

The road towards zero hunger is located at the coastline of Denmark

Enough food is quite normal for people in a large part of the world. Unfortunately there are still too many people who die from malnutrition worldwide. Especially in Africa and Asia there is a shortage of healthy food supplies. This is one of the biggest problems of our time. The solution for this problem needs to be found. This solution is located on the coastline of Denmark.

Denmark is just a small country with a surface of 43.098 km² and a population of 5.7 million with a density of 130 people per km². Denmark has a great infrastructure. About 25% of the gross domestic product comes from large industries such as fishing and "only" 5 percent comes from agriculture. ¹ Agricultural products accounted more than 20 percent of Danish goods exports two years ago. The value of those exports rose from 4 billion euros to the amount of 16.1 billion euros nowadays. It is aimed that this number will be increased with another 6.7 billion euros by the end of this decade. ² The main export products of Denmark are agricultural products, meat, fish and metal. An average family from Denmark consists of 2.2 people per household. This is slightly below the average of the world. ³ The purchasing power per head of a family was the sixth highest in the world in 2005. In Denmark there is enough and healthy food available. In Denmark there is an social policy for areas such as health, childcare, education and protection of the unemployed. This is all part of a "solidarity system" that ensures that almost no one is found in economic despair. Danes pay high taxes but in return they get a high quality of life. Health care in Denmark is universal, free and of very high quality and anyone can use it with the right to the Danish citizenship. ⁴ Electricity, clean and healthy water and supermarkets are from a very high quality, provided by the government. Denmark is one of the richest and economically highest developed countries in the world ⁵. So one of the biggest problems of our time does not apply to Denmark. But one of the greatest solutions may come from this country.

By 2050, our planet will have about thirty percent more inhabitants. ⁶ This means that we have to feed more than nine billion mouths by 2050. ⁷ In order to continue to meet the demand for food, production will have to increase by seventy percent, because the

¹ editors, 'Denemarken' <http://agriteaminternational.nl/informatie/landen-informatie/denemarken>

² Horckmans, M 'Hoe Denemarken het silicon Valley van de landbouw werd' <https://nl.express.live/2014/01/06/hoe-denemarken-het-silicon-valley-van-de-landbouw-werd-exp-200666/>

³ editors, 'Five family facts' <https://www.oecd.org/els/family/47710686.pdf>

⁴ Sanders, B 'What can we learn from Denmark'

https://www.huffingtonpost.com/rep-bernie-sanders/what-can-we-learn-from-de_b_3339736.html?guccounter=1

⁵ Verrijp, A et al, 'Denmark' <https://www landenweb.nl/denemarken/bevolking/>

⁶ editors, 'zeewier' <https://www.wur.nl/nl/Dossiers/dossier/Dossier-Zeewier.htm>

⁷ Lenskens, S., 'Column: ik los het wereldvoedselprobleem om'

https://www.vmt.nl/Nieuws/Column_ik_lost_het_wereldvoedselprobleem_op_delaware-171116060000

consumption per person will increase.⁸ According to researchers, we have a serious problem in about 40 years if we continue the way we do now. According to these researchers, food production worldwide will be limited for the first in history due to a shortage of land, water and energy.

The world food problem is about proteins. The biggest problem is the amount of meat that we consume. Not only the people in the West, but also the people who live in the countries that are becoming more and more waking are eating more and more meat. Meat is an important part of our diet. Meat is full of proteins, but in addition to proteins, it also supplies minerals, with the most important, iron. Today, we consume so much meat per person that, in addition to providing a food shortage, it also poses health risks. Examples include cancer, avian flu and swine fever.⁹ New ways of providing food should therefore be created with a view to sustainability. A solution to this challenge can be found on the coastline of Denmark.

Seaweed could make a big contribution to solving the world food problem. Seaweed is already really emerging as a source of food. The big advantage to seaweed is that we don't need to use expensive and limited agricultural land, because seaweed grows in the sea. In addition, it is very healthy and tastes good. The species from our research, sea lettuce (*Ulva lactuca*), contains around 14% of proteins. Meat contains 12 to 27% of proteins. This high level of proteins makes sea lettuce suitable as a meat substitute. Furthermore, sea lettuce contains a lot of fibre and is a source of vitamins and minerals, including vitamin A, B1, B2, calcium and iron. Also, sea lettuce is relatively easy to grow and it grows fairly quickly. All this makes seaweed very suitable for human consumption. If the production increases and the seaweed is exported to places where the demand for proteins is increasing rapidly, it helps minorities to end up with healthy food more easily and cheaply. In addition, seaweed does not pollute the sea. Seaweed even has the ability to remove heavy metals from the sea, a cleansing ability. It therefore has no disadvantages for the environment, but it is also not harmful to humans. Denmark would be a good country to grow and export a lot of seaweed because it has a long coastline with good quality seawater.

We have also researched the way in which sea lettuce grows the fastest and the best. We did this by growing sea lettuce under different conditions. We have exposed sea lettuce to different light intensities, different temperatures and different colours of light. This research has shown that sea lettuce grows best under red light. Denmark could also be a good country to increase the production of seaweed because Denmark is a rich country with an excellent energy supply, which could be used in the sea.

There are already many other solutions to solve the world food problem with protein alternatives. Both in Denmark and outside. One of them is the consumption of insects. Approximately two billion people worldwide have included insects in their diet.¹⁰ The consumption of insects can serve as a replacement for high-quality protein from meat and fish. Insects as food for people will come quickly. Bugs contain good fatty acids, a high iron content, they consist for 30-70% of proteins and they contain a lot of vitamin B. There are almost 2000 types of insects that can be consumed by humans. Also, insects, in contrast to,

⁸ editors, 'Als je het wereldvoedselprobleem wilt aanpakken, moet je het lef hebben om het gesprek aan te gaan met mensen van andere disciplines'.

<https://www.uu.nl/nieuws/utrechtse-voedselonderzoek-op-de-kaart-in-europa-de-consument-voelt-zich-belazerd-en-terecht>

⁹ Boom, R., '9 miljard monden vragen om beter grondstoffengebruik'.

<https://weblog.wur.nl/voeding/9-miljard-monden-vragen-om-beter-grondstoffengebruik/>

¹⁰ editors, 'Insecten op het Afrikaanse menu'.

<https://www.wur.nl/nl/show/Insecten-op-het-Afrikaanse-menu-1.htm>

for example, cows, emit few greenhouse gases. A major problem with insects, however, is that only a few people in Western countries are interested in eating insects. People will not easily switch to a diet with insects. A lot of research has been done into persuading consumers to consume insects. Among others by researcher Muriel Verain, associated with Wageningen University & Research. She discovered, among other things, that people are no longer inclined to eat insects when they are ground in, for example, a 'hamburger', than when the insect is consumed in its entirety. Her research showed that consumers have almost the same aversion to whole insects as to ground insects. People also saw eating insects as less safe than eating beef, for example, and consumers were less inclined to eat beef from a cow that has had insects as food than from a cow that was completely fed with insects. According to Verain, there is still hope when eating insects is made more accessible by selling insects in more supermarkets, for example. In the long run, according to Verain, it will take a while for insects to be accepted as a substitute for meat, but in the short term it is possible to process insects in cattle feed, because people will have to get used to the idea for a quit long time. Verain also sees more hope for the consumption of seaweed, because this product is much more accessible.¹¹

Clean meat can be a good alternative to regular meat. Growing it with stem cells is fairly simple, according to Mark Post of Maastricht University. From stem cells of a living cow, minuscule pieces of muscle tissue are cultivated in three weeks.¹² These tiny pieces of muscle tissue are stuck together into a hamburger. The big advantage of clean meat is that consumers indicate that it is easier to accept as an alternative protein source than, for example, the consumption of insects or seaweed.¹³ The disadvantage is that it is still in full swing. The taste does not yet correspond to the taste of real meat, because it is not yet possible to get myoglobin into the clean meat. Myoglobin gives the metallic blood taste to for example beef. In addition, it is currently being grown on the blood of unborn calves. But this blood is not animal-friendly, not energy-efficient and is not safe enough for the food industry: it has a great chance of getting infections. Another disadvantage is that it is still unaffordable at the moment. Much remains to be done before clean meat is actually a good and affordable alternative to regular meat, but in the long term it is a good option.¹⁴

Another possible solution to the world food problem, when talking about a lack of arable land, is vertical agriculture: buildings in which vegetables are grown on racks. The cultivation of these vegetables can be fully controlled, so that a minimum quantity of pesticides needs to be used and the amount of water consumed can be greatly reduced. The unused water is also not lost but can be collected and reused. There is also no possibility that insect pests will break out. In addition, fresh vegetables can be delivered at any time by means of vertical agriculture, regardless of the weather, the climate, the season, et cetera. The quality of the vegetables can be guaranteed. An additional advantage to vertical agriculture is that it can take place in vacant buildings in large cities, so that there are few to no transport costs, as urbanisation is increasing. Vertical agriculture is in fact an extension to greenhouse horticulture. Where you are dependent on factors such as sunlight when growing vegetables in a greenhouse, you can regulate all factors yourself in vertical agriculture. Light from LED

¹¹ editors, 'Insecten eten: hoe krijgen we de consument zo ver'.

<https://www.wur.nl/nl/nieuws/insecten-eten-hoe-krijgen-we-de-consument-zover.htm>

¹² Hosselet, L. 'Van het lab naar een bord is een lange weg voor kweekvlees.'

<https://www.trouw.nl/groen/van-het-lab-naar-een-bord-is-een-lange-weg-voor-kweekvlees~ae6d9867/>

¹³ Onwezen et al. (2015). Consumentenacceptatie eiwitbronnen: Insecten, vis, zeewier, peulvruchten & kweekvlees. LEI, Den Haag

¹⁴ Van Santen, H. 'Kweekvlees komt eraan'

<https://www.nrc.nl/nieuws/2016/08/16/kweekvlees-komt-eraan-3786210-a1516552>

lamps is used instead of sunlight. The colours of the light can be adjusted in such a way that the photosynthesis in the plant is maximal. Also, unlike sunlight, the light from LED lamps not only comes from above, but can also come from the side, making the distribution of light over the plant optimal. Of course there are also disadvantages to vertical agriculture. For example, it is very expensive because a lot of money goes to the energy costs for the temperature control in the building. It also costs a lot to set up the building and all equipment such as the racks, the LED lamps and the irrigation systems. Costs that growers do not have to grow crops in the open air. However, the yield of vertical agriculture is also many times greater in comparison to open-air agriculture. In vertical agriculture you adapt the environment, until it is optimal for the crop that you want to grow, while in outdoor agriculture you adapt the crop to the circumstances and use pesticides.¹⁵

But all this is not enough. That is why we recommend using Denmark as a production country for seaweed to significantly increase production. It is necessary to produce seaweed sustainably and safely, so that the ecosystem will not suffer any damage. So strict legislation will have to be introduced to ensure that the cultivation of seaweed is done in a safe way. In addition, it is up to the government to encourage young, talented entrepreneurs who are interested in starting up a business in the sea. For example, subsidies will be granted to these young entrepreneurs. Extra money can make it more attractive for entrepreneurs to start a business in the sea and export the harvest. An example is to make large basins between wind farms in which seaweed is cultivated with red lamps above it, so that the seaweed grows faster, it can be harvested more often and the world can solve the biggest challenge of this century.

In short, Denmark is a good country to be able to solve the shortage of healthy food. It has a long coastline, good water quality, a great infrastructure and perfect energy facilities. All the conditions that are needed to grow and export seaweed in a good and high quality all over the world.

¹⁵ editors, 'Could indoor farming help address future food shortages?'

<https://www.pbs.org/newshour/show/could-indoor-farming-help-address-food-shortages>

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