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Mariculture: A Resource-Efficient Food Production[1]

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Abstract

Due to a resource-efficient food production – famine will be a thing of the past in our affluent society. Famine due to climate change is simply not true. We can easily feed everyone – even if we are more than ten billion people.

Background

Most of the issues we have in the rich countries are small related to the problems in the developing world. The famine we sometimes observe is due to bad government – not related to climate change. The most important resource we have is the human being. Many books are written about that. The speaker especially recommended books by Julian Simon, Bjørn Lomborg, and Martin Ågerup (see the literature list).

In Martin Ågerup's book: *Doomsday is Cancelled*, or Dommedag *er aflyst* (Danish), we get a list of expected improvements in our near future:

- We are more: 10-15 billion
- We live longer, get richer: seven times per hundred years,
- We get well-fed
- We get energetic
- We get access to ample resources and water
- We get more peaceful
- We are solving nature, environmental, and climate challenges
- We will still be afraid – for good reasons: maybe richer people are more afraid of losing their valuable items?
- We will have an accelerating technological change

The myth of ecological doomsday is neither catastrophic nor existential. We enjoy large positive effects of the use of stored solar energy as cheap energy sources.

The speaker and Ngyen Thi Kim Oanh have concluded: It is evident that the proposed cure of excessive CO_2 emission reductions may well be far more costly than the disease of global warming.

The four beasts in the eye

1 The number of *wars, deaths and refuges* is declining. We never had such a peaceful decade as the last one.

2. *Pestilence*: deaths are manageable, thanks to modern vaccinees and health care.

3. *Deaths from extreme weather* is down from half a million per year 100 years ago to 20 000 per year with a larger population. The cost of damage is declining from 0.3 to 0.2 % of BNP.

[1] Lecture: https://www.youtube.com/watch?v=SPnbKiqgFPg (Recorded by Yngvvar Engebretsen).
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4. *Famine:* The warm, wet, and CO_2-increasing world is better for plants. They are now starving for CO_2.

All the four beasts are less important now. We have managed to greatly reduce their importance, in particular due to the effect of cheap and easily available fossil fuel.

Improved agriculture

Man does much better than Nature in growing plants, through increasing the Nitrogen cycle. The table below shows the development of the grain-yield based on various techniques:

Technique	**yield (ton/ha)**
Slash and burn	<1
Backbreaking hard labor	1-2
Global average today	4
Modern farmer	10
Iowa's best farmer	30
Future GMO/Crispr/seaweed	100
Lighted greenhouses	>1000

The lighted greenhouses are much more expensive today, but since we all get richer, we can afford it. Food cost is relatively less in the rich part of the world now than 50 years ago. The limiting factor is water, but cost of desalination is about 0.5$ per m^2. Today this doubles the price of grain. This is affordable in the rich part of the world. When we get richer this will also work in the rest of the world. Today we find 800 million people in hunger due to bad governance. This is not due to climate change.

It was long preached that food could only grow linearly, while the number of people grow exponentially. Now it is opposite. Food production grow exponentially and in line with the population. We are getting well-fed. There is no excuse for hunger in this world. We must get rid of the poverty. The endless whining of catastrophic famine due to increasing population is due to false prophets. In the real-world food production has tripled since 1960, and food prices have been falling since 1700 in deflated money value.

Thanks to the global supply chain and the ingenuity of farmers and agricultural research, there is a huge capacity potential. Farmers are clever. They adapt quickly to changing weather and climate, while the researchers behind IPCC think the farmers are stupid and stick to the old farming methods. But it is quite the opposite. It is the IPCC-researchers that are stupid, not thinking that farmers adapt. The speaker gave some examples. One is repeated here:

Sweden had a serious famine in 1867-1869. 1867 was very cold: 80-100 000 died, emigration to America skyrocket. Denmark had serious drought in 2018 with 23 % less grain and a huge (10 %) economic loss. This should be a catastrophe, but nobody died of hunger. In the supermarkets there was no sign of food scarcity. In the modern resilient society – there is no feeling of disaster.

The future

More rich people will certainly result in an Increasing demand for meat. Meat is healthy and good for the soul. The Amish solution produces more obesity than hunger. We expect 35 % higher demand for animal protein in the next 20 years. Now we are reaching peak farmland, which is the maximum area used for farming. However, we will eventually use far less land for farming. Except if we change to organic farming. This is a disaster because of producing less on more land. This is a waste of good land.

The oceans have a great potential for food production. In practical terms the space and the quantity of water are unlimited. Small variations in salinity and temperature leads to stable production. This is the fastest growing food production field in the world.

The biggest fish farming catch volume is the freshwater fish carp. But in sea farming value, Norway is the Global front runner producing 1.4 million ton of salmon for a yearly revenue of 60 billion NOK. This is half the salmon produced in the world. The global market will be in the the order of 10 million tons.

Resource efficiency (RE) is defined as the value added per unit of environmental impact.

Salmon is a high-value product with RE double of beef, because fish is cold blooded (poikilotherm) and need no energy for warming. They live in zero gravity and need minimal energy for moving around. The environmental impact of fish farming is low off-coast and offshore.

Then we hear about the insect eating craze. Insects and fish have more or less the same food conversion rate[3], but fish is much more in demand and valuable. We are now down to 1-2 kg wild fish per kg salmon. This is for the protein and Omega3 fatty acids. The rest comes from the land like soya etc. But in food production the future is GMO-plants and seaweeds.

Off-shore Agriculture is coming, pioneered by Norway. Seaweed production is increasing – here the whole plant can be used.

Conclusion

A sane world will never run out of food. We have an unlimited production capacity on land and sea together. Climate change will only be a minor factor. Production can always be moved to better places. A richer world can accept higher food prices. More CO_2 is better for the plants and the food production. The myth of ecological doomsday is neither catastrophic nor existential. We can praise the relatively large positive effects of the use of stored solar energy.

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[3] Food conversion rate (FCR) is the weight of feed intake divided by weight gained by the animal.