - the invisible hand of the market is seen by many as a convenient culprit - allowing you to say that it was a inevitable development -

It is proven beyond doubt that this process happened as a result of massive state intervention - and that

this intervention continues to this day.

I have my home in Europe - and as a farmer I have suffered the CAP - The Common Agricultural Policy of the EU - In this country, farm bill after farm bill has shaped - or unshaped American farming.

Dislocation comes in 3 dimensions - horizontal, vertical and radial.

Horizontal:

The individual farm has lost its bandwidth. Farms are no longer mixed farms - instead they specialize - narrow down their production to 2 or 3 cash crops - and only one farm animal species on the individual unit.

Vertical:

The farmer no longer controls the destiny of his or her production. The grain goes to the elevator and becomes anonymous - the cattle or pigs go to the feedlot and into the meat processing plant and becomes not only anonymous but also physically enmeshed in collective substances such as ground beef.

Radial:

Vast tonnages of farm products travel across continents and seas to find its end user.

Governments and industry colluded for decades in bringing this about. There was an infatuation with the concept of cheap food.´You could say that it did not stay at the infatuation level - it became an adulterous relationship between food industry and state governments.

Eric Schlosser has decribed it very well in Fast Food Nation, as has Michael Pollan in The Omnivore's Dilemma.

And these books draw on a number of references.

How then do we go about creating a **re-localisation** of what has been so fundamentally dislocated ?

This is where all the writers that have so eloquently described the problem become far less distinct in their prose.

Most of them in fact point towards a return to old agricultural values - the Wendell Berry sort of solution

- I haste to say that Wendell, who I count as my friend and deeply admire - would not take offense at this characterization.

But my contribution in this paper is to explore new territory for agriculture - not to revel in nostalgia about the good ol' days.

And this brings me back to my beginnings.

We are indeed at a tipping point in human history.

The next 10 to 15 years will be decisive in how our future works out. And I say this from a position of opportunity, not despair.

One could rightly say, that the scaremongers have hitherto been proven wrong - but the jury is no longer out on the happy-go-lucky optimists.
We do need to come to terms very rapidly with the end of the fossil fuel era of mankind.

And the truth is - as always - somewhere halfway between the Jesuit - read it'll be alright on the night - and Taleban - read end of the world as we know it - position.

The fossil fuel era allowed us to become urban creatures - coal was a condition for the railways and the steamships - later substituted by oil - and even more efficient mobile storage vector of energy.

In the course of just one generation virtually made obsolete one of the most resilient cultural inventions of mankind - the selfsufficient village community.

If you study European history from the Vikings and romans until the 1850'ties - Europe consisted almost entirely of villages. The same is the case in most of the Southern hemisphere.

A sustainable village is a highly complex multi-circular structure around a shrine or some other place of worship. The innermost circle consists of dwellings for man and livestock - then you have an intensive horticultural layer, then orchards, then cereal fields followed by a commons of permanent grassland intersparsed with tress - and eventually forest - or wetlands.

This cellular structure - survived for thousands of years - and you must remember, that there were constant wars between warlords - plagues and diseases of all sorts - micro ice-ages - villages were repeatedly burnt to the ground, diminished by outbreaks of infectious diseases - and still they survived.

The reason why it survived was the manner in which it emulated a natural system. You can compare it with the structure and metabolism of a cell. A nucleus of DNA, mitochondria and protoplasts all held together by a semipermeable outer perimeter, the forest or wetlands.

Another important characteristic of the village as an entity is the the concept of a commons. By sharing resources the community was able to utilize the potential of the habitat to a much greater extent.

Village community agriculture can be seen as a positive feed back loop. An extra effort in the intensive inner circles of the community - typically the horticultural activities, leads to increase in fertility, the potential to utilize waste streams and diversify output.

Hunters and gatherers - the forebears of the early settlers — were limited in their reproductive development by a negative feed back loop - the more they hunted or collected the more they would exhaust the available resources.

One does however need to modify this distinction between settled farmers versus hunter- gatherers. There are habitats across the globe in which a hunter gatherer approach to this day is the most effective.

This is typically the case in large arid or mountainous habitats - where wildlife and flora is more productive than domesticated species. Examples of this abound - The Australian Desert - in which the aborigines lived. The East Africa Savannah where it has been proven that the meat production in a pristine wildlife ecosystem is higher than a livestock system.

The rapid increase in human population over the last centuries has of course happened in habitats where agriculture was indeed practicable. Estuaries - Valleys - Oases, Raised seabeds and so forth.

Before we get into speculating about how we can learn from the past it is necessary to look at population forecasts. One cannot conceive a resilient 21st century food system without knowing how many members will be at the table so to speak.

I am no expert in the field, but I do subscribe to the theory that we are getting close to a peak in numbers. It is likely that we will reach the 10 billion souls mark, but also obvious that numbers will begin to go down thereafter. As soon as the average litter - please excuse the phrase — goes under 2,4 - populations begin to decrease. He western world has been in decrease for a long time now if you adjust for

immigration - and developing countries will rapidly move in that direction too.

So the daunting task before us is to set up an innovative sustainable food system that will support a global population of 10 billion people for a 1000 years.

This long timeframe may generate surpluses in the later phases, if the drop from the 10 billion peak is sharper than anticipated - but will also be able to handle a slightly higher peak.

At first it seems like a mission impossible - but there is help to be found.

In a simple calorie count - we have 1,3 billion hectares of arable land across the globe that are able of producing 14 million calories per year on average which translates to 38.000 calories per day - and with a recommended intake of 2500-3000 calories per day each hectare can sustain 10 souls.

So what we need to do is to undertake a redistribution exercise - and to increase and sustain the efficiencies within the system.

Send in the management consultants would be the standard answer if this was an industrial case.

But it is not - and many of the mistakes of the past 2 centuries have to do with the fact that one has treated agriculture as an industrial model.

And if you couple that with a capitalist system which relies on property rights and monetary exchanges for its existence - you have a model prone for disaster.

And state intervention has been at the centre of the breakdown of local sustainable food systems. Before the English came to India 2-3 centuries ago - the country was in a steady state from a food security perspective.

Even Africa - the most traumatized continent in our lifetime - was widely in a healthy balance before the arrival of the white man's burden.

Livingstone, I presume met well nourished Africans apart from meeting the other white guy whose name escapes me.

To this day - state intervention is being counter productive to obtaining a balanced food supply across the globe.

Development aid has widely been used to export agricultural technology that has been ill-devised to function in tropical and semi-tropical zones.

The establishment of highly specialized cash crop systems based on export potential has riddled third world countries with unnecessary exposure to the risks of world market prices, crop failures and debt service.

Simplistic models have been allowed to transform complex agricultural models that had gained from millennia of positive feed back loops to deserts of failed monocultures. Land that somehow contained a deep deep collective memory bank of resilience was given a frontal lobotomy by the white man.

And all this sounds terribly dire - were it not for the fact that we now possess the knowledge and the capital to solve the problem.

What we do not presently have is the resolve to do so.

If a martian or similar extra terrestrial creature was asked to grade our ability as a civilisation to set up a sustainable food system for all - we would all fail the course.

One is even tempted to quote Mahatma Gandhi who supposedly - when asked about what he had to say about Western Civilisation - supposedly answered that that would be a wonderful idea….

It all really boils down to the calorie count - the food miles count and the capital available to solve the problem.

And the capital question is what is keeping us from moving forward as fast as we should on this issue.

But before we investigate that question - it is necessary to mention the dark horse in this very large equation.

It is climate change. Hotly debated presently - to say the least.

We need to deal with it urgently. If you ask why the simple answer in this format is that large percentages of the 1,3 billion hectares that delivered all those calories are riparian or even estuarian and temperature increases will flood them permanently.

The bad news of course is that the problem is gargantuan and that strong forces of human vanity and unwillingness to face up to reality is blocking the way to a quick fix.

The good news is that agriculture itself can play a huge role in bringing about this change. Agriculture in fact holds the key to solve the problem.

Although it is not today's theme directly, I consider it a cornerstone in a comprehensive food strategy.

Carbon

Presently - agriculture is blatantly carbon negative. Emissions resulting from agricultural practices and the food industry make up more than a quarter of total emissions.

We have the knowledge to reverse this. Food and Agriculture could become carbon neutral. Even to a point where humanity reversed the trend and became a net sequester of carbon through a judicious global land use strategy.

The science on this - as with much of the carbon and climate change science still need to develop much more - but if you use the Fermi paradox* - you can still come up with very solid data.

*Enrico Fermi, the Italian nuclear scientist , very precisely estimated the energy release from the first bomb in the Manhattan Project by using simple arithmetic assumptions.

Over the next 10 years we will experience huge innovations in this field. The entire concept of a global food supply will be taken apart and reassembled in new ways.

This claim can seem preposterous - mainly by way of the negative rationale - if nobody is mentioning agriculture in the climate change debate - then how can it be such a large contributor to the solution ?

The answer is fairly simple. Most scientists and politicians have a fairly shallow appreciation of the Carbon storage potential of Ecosystems.

They are largely unaware of the innate propensity for natural ecosystems to store ever greater Volumes of carbon. Carbon can actually be looked upon as the equity of the natural world. Prairies, Rainforests, Wetlands, pastures - even deserts - even the high seas - slowly amass carbon.

That is - until industrial agriculture or silviculture begins to fool around with them.

And over the last 2 centuries we have witnessed a destruction of carbon equity at an astonishing scale.

But human intervention is not a one way street. We can indeed reverse the trend.

It will however require a huge paradigm shift in how we perceive agriculture and food systems.

This paradigm shift is at the core of what a Sustainable Food System for the 21st century is about.

In carbon terms we can totally change the balance by requiring farms and food businesses to become carbon positive - ie. to facilitate carbon sequestration as an integral part of their business system. We will — of course — have to pay for this somehow - but in the face of the threat of climate change it is my considered opinion that there is a willingness to pay.

It will be a citizens obligation - and by creating a marketplace for it — integrated into our food system - we can foster innovation and efficiencies in this field.

Hitherto carbon off-setting has been a stand alone sector. You could off-set your trip to Antigua - if you are a private citizen - and you could off-set your new coal-fired Block 4 - if you were a power plant.

This has been only scratches on the surface - there is so much more to come.

Part of the shallowness of the understanding of the potential of food and agriculture is the disregard for dynamic factors. In a strictly linear system, it is hard to believe that a sector such as agriculture - beset with WTO-problems, diseases, pestidice scares and dependency on fossil fuel based fertilizers - can really buck the trend.

But the reality is that the adoption of Sustainable, Carbon-conscious agriculture will immediately lead to carbon sequestration on a very large scale - and because we are talking agriculture and not pristine nature (as in the hunter and gatherer era) we enter into positive feed back loops.

For every ton of carbon sequestration you are tuning the system towards more sequestration.
You are kicking in an open door, so to speak. Natural ecosystems respond to being "fed" carbon.

And by emulating natural systems in farmed landscapes you can draw on 2 billion years of on-the job experience.

Consequences:

You do not need a phD to figure out that food will become more local as a result of this.

Food miles create emissions - so long distance food will have a greater carbon foot-print to account for. But there are modifications to this. Certain regions in the world are very carbon efficient — Argentina, The Ukraine, Western Canada - and they have structural food surpluses - but carbon accounting could lead to a more regionalized approach - so that Argentine beef and wheat stayed in South America - that Manitoba wheat hung around in this region - and Ukrainian grain did not feed pigs in Denmark that would then have to be exported to China or Japan.

This may be an aside, but I live in a country that is arguable the cleverest hog farming community in the world. And I can tell you, I am not proud of it.
There are just over 5 million human souls in Denmark which covers 44.000 square kilometres.
And 24 mio pigs are raised and slaughtered every year, 95 % of which are exported.

It is a huge environmental problem - the eutrophication of fragile habitats has caused irrepairable damage.

And from a carbon perspective it is utter madness. Denmark cannot feed the pigs. We depend heavily on Brazilian soya, Ukrainian wheat, even Thai tapioca (sic) and loads of antibiotics, of course.

Previously we had a balanced food economy, not unlike the US in the sixties. A net exporter, but with a thriving rural economy. Those were the days, one is tempted to say, were it not for the earlier remark that I will not in this paper go down Wendell Berry Lane.

Carbon Networks:

I propose that carbon footprint of food products be labelled - next to food additives and GMO- status.
The three vices of the fossil fuel era - Vertical, Horizontal and Radial dislocation.

Vertical — as in industrial
Horizontal - as in diminishing gene pool
Radial — as in global sourcing of raw materials

These three vices will hopefully be overcome by the three Graces of the 21st Century:

Carbon - our equity - our inner framework - our past
Nitrogen - our spirit - our conscious (and physical) metabolism — our gravity
Oxygen - our creative energy - our ability to transform - our future

If we can harness the three Graces - or rather if we can cooperate harmoniously with them — we will have come a long way towards having a 10B souls resilient Food system.

We have spoken at some length about Carbon now.

Nitrogen

Nitrogen is of a different nature. We talk so much about C02 levels in the atmosphere that is dwarfed by Nitrogen from a volume perspective. 78 % of what you breathe is pure Nitrogen.
And you cannot avoid it. The Clinton solution of not inhaling, I cannot recommend.
But it is inert - passive - all embracing - like the softest cushion in the universe.

When you put it in an aquatic or sub-terrestrial environment it becomes a strong, powerful and outright dangerous agent. No wonder that explosives are nitrates - that ammonia burns in your nostrils.

Before the Haber-Bosch process*was invented in the early 20th century - mankind operated a balanced nitrogen regime where carbon and oxygen plus a lot of hard manual labour assisted in maintaining this. Farms were mixed, ie. an intimately balanced combination of crops and livestock. Artificial nitrogen totally changed the landscape. Once hailed as the mother of modern agriculture - we are increasingly waking up to the fact that artificial nitrogen has been the destroyer of resilient food systems. And not only that - also a destroyer of human health.
Sustainable agriculture in the future depends heavily on a new understanding of the role of nitrogen. Nitrogen on farms as well as nitrogen in our metabolism. Proteins are proteins only because the contain nitrogen - otherwise they could be carbohydrates or sugars.

The use of artificially produced fertilizer led to the formation of the concept of bio-dynamic agriculture in 1924 - borne out of strong concerns that soil fertility, food quality and human and livestock health would be compromised by the use of these inventions.

Bio-dynamic agriculture was the fore-runner of what is today organic agriculture.
Over the last 10 years the organic movement has gone from strength to strength and is now happening in more than 170 nations and an estimated global turnover of 15,5 billion USD.

It is important to understand this course of events. Most people associate organic agriculture with the decision to not use pesticides - but it was the fertilizer and food quality question that gave birth to the ideas.

*The Haber Bosch process enables the production of ammonia from atmospheric nitrogen and hydrogen under very high pressure and temperature. This invention, made in Germany in 1908-1910, is the key prerequesite for the nitrogen fertilizer industry. The energy needed to run the process results in a strong carbon footprint on nitrogen fertilizer.

It is understandable that the scientific community and the farming community wholeheartedly embraced the idea of nitrogen fertilizer in the early 20th century. It promised dramatically higher yields per hectare and a liberation of the farmer from the need to always combine livestock with arable food production.

And there continues to be a strong fertilizer lobby which claims that we cannot successfully manage present and agriculture without this commodity.

The way in which nitrogen works in the soil makes it very clear what the problems are.
In pristine ecosystems - and organic agriculture - the nitrogen supply for plant growth comes solely from the decay of organic matter - in the case of organic agriculture mainly from the decomposition of animal manure. These are slow release processes and ideally, the concentration of nitrogen in the soil never reaches very high levels.

So nitrogen is an important resource, but not all-important. The plants will react to the availability of nitrogen by taking it up in the plant sap - they cannot resist it, so to speak.
And excess availability leads to excess uptake and lodging of crops.

A much bigger problem however is the destruction of microbial communities in the soil.
Application of fertilizer kills beneficial microbes simply because they cannot survive under such high nitrogen concentrations.

Imagine a wonderfully balanced Italian main course full of herbs and other fresh ingredients. You then drop the salt bowl into it - rendering it totally inedible. The other taste notes "die".

Add then op top of that the fact that nitrogen is responsible for a "crowding out effect" at the molecular level. The nitrate or ammonia ions in the plant sap forge links with complex carbon sugars and starches in the crop - taking up in the process the spaces from other "more interesting" mineral salts in the sap.

This is one of the main reasons why industrially produced vegetables and lettuce taste of almost nothing. They are full of nitrates instead of minerals.

This not only affects the human diet - there is no doubt that some livestock diseases are directly linked to a diet with too high nitrate content.

It is therefore clear, that we need to manage nitrogen in a far more conscious manner.
The principles of organic agriculture have shown the way - but we have a long way to go still. Even within the organic movement there are discussions about which nitrogen "quick fixes" should be allowed.

OXYGEN

The third Grace - **OXYGEN -** is the most dynamic of the three. In this paper, the oxygen is the entrepreneurial factor, the creative element.

Oxygen has that quality - being at the same time the destroyer and creator of matter in our ecosystems. Oxygen is at work when something corrodes or rusts - when plant material composts -
And at the same time one needs oxygen in photosynthesis, in almost all processes of creation, even when you are welding or rolling steel. Oxygen is everywhere, actually half of the weight of the earth's crust is oxygen.
Our atmosphere contains approx 21 percent oxygen - and this is a most delicate balance - neither too little or too much. Actually it has been claimed that if the oxygen content would rise by more than 1,5 percentage points - large parts of the tropical forests would face great risks of self-incineration. If - on the other hand - the proportion of oxygen in the atmosphere should go down by a similar amount from today's levels - we would be in dire straits because photosynthesis would be cut back by 20-30 %.

So either we burn up or we suffocate as a system - OR we decide to understand oxygen (and ourselves) much better.

Oxygen as a metaphor for money

In the economic world money has a role not unlike oxygen in the natural world. Money plays a vital and dynamic role in the economy.
And just as the oxygen balance in nature is a delicate balance between too much and too little in the atmosphere — money is necessary in the economic world in a balanced proportion.

A new idea - a start up company - or a new project within an existing organisation has to navigate a fine line between burning up too quickly on the one side - or suffocating on the other side.

Carbon as a metaphor for structure

As we have described earlier in this paper, carbon plays a unique structural role in all food systems. Typically carbon structure is taken as a given in scientific and economic discusions - but the obvious climate challenges before us calls upon us to engage in proactive strategies to create positive feed-back loops.
Industrial companies typically break down carbon, at least from a net energy perspective - while agricultural systems have the ability to "build" dynamic carbon inventories.

Setting up the food system for the 21st century

We now have the defining drivers of this century - carbon, nitrogen and oxygen.

Underneath all our aspirations going forward there should lie a deep felt reverence for these 3 graces.

We have also en described in some detail that the dislocating factors of the 20th century need to be urgently addressed.

The strategic ingredient in the realization of this idea is the individual human interaction.
And through such interactions the future of food can be shaped.

The present global food system is blatantly out of tune with what is required.
It is an industry that is begging for change.

We have all been through the dot.com revolution. It got rather messy at one stage but one has to admit that the world is no longer the same.

Picture a dot.con revolution in food. And the acronym of course is Carbon, Oxygen and Nitrogen. Or could it be citizens of nature….

Citizenship will be a key ingredient in this transformation. 2 centuries ago ago some of our forebears prided themselves of having conquered nature. What they did not realize was that they were, in effect, on the losing side.

In the work of Aarstiderne, the organisation that I have the honour and privilege of chairing, we have ousted the c-word. It is a word that so permeates the thinking of our culture, that we could see no other solution than total rejection. The c-word is the word consumer.

The more you think about it the clearer it becomes that this phrase - supposedly invented by economists to bundle us all into deterministic behavioural models - is so derogatory and misleading that it should be looked upon as an serious insult to humanity.

We are citizens, and we increasingly behave as such - and it is time for us to transform global society from a consumerist ethic to an aspirational ethic.

We are no longer homo economicus - we are indeed becoming homo ecologicus.

In game theory it has long been proven, that modern citizens make choices based on moral convictions rather than strict economic thinking. Most convincingly through the game in which you are offered a sum of money if you can convince someone of being a partner in the deal against receiving a slice of the money. You are only allowed to have one try, so dutch auctions are avoided in the game.

People typically offer potential partners more than 20 % to obtain their cooperation.
Interestingly enough economists significantly underperform these games by offering too low incentives to partners.

I am fully aware of the fact that many economists will flatly state that what I am trying to prove is a a bunch of useless flower power hyperbole.

My excuse is that I am an entrepeneurial spirit. And such people rely on what you could call early pattern recognition capabilities.

The shift away from food as a branded commodity has not yet hit the statistics from which the economists draw their data but it has certainly hit the r and d departments and the creative agencies that give advice to the food industry.

The point is however, that this is only the famous tip of the iceberg. There is a potential for a far more profound change in how we value what we eat and which contexts we associate with food production.

To study such phenomena it is relevant to check out the avant-garde - the pioneers.

And they are into artisanal local food in a very big way.

10 years ago your average rock star would boast about his or her Tuscan vineyard. Now the object of desire is a farm based unpasteurized cheese production originating from grass fed old heirloom breed

cows.

This observation may sound shallow but it is my firm belief that we are experiencing a shift of paradigm.

Even snowboarders in Norway are suddenly into organic food.

The role of governments

In Europe , agricultural policy is rapidly moving towards supporting rural activities rather than industrial production. We still need to see that happen in this country.

It is a classical observation that governments have a tendency to support losing sectors for far too long.

Instead of bankrolling corporate commodity farmers and feed lots - lawmakers should pave the way for a truly innovative food sector in which a career in food and farming suddenly becomes an honourable profession again.

Natural Food is the next big thing. So put your money where your mouth is. Literally speaking.

Second Careers

I can certainly respect the argument that the idea of moving to western Illinois will not appeal to your average Ivy League graduate - they are more likely to enter into careers in well connected gastro hubs in the major cities - but they are not lost forever. Many such people will plan their careers in serial mode - and agriculture suddenly becomes relevant if you realize at the tender age of 45 that a deep feeling of connectedness to the universe is more easily accomplished in the vast plains than in the urban sprawl.

Closing Remarks

This paper suggests that Food and Farming will be the pivotal sector of the 21st century.

That instead of worrying about how to keep a frustrated semi-proletariat on the land - governments and NGO's should set an ambitious agenda for Sustainable Agriculture in the broadest possible sense of the word.

It is through the interconnectedness of everything that the future will unfold.

And in that context it is only natural that Wendell Berry be given the last word:

“Eating is an agricultural Act”

For every household you co-opt for the cause - you get a ripple effect in that particular community.

relocalizing food supplies