

# Seaweed mulch



Cathrine Dolleris  
Geoliv.dk  
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# Seaweed mulch

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## Design Brief

I moved to a new house on an island, Orø, in a fjord, Isefjord, in June 2014. I started designing the garden and wanted to mulch parts of it, namely the forest garden area and some of the smaller beds. In all around 250 m2.

I am very aware of the pollution of the fjord and sea in general and this problem is generally discussed in Denmark and the world.

I am familiar with seaweed as a good mulching material and want to increase knowledge about it.

These are the three factors I want to bring together in this design. The theme principle for the design becomes:

**Waste is a resource out of place**

## Research

### Mulch materials

Normally compost, manure, grass clippings, woodchip, leaves, straw, pine needles, plastic, bark, newspaper, cardboard, seaweed, rock/stone are accepted as useful mulching materials. See for example: <http://www.no-dig-vegetablegarden.com/no-dig-materials.html>, [http://eartheasy.com/grow\\_backyard\\_vegetable\\_garden\\_03.html](http://eartheasy.com/grow_backyard_vegetable_garden_03.html).

All these materials have their strengths and weaknesses reported in the sources above. However, I needed mulch available to me, so I did a survey on my property and on the island for mulch materials.

Observation of materials used for mulch:

- Compost – in production at my newly set up compost system, but not enough for 250 m2.
- Manure – I would have to negotiate with someone with horses on the island. Doable.
- Grass clippings – My hand driven lawn mower does not collect grass clippings and the paths I'm mowing is anyway far from enough for the area needing covering.

### Long term goal

To provide options for increasing happiness and contentment of people and myself within the limits of our biological resources.

This design uses the

### PRIME model

- Problem/Design Brief
- Research
- Ideas
- Make
- Evaluate



- Woodchip – not available at the moment.
- Leaves - not available at the moment, will be available in autumn but not enough for 250 m2.
- Straw - I would have to negotiate with someone with horses on the island. Doable.
- Pine needles - not available at the moment.
- Plastic – available, but not my preferred material for the forest garden. Some parts of the annual vegetable garden are covered with plastic.
- Carpet – a few areas covered with 100% wool or cotton carpet, but not enough for forest garden.
- Bark - not available at the moment.
- Newspaper – some available, but I prefer cardboard because newspaper blows away easily and gets slippery.
- Cardboard – available in the shops and can be collected easily when shopping anyway with car
- Seaweed – available on the beach 2 kilometers away and can be collected easily when going to the beach with car.
- Rock/stone – stones are abundant in the garden and will be used for delineation of the beds.

Looking over the list of mulch materials, the most suitable are manure, straw or seaweed with cardboard or newspaper as the bottom layer. All are materials that I am very familiar with as mulch. Negotiating with neighbours about getting manure or straw is something I would look forward to doing in the future, however because of time constraints and the advantages of seaweed, I chose to work with seaweed as the bulk mulch material in my forest garden and for some of the smaller beds.

I became familiar with seaweed as mulch as I was woofing in New Zealand and stayed at a place where they were setting up a permaculture garden. The mulching material we used was a combination of seaweed that we collected from the beach, cardboard, leaves and other organic stuff. The beach on my island is full of seaweed, thus this resource is abundant and within reach. Knowing that seaweed is good for mulch and having worked with it before, I decided to do a design around using seaweed as mulch and a bit of research to make sure I was doing no harm.

### **Survey of seaweed as a local resource**

The sea is nearby, just 1-2 kilometres away, and is easy to reach by foot, bicycle or car.

I like to go to the beach and to walk on the marine foreland that is common on this island. I enjoy exploring the plant and animal life on the foreland and the biodiversity, the landscape and the seasons. I also like to take my visitors to the beach for a walk and if we feel like it, we combine the walk with harvest of seaweed from the beach.

The beach is a flat stretch with shallow waters extending into the sea. An abundance of seaweed grows here which is washed to the shore mostly in autumn and can be collected easily in bags.



Seaweed, mainly eelgrass, *Zostera marina*, washed ashore.



*The beach on my island Orø is proud of its Blue Flag, signalling high quality water.*

## **Pollution**

The local newsletter lately described pollution of the drinking water and the fjord with nitrate. Nitrate comes mainly from the very big pig farms, common in Denmark. The pig manure is spread on the fields and can cause nitrate pollution of the ground water and the sea. Several fjords in Denmark have had serious problems with pollution of Nitrate. It is not a serious problem in Isefjord, but something to be aware of.

Nitrate in drinking water is unhealthy for people because it can be transformed to nitrite in the stomach. Nitrite reduces the oxygen uptake in the blood, especially a problem for infants. Nitrate can also react with amino acids to create nitrosamines which are carcinogenic.

### Nutrient cycle

In Denmark, a lot of nutrients are imported for the agricultural industry from other continents. This means a large accumulation of nutrients in our soils, washing with the rain out to the waters or drifting in the air from the liquid manure sprayed on fields or venting out from industrial stables.

There are strict nutrient calculations to do when you are a farmer in order to not apply too much fertiliser to the soil. However, an excess of nutrients will end up in the sea. This sometimes causes toxic levels of algae growth and depletion of oxygen in the water causing fish to die.

The pollution of Danish waters is now being controlled, but the nutrient levels are still high. This means that using seaweed washed to the shore is an abundant resource and will mostly help the marine ecosystems get back into balance.

Taking a little seaweed washed up from the shore is of course but a drop in the ocean. However, it is reversing the general direction of nutrients from terrestrial ecosystems to marine ecosystems.

### On the beach

The rotting seaweed is mostly an annoyance to guests on the beach. It sometimes gets removed by big trucks or scraped to one end of the beach.

There is a camping site nearby and the beach water gets analysed regularly for pollution and dangerous substances. For that it earns the quality of "Blue Flag Beach" displaying clearly its cleanliness. For collection of mulch material for the garden it is good to know that the seaweed and sand is not full of e.g. pollutants, heavy metals, coli bacteria. It is also good to know if I want to eat some of the seaweeds or algae from the beach that it is relatively clean.

### Seaweed species on the beach

I've used the DAFOR method to look at seaweed species. Dominant, Abundant and Frequent species were the only ones I found so far, while Occasional and Rare species will require more research, possibly at different times of the year.

#### Dominant species

Mostly I've identified [Zostera marina](#), in English "common eelgrass" or "seawrack", in Danish "ålegræs" or "bændeltang". This makes up the bulk of what is deposited by the sea on the beach. It is not good to eat, but in Denmark is traditionally used on one island as roofing material. It also has good potential as an insulation material. Seaweeds in general do not burn easily because they naturally contain salts that work as fire retardants.



### Abundant species

[Fucus vesiculosus](#), in English "bladderwrack", in Danish "blæretang" is an edible seaweed when cooked. It occurs in the deposits on the beach.



### Frequent species

[Ulva lactuca](#), in English "seasalad", in Danish "søsalat" is a delicious edible seaweed. In Denmark it has some potential to be grown commercially. It doubles its size in one day and is thus very productive.



*Seaweed and algae float in the coastal waters in abundance.*

### Applications of seaweed in terrestrial ecosystems

In some parts of the country near coasts with an abundance of seaweeds washed ashore, farmers occasionally harvest the seaweeds to use them on their fields. In some areas it was a practice that was carefully controlled, since the seaweed was very nutritious and was added as a precious fertiliser to soils.

W.A. Stephenson explores seaweed as a soil condiment (in *Seaweed in Agriculture and Horticulture* by Faber & Faber, 1968):

*"It is a matter of common experience that seaweed, and seaweed products, improve the water-holding characteristics of soil and help the formation of crumb structure. They do this because the alginic acid in the seaweed combines with metallic radicals in the soil to form a polymer with greatly increased molecular*

*weight, of the type known as cross-linked. One might describe the process more simply, if less accurately, by saying that the salts formed by alginic acid with soil metals swell when wet and retain moisture tenaciously, so helping the soil to form a crumb structure. (...) ... 0.1 of a gram of sodium alginate added to 100 grams of soil increased its water-holding power by 11 per cent. This is the first way in which seaweed and seaweed products condition the soil: by increasing its water-holding capacity, and encouraging its crumb structure. This in turn leads to better aeration and capillary action, and these stimulate the root systems of plants to further growth, and so stimulate the soil bacteria to greater activity."*

For more information about seaweed as mulch, especially its chemical properties, please refer to Stephenson (1968): [http://journeytoforever.org/farm\\_library/seaweed.html](http://journeytoforever.org/farm_library/seaweed.html)

More recently, Martin Crawford (*Creating a Forest Garden, 2010*) states that seaweed has contents of Nitrogen at 2 g/kilo and Potassium at 22 g/kilo. Thus seaweed is particularly a good source of Potassium.

People have reported good results from applying seaweed in their gardens. Seaweed contains trace minerals like iodine and selenium and natural growth hormones. Plants fertilized with seaweed tend to get more resistant to fungi and frost damage.

Kale and asparagus reportedly grows well in seaweed, because they come from families originating from the beach and thus has higher salt tolerance.

Mulching with seaweed under fruit trees also has reported beneficial effects. Apple trees with cancer, fungi attacks and yellow leaves have been cured and are now healthy, highly producing trees.

Seaweed has also been applied as bedding for chickens with good results. If left outside in the chicken pen some of the salts will be washed out. The chickens enjoy scraping and eating the flora and fauna of rotting seaweed. They will add manure to the seaweed. It can later be added as a fertilizer to the kitchen garden.

Seaweed seems to be unpleasant to slugs and snails. My salads have not suffered much from slugs where they were mulched with seaweed. This is likely to be because of the salt content.

The salt content of seaweed can be problematic. Depending on the application, it might need to be washed before use around sensitive plants.

This problem can become a solution, because the salty seaweed can be used to kill off weeds on garden paths or likewise, before being applied as fertiliser.

### **Previous experience with seaweed mulch**

I have used seaweed mulch on several occasions in my parents' garden and my previous garden. Applied in thin layers together with other mulch materials I have covered potatoes in raised beds with up to 50 cm of material. The potatoes turned out nice. The soil was very soft and organic after the harvest. I continued to cover the raised bed with seaweed for a year until it was dug down (not by me). The seaweed bed has been very fertile, but not cultivated recently.

Other beds have been covered with seaweed and cardboard and planted with e.g. strawberries. The strawberries didn't grow well, but this could be attributed to other factors than the seaweed. With lettuce and broccoli the seaweed mulch did not affect the growth negatively.

## Permaculture ethics

Any good permaculture design must find the sweet spot of fulfilling all ethics. Using seaweeds as mulch is therefore analysed from each of the three parts of the ethics. When analysing I relate the “upstream” and “downstream” effects of my action, i.e.

**Earth care:** As mentioned, the nutrient overload in our part of the world increases the nutrient content of our seas and especially fjords and estuaries with limited water cycling. Seaweed is generally in abundance and washes up on the shores. Here they become part of marine foreland ecosystems, beaches and marshes. Removing some seaweed in large amounts would have some impact and could potentially upset local ecosystems; or balance them were the nutrient content of the water is too high and causes overgrowth of algae and seaweed.

Adding seaweed to garden soil is reported to have beneficial effects and is part of regeneration of the soil creating a more fertile top layer of humus rich soil, i.e. carbon sequestration. Its contents of trace minerals add micronutrients to the soil.

**People care:** Seaweed is generally an annoyance for people staying at a beach and beach owners sometimes clean their beaches if allowed.

The beach at Orø has a lot of seaweed, which is either scraped off the beach and piled at one end or removed all together. Harvesting seaweed is at best caring for the people who use the beach, at worst it does not make a difference.

I almost always get questions from people on the beach about why I collect the seaweed. I always take my time to tell them about the beneficial effects of using seaweed as mulch and reducing pollution.

In the garden, dried seaweed looks nice, it helps suppress weeds and adds nutrients to the soil, it reduces the amount of slugs in the vegetables mulched with seaweed, thus in many ways supporting care for the people who manage the garden.

On a bigger scale, using seaweed as fertiliser in agriculture could solve problems of importing fertiliser, not only in Denmark, but on a global level. This would add to Earth care and eventually to People care, because we have to live with the pollution of the sea otherwise.

**Fair share:** Using seaweed for fertilizer is of course much better than using chemical fertilizers that cost energy and pollution. It is neutral in energy consumption compared to an organic fertiliser from the garden, at least if there wasn't a lot of driving a car to transport the seaweed. In my case I have to drive 2,5 km to collect the seaweed and come back. I only drive to the beach if I have friends with me who wanted to go to the beach anyway. Or else I will go by bike – but carrying seaweed in large quantities is not possible on a bike.

Seaweed can help to increase the creation of surplus from the garden to the potential benefit of all.

**Conclusion:** The use of seaweed enhances Earth care if taken from managed areas in moderate quantities. It increases mainly the care for the people using seaweed, because it has many benefits. It generally

increased fair shares too. The only flaw is that it is mostly necessary to go by car to collect seaweed. That flaw can be limited by having other purposes for going to the beach and choosing beaches/shores as close by as possible.

## Ideas

Ideas include how to use seaweed in the most beneficial way, while being guided by the principles of permaculture.

**The problem is the solution:** I moved into my house recently. I didn't have enough mulching material for the garden and was in search of a good material to use. I scanned my resource inventory for suitable organic matter, but I only had quite fresh garden cuttings and branches not suitable for mulch. The nearest place I could get organic material in abundance for free was the seaweed.

There are farms around me, but they are not organic, so having manure from there is not my preferred choice.

The seaweed mulch was appropriate and slightly reduced a problem with too much rotting seaweed and over supply of nutrients at the beach and resulting pollution.

**Cycling energy, nutrients and resources:** For what it's worth, the cycling between marine systems and terrestrial systems got a little bit increased with my collection of seaweed. Mostly excess nutrients from farming, sewerage and industry are led to the sea and come back in much smaller quantities in fish, mussels and other sea products.

**Each element performs many function:** The seaweed has several functions in the garden. It is used to cover the soil to prevent drying of the soil surface. It adds nutrients and trace minerals. It adds organic matter. It can kill some weeds when still salty and suppresses them by blocking out light. It gives the soil a fluffy, soft texture. It keeps away slugs and snails. Some plants like kale and asparagus grow better with a thick layer of seaweed. It helps to prevent fungi and cancer on fruit trees.

**Creating beneficial connections:** I like spending time on the beach for recreation. The prospect of collecting seaweed can convince me of getting out and enjoying the beach, which I otherwise would not prioritise. Thus, the beach and marine foreland becomes a part of my system – a part of my zone 3 or 4. I also observe and learn from the beach and wild marine foreland and as such it is part of my zone 5.

While I'm at the beach I also look at other potential benefits. I harvest fresh sea salad and bladderwrack for cooking. I forage for wild edible plants and sometimes I find a piece of driftwood or some stones I use for decoration.

I enjoy taking friends to the beach, extending my knowledge about the beach plants, animals and functions to them, and go on walks from there.

In the garden I use it in zone 1 and 2 beds. I have also mulched the forest garden area in zone 3 with seaweed.

**Use and value biological resources:** Seaweed is a very biological resource and it can be used not only for mulch, but also for insulation, thatching, eating, weaving and decoration. Using seaweed as mulch material is a first step on a journey about rediscovering seaweed as a resource that can fulfil many functions. It's a material with roots deep in Danish history and has been valued for its beneficial contributions, but now this is nearly forgotten knowledge.

## Make

**Collection:** I like to collect the top dry layer of the seaweed from the beach. The top layer has been more exposed to rain and the salts have been washed out. If there is not enough, I take also more fresh seaweed, but then I have to be more careful where I put it.

I started collecting seaweed in reused plastic bags when I moved in. I have been emptying the house and taken much garbage to the recycling station, 300 meters away. For the garbage I use clear plastic bags. If they are not too damaged, I empty them out at the recycling station and bring them home to be reused.

**Application:** I have used seaweed mulch on my salad and herb bed, with the hosta bed, the orpine bed, in the forest garden and in the compost system.

I first cut the weeds and even out the area where I want to mulch, if necessary. The weeds can rot and add to the soil carbon and nutrients. I apply cardboard in 2 layers and make sure the cracks are covered with at least 20 cm cardboard on either side for nettles and couch grass not to get through. I put the seaweed on top in a layer of about 15-20 cm.

So far it functions well. The salads, herbs, hostas and orpine seem to be thriving with the seaweed mulch.

In the salad and herb bed, the amount of slugs seems to be low, compared to the grass a meter away.

One plant, *Hablitzia*, has disappeared since I planted it. Whether it was sensitive to being moved, to the seaweed or something else is unclear. I will be careful next time to observe *Hablitzia*'s reaction to seaweed, preferable when I can compare two plants.



Chives, mint, sage and chervil in seaweed mulch to the left. Lettuce, mint chives, anis hissoop and a South American cucumber like plant called “fat baby” all seem to be growing well in seaweed mulch. This seaweed was taken from the top layer on the beach and applied directly to the beds.



To the left: Seaweed mulch with two different kinds of seaweed, mainly eelgrass and a little bright green sea salad. To the right and below: Mulch in the forest garden area. Cardboard covers a rich soil where nettles used to thrive and barely let skinny currants come through. The seaweed was quite fresh and not washed before applied. It is the intention that it reduces the growth of nettles without damaging the currants and trees.



Above: Seaweed mulch used with hostas to the left and orpine (Sedum telephium), Malva (Alcea rosea) and bramble to the right. Birds like to scrape the seaweed and spread it all over. I had to put in a stone edge, which I would have done anyway, to keep the seaweed from being spread.



Above: Seaweed used in bulk in the forest garden area.

### **Maintaining beds and forest garden cover**

When my production of compost from the garden and kitchen is in good flow, I can lessen the amount of seaweed I put on as mulch. That will happen from next spring.

I will still continue to use seaweed mulch because of its beneficial properties, but I will mix it together with my garden compost and more selectively use it on plants that are especially thriving with the seaweed mulch.

The mulched bed with hostas has around 10 cm of seaweed mulch. After three months, it is still moist underneath and a lot of sandflies are still jumping around when the mulch is disturbed. That means that even with a very dry summer, like we had this year, the mulch is moist enough to keep a population of sea insects that require constant moisture alive. The soil underneath was nice and moist as a consequence of the mulch layer.

The nettles are getting through in some places, most likely because I am walking on the mulch in some places and thus breaking the cardboard apart. Putting in proper paths and covering with cardboard again will help this problem.

### **Salinity**

Salinity could be a problem if large quantities of unwashed seaweed are applied on the soil over extended periods of time. However, I assume the problem is mainly local for plants that are not tolerant to salt.

In dryer climates, the salty water will evaporate off the surface and create a high salinity near the surface, often harmful to the plants. Salinity in agricultural soils is mostly caused by applying irrigation in amounts that will water the plants, but at the same time dissolve salt in the upper layers of the soil and transport them towards the surface because of evaporation.

In Denmark, we have enough rainfall every year to flush the soil of salt and the net transport of the salt will be towards the ground water. The salt will mostly be absorbed in clay minerals and organic matter before it reaches the groundwater table.

I am not familiar with studies done about applying seaweed to soil and the effects of salinity on the soil over longer time. If applied in large quantities, I would seek more information about seaweed as a fertiliser.

On a small scale, like my garden, I am not worried about applying seaweed in layers of 5-10 cm, based on the reports I have studied of other people applying seaweed in the same amounts. One report is based on 25 years of experience with growing kale and asparagus in layers of seaweed that are maintained at a depth of 10 cm and renewed every year.

## Evaluation

The seaweed mulch has performed the functions that were the starting point of this design: to provide mulch material and to help reduce pollution.

Doing an evaluation exercise will further highlight positive and negative aspects of using seaweed mulch. I have chosen Edward de Bono's tool "Plus, Minus, Interesting" (PMI) to structure the evaluation.

PMI for using seaweed as mulch		
Plus	Minus	Interesting
<ul style="list-style-type: none"> <li>• Carbon increase in soil</li> <li>• Soil protection from rain</li> <li>• Prevents soil from drying out</li> <li>• Adds nutrients</li> <li>• Anti fungal properties</li> <li>• Growth enhancer</li> <li>• Reduces slugs and snails</li> <li>• Suppresses weeds</li> <li>• Creates light soils when dug in</li> <li>• Reduces nutrient pollution of the fjord</li> <li>• Increases enjoyment of people on the beach</li> </ul>	<ul style="list-style-type: none"> <li>• Increases salinity of soil</li> <li>• Some plants are sensitive to salinity.</li> <li>• Car/petrol is used when picking up seaweed.</li> </ul>	<p>Some plants may react negatively. This can be used as a plus when suppressing weeds and can act as a minus if it affects the cultivation of crops.</p> <p>Seaweed has the potential of becoming a widely used fertiliser in agriculture.</p>

**Conclusion:** Seaweed is overall good mulch, but should be handled with care around sensitive plants and in large quantities. It acts sometimes as waste in the wrong place, but could be a valuable resource if used in beneficial connections. It could have the potential to become a widely used fertiliser in agriculture instead of more chemical fertilisers. It is enjoyable to work with seaweed both in its natural environment the beach and in the garden.

### Next steps

- Experiment more with seaweed mulching
- Research more on applications of seaweed
- Go for more walks on the beach



*The productive edge between land and water is very present on the island where I live. Salvig "Bay of Sal", Orø, September 2014.*

### Reflection

It has been a pleasure to work with a small design around a very tangible topic. Highlighting the ethics and doing the PMI created an awareness of some things to be careful with, i.e. the salinity of seaweed.

I changed the design model from SADIM to PRIME because it works better for this kind of design in my opinion. Starting with the design brief or problem or context and doing research on the solutions worked better for me in this case. I knew that I wanted to use seaweed, because I am familiar with all its beneficial

properties. I decided years ago that seaweed as mulch is something I want to work with because it's beneficial and available. I have included the other types of mulch for the sake of showing that I'm aware of the other types of mulch. My design is more about why and how seaweed is good to use and about cultivating knowledge about seaweed rather than about an analysis of why I choose seaweed in the first place. I want to get more familiar with seaweed, its properties and functions and that's why I did this design.

I realise there are different starting points to a design:

- An element in abundance (or being a problem) that can come to fulfil certain beneficial functions – the design is then about: how should this element be fitted into the design?
- A need or function that calls for a solution – the design is about finding the right element for the solution.

This design has a beneficial element in abundance and the right need to make use of the beneficial element. On top of that, the element can be considered waste or pollution if not in the right place. I think raising awareness of a beneficial element out of place is a valuable approach to a design.

### **Waste is a resource out of place.**

Discovering more about seaweed and its use as a fertiliser is on my list of next steps. I would like to find a balance of getting the beneficial properties of the seaweed while limiting the negatives.

There hasn't been any "done differentlies" in this design yet in the "Make" stage. I accept that experimentation with seaweed as mulch will have negative impact on growth occasionally. "Working with nature" might imply not using materials from the sea in a forest type ecosystem.

I look forward to do more experimentation like comparison of beds with different kinds of mulch. Seaweed is an abundant resource in Denmark and available to me, so I want to maximize the benefits I can get from this resource.

## **Accreditation criteria**

<b>Demonstrating Design Skills</b>	<b>Applying permaculture in my own life</b>
<ul style="list-style-type: none"> <li>- PRIME</li> <li>- DAFOR (half)</li> <li>- Ethics</li> <li>- Principles</li> <li>- Zones</li> <li>- PMI</li> </ul>	<p>Getting more familiar with the natural environment around me has been very important. The beach and marine forelands are a major part of the natural environment accessible to me. Harvesting a yield while recreating is optimal use of time and resources like petrol.</p>

<b>Learning from and developing your permaculture practice</b>	<b>Applying permaculture to my work and projects</b>
<p>Using design tools on a small and tangible topic makes it easier to focus on getting the design right. Some of my other designs are life altering on a big scale and the designs can get very complicated and cluttered with different influences. This design was a challenge in “going by the book” and reassuring in its outcome.</p> <p>However, the process was not accepted by the tutor and I had to understand where this was coming from. I found that using a model for design is sometimes like using crutches when you want to run. Models can be constraining a creative design rather than helpful. Choosing the right model is of course very important.</p>	<p>Using Holmgren’s domains this project is within Land and Nature stewardship, while in the 12 categories “site design” or “other” categories would apply.</p> <p>A small design like this falls under the category of “site design” as part of a site design, but obviously not being the whole design.</p>