

Diploma Design: “Harvesting habits” - The animals system at Delfryn

By Neil Kingsnorth

Implemented: Yes (and in progress)
Design start date: Started Jan 2022
Holmgren Domains this design is
associated with: Land and nature
stewardship



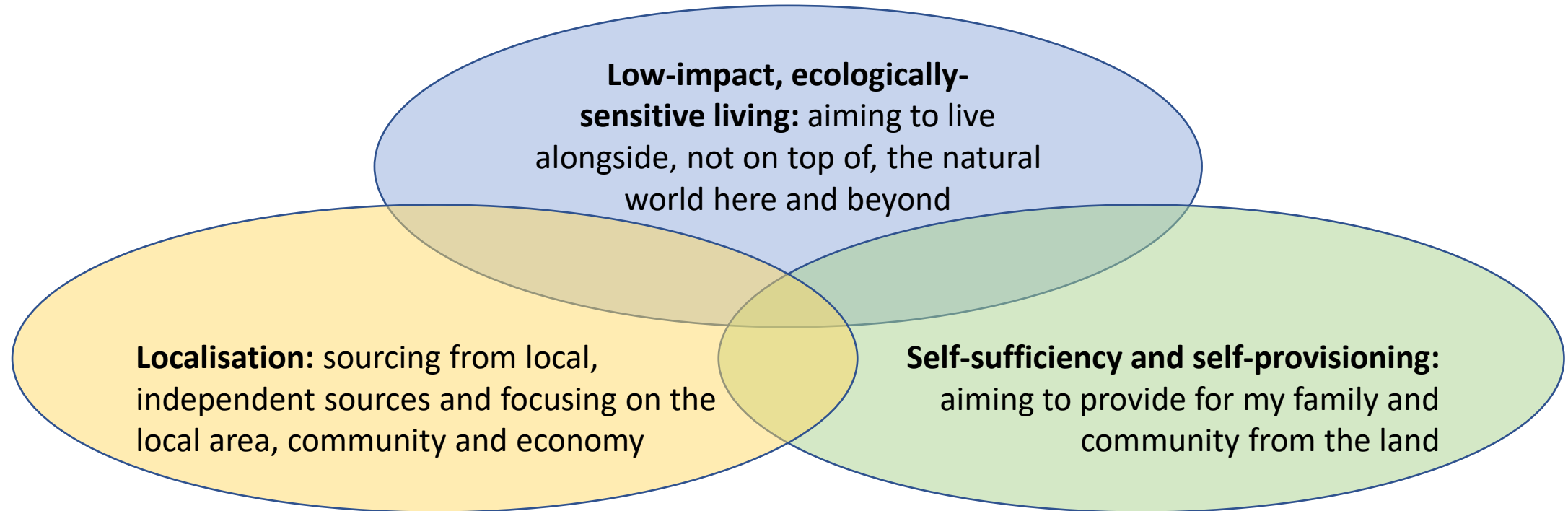
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Introduction

Context

I am developing a nearly-five acre smallholding in Pembrokeshire, which is currently mostly pasture, in to a permaculture-guided, regenerative, productive space aiming to produce the vast majority of everything I need from the site (including energy, food and income). The aim is to focus the project around a combination of three guiding ambitions:



As part of this ambition, I will be integrating some domesticated animals into the land system to help the system to function in line with these three key guiding ambitions. This design is the process of working out what animals I will keep, and how. It is focused specifically on domestic farm animals – not the integration of wild animals in to the system and not pets. These will be integrated, but not in this design..

Introduction

Ethics

As is clear from the guiding ambitions above, the project as a whole is strongly aligned with permaculture ethics. I will use the ethics again to check and shape the principles for this project and later again for a check against the design.

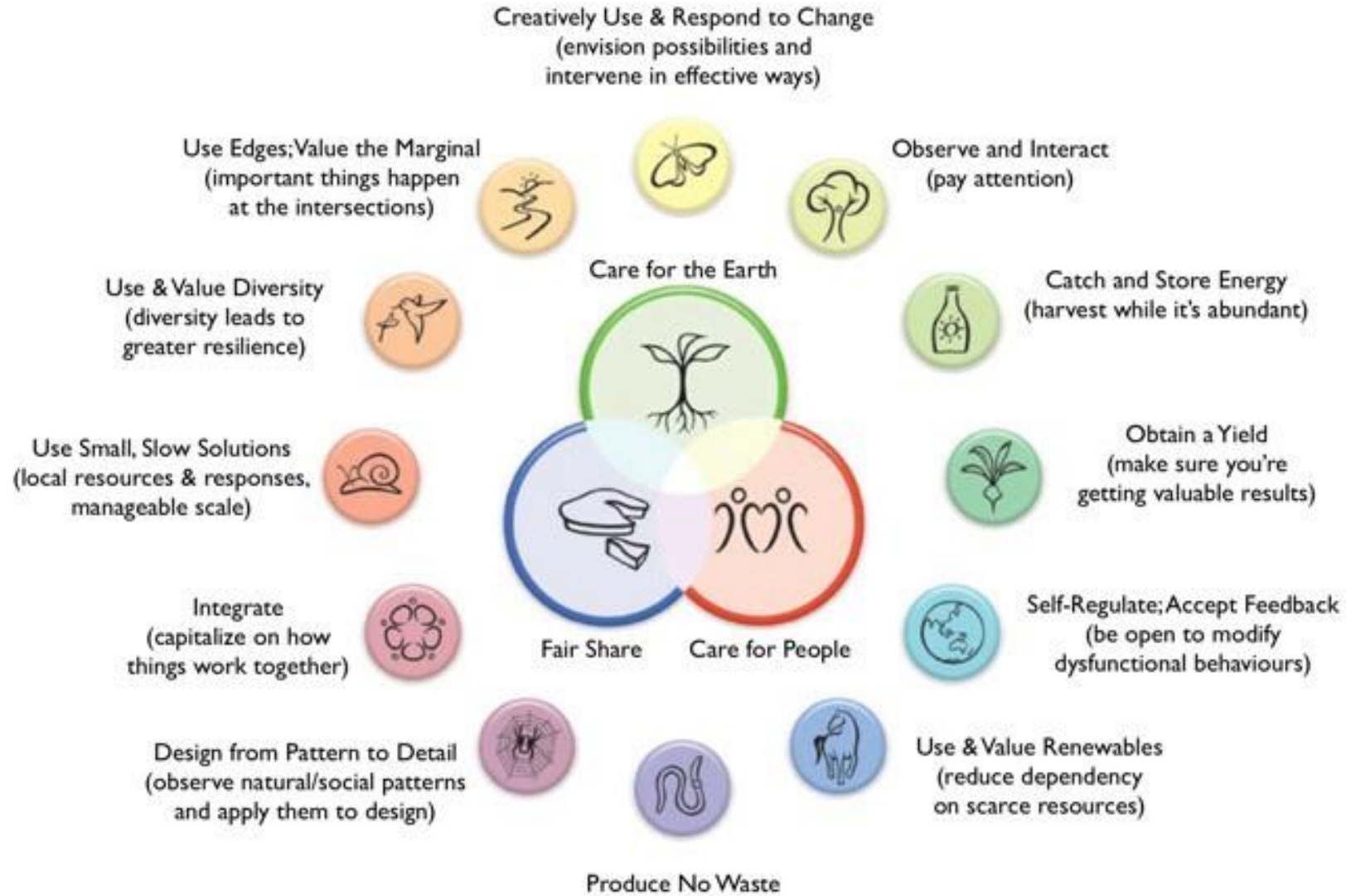
Design framework

I have used the Remiarz Web of Principles framework for this design.

This framework places the permaculture principles at the heart of the process, putting them front and centre of the design thinking. It is a non-linear design framework, allowing me to move fluidly from principle to principle as the design and energy takes me. Each time I have completed a step, I will look across the principles and see which one feels like it the best to go to next.

In order to implement the framework as originally designed, and to test out a new approach, I will be using the Holmgren principles rather than my working version.

Introduction - Holmgren principles

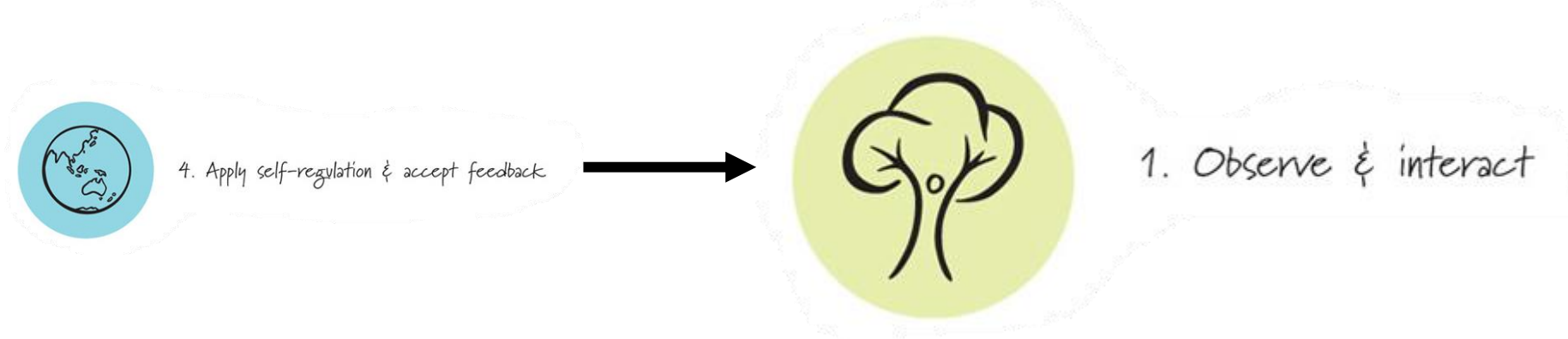




4. Apply self-regulation & accept feedback

I have chosen to start with self-regulation. This is because I have a set of guiding principles that I have chosen to observe, shaped by the permaculture ethics, and which I have decided all decisions on animals in the system need to adhere to:

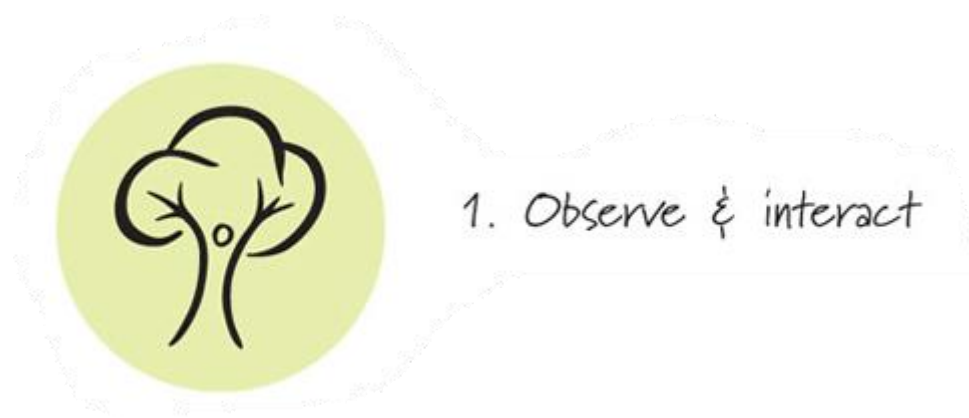
Self-regulating principles	Aligned with permaculture ethics
Animals will not be kept for the purpose of killing them or their offspring	Earth Care
Animals will be able to perform their natural habits at all times, and it is these, and their waste, that will be put to use in the system – we will “harvest their habits”	Earth Care
Feed, bedding and other animal needs will be produced on site as far as possible	Earth Care, Future Care
Although some digging will happen for land preparation, from then on we will be applying a limited-till system to the soil	Earth Care, Future Care
All animals must have their basic needs for comfort and natural behaviour provided at all times	Earth Care
We will not use fossil fuels for any ongoing work on the site	Earth Care, People Care, Future Care



Moving from self-regulation, to observation, I think it's important to observe and identify the issues that I have to address for the smallholding project to function effectively, and where animals may play a role. Following the classic idea that the problem is the solution, I will use this list to help guide which animals are best for the system.

These issues are (continued below):

- **Grass cutting:** Because of a camping business, paths, an orchard and a timber area, some areas of the land will need to be cut grass – too many for regular scything during the summer
- **Soil feeding:** The soil across the site should be fed regularly with solid, carbon-based, organic feed, to improve and then maintain structure – especially for the vegetable and grains areas
- **Complete protein:** The land needs to provide sufficient complete protein (either in one or through multiple sources)
- **Managing invasive plants:** Edges include bracken, blackthorn and bramble, all of which need managing to stop encroachment



Continued...:

- **Wire worm and other soil pests:** The soil (mostly mature pasture) will contain wire worm as well as other pests
- **Orchard pests:** The orchard will need pest management
- **Slugs and snails:** Slugs and snails are a significant problem, especially in the vegetable-growing area
- **Sweetness:** We would like a source of sugar as well as fruit
- **Calcium:** The land needs to provide complete sufficient calcium
- **Manure:** Given the scale of production, an ongoing source of organic, composted manure would be very helpful for soil fertility
- **Weeds:** There will be plenty of weeds in the soil that will need management. Animal assistance, alongside the how, would be helpful
- **Voies:** There are a lot of voles on the land, which will eat young trees and vegetables



1. *Observe & interact*

Staying in the observation stage, there is a set of land survey information that is important to inform the design decisions. I have set these out in line with the scale of permanence, as a useful layout (but not using the scale of permanence for design thinking at this stage). After this is a sketch map of the site, for reference.

This survey information is provided at a sufficient level for the animals design – more detail will be provided for the site as a whole, in the broadscale design:

- 1. Climate:** Wet mild winters, Warm, variable summers, Very strong South-Westerly and Northerly winds at times
- 2. Land shape:** Gently-sloping, south-facing land, around 180 metres above sea level. The site is just under 5 acres, but after land used for housing, structures and a mature wet, willow woodland the available productive land is around 3.4 acres
- 3. Water Supply:** Seasonal springs at the North-Westerly corner of the land, feeding an existing pond at this end of the field. Irrigation ditches move water from North-Westerly boundary and south-westerly boundary. The southern boundary, and the westerly edge of the willow woodland, are both very wet from late Autumn to Early Spring.
- 4. Roads/Access:** Access for vehicles is possible from gates as indicated on the sketched map below, each leading directly from a B-road. This access is large enough for a tractor and trailers, for example.



1. Observe & interact

5. Trees: Over 1500 trees have been planted around the boundary since January 2020, creating a windbreak and shelterbelt. However, these are all very young. There is a mature willow woodland at the South-Westerly corner of the land. There is a collection of more mature trees on the South-Easterly edge of the main field and in the paddock in the north-eastern edge of the plot. This includes a mature fir, a mature sycamore, mature hazels and three mature Ash trees, all of which have die-back.

6. Structures: there is a house, garage and agricultural hay barn as well as two dilapidated tin shed in the paddock. There are no structures on the main field.

7. Subdivision and fences: Fences and hedges are planned for the site, but these are not yet planted or installed. Their position will be confirmed in the main broadscale design for the site. At present there are no permanent fences or hedges in place.

8. Soil: The soil is clay-dominant, with a pH of around 7 in most places. It is stony (slate and granite) with different levels of fertility across the site.



1. Observe & interact

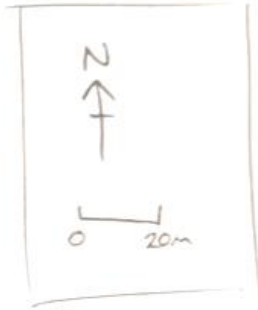
North-Westerly winds

Young planted willow area

Irrigation ditch

Springs

Pond



Mature wet willow woodland

Windbreak (young)

Main field

Gate to road

Irrigation ditch

Dilapidated tin sheds

Windbreak (young)

Gate to road

Barn

"Paddock"

House

Garage

Driveway

Southerly winds



1. Observe & interact



7. Design from patterns to details



Having set some of the main patterns of the design, with the identification of the guiding principles and problem/issues above, I now want to dive down in to some detail to start to assess options. Guided by these patterns, the following is a consideration of the main domestic animal options I am considering for the site. First up is the list of animals considered:


- Pigs
- Sheep
- Rabbits
- Chickens
- Ducks
- Guinea fowl
- Geese
- Cows
- Horses
- Llamas
- Bees
- Goats



7. Design from patterns to details



Having set some of the main patterns of the design, with the identification of the guiding principles and problem/issues above, I now want to dive down in to some detail to start to assess options. Guided by these patterns, the following is a consideration of the main domestic animal options I am considering for the site.

ANIMAL	PLUS	MINUS	INTERESTING
 Pig	<ul style="list-style-type: none">• Can in theory eat cooked waste food• Would trample edges (helping to control invasive plants)• Could be used for initial digging and land clearance	<ul style="list-style-type: none">• All pigs dig, even the Kune Kune breed, and this is one of the main benefits of pigs. After initial preparation, we plan not to dig the soil. Pigs can live for 20 years and we do not have digging needs after the first year.• We do not plan to eat kept animals, so this feature of pigs is of no interest.• Most pigs need more than just grass, so feed would need to be grown• Pigs are mostly very heavy so would cause pocking in the clay soil in winter• Pigs need housing• Pig manure is not easily useable compared to ruminants	<ul style="list-style-type: none">• Law prohibits pigs eating most cooked waste food and even fresh food prepared in-house, negating this benefit

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Sheep



- Cheap to purchase
- Some can live all year just on grass
- Light footed so no pocking caused in winter
- Provide an annual source of wool
- Manure feeds the soil as they graze
- Low/zero medicinal needs
- No housing needed
- Excellent for strip grazing to keep grass short where needed
- Some breeds will eat bramble and can trample invasive plants

- Manure feeds soil but not easy to collect for bulk manure
- Can escape more than some other animals
- Can eat grass too low if left in one area for too long
- Sheep milk is not a viable by-product as it requires breeding and some killing of offspring, breaking a principles of the project

- A local breed – the Welsh Black Mountain Sheep – is resilient needing no feed beyond grass and no housing
- It would be a good idea to produce Hay for winter in case of bad weather - this is an opportunity for a wildflower hay meadow
- Housing not necessary but animals would be more comfortable if housing provided

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Rabbits



- Small – no pocking and easy to handle (if can be caught)
- Cheap to buy
- Would feed the soil with manure (although their manure is not very rich)

- Dig the soil a lot as habit, which would be damaging
- Easily taken by local predators – foxes, badgers and Red Kites, so would need a full cage, making it hard to move them around
- Not useful as a source of meat due to project principles
- Hard to collect the manure for bulk
- Diet and weight means they can't manage invasive plants

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Chickens



- Can eat pests in the soil
- Happily eat slugs
- Like to scratch, so good for weed control and gentle soil prep
- Can eat pests in the manure of other animals
- Produce eggs for protein and calcium
- Egg-shells could be ground down for source of calcium
- Produce feathers as a by-product
- Easily moved from area to area for strip grazing, if not free-ranged
- Feed the soil with manure whilst ranging
- Waste from coops can be used for good-quality organic compost

- Require feed, especially for laying. This would need to be grown.
- Can easily be taken by foxes if not housed properly

- Feed is mainly grain, which can be grown on site
- Electric netting can be an effective way to withstand foxes and trip graze
- Could eat parasites in the waste of other animals, helping reduce disease

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Ducks



- Provide eggs for protein and calcium
- Source of feathers
- Manure the land
- Provide manure from bedding
- Love to eat slugs and snails
- Do not scratch, so can be put amongst tough vegetables that can withstand a trample
- Duck pond water would be a source of fertiliser as it is enriched with their waste
- Activity of waste and movement can be used for puddling – lining ponds
- Can be free-ranged or contained

- Need a pond as well as drinking water, so hard to move around
- Make a mess of land if contained in one area, damaging soil structure

- Although some advice suggests that some breeds of duck do not need ponds, my view is that they strongly do and not providing one would break the principle of the project to allow animals to behave naturally

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Guinea fowl



- Particularly good for managing orchard and soil pests
- Provide eggs for protein and calcium
- Manure the land
- Source of feathers
- Easily moved for strip grazing, or can be free-ranged

- Eggs are small
- Very hard to manage as they are very flighty and like to roost in trees
- Small enough to be taken by kites even if contained by electric netting
- Very noisy, which may impact campers and neighbours

- Act as quite effective guard-birds, sounding alarms when there are threats

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Geese



- Source of large eggs for protein and calcium
- Source of feathers
- Good guard birds, protecting and sounding alarms when threatened
- Eat grass so can manage grass, though to a lesser degree than ruminants
- Like to eat slugs and snails
- Eat mice and voles, which are a pest on the field

- Not as many eggs and chickens and ducks
- Like ducks, they need a pond
- Too heavy to put amongst vegetables for slug control

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Cows



- Good for grass management as they don't eat it as low as sheep and their eating style means it is cut at a variety of lengths
- Manure the soil
- Some breeds can eat roughage like invasive plants listed and they are able to trample invasive plants at edges

- Manure not easily collected
- Very heavy – even small breeds – and will cause pocking over winter
- Observing nearby farmers, they may need substantial housing in at least some of the winter, which is not available
- May damage trees and hedges due to size
- Probably don't have enough land for the minimum required number of two, to feed all year
- Expensive to buy
- Can't be used for grass management in small spaces
- Milk is not a useful by-product due to project principles

- Some breeds can live happily on just grass and hay

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Horses



- Like cows, they are good for the grass plants themselves, as they don't eat it as low as sheep and their eating style means it is cut at a variety of lengths (but note the minus)
- They manure the soil whilst grazing
- Some breeds will happily eat invasive plants and all will trample it at edges

- Damaging to pasture diversity and encourage weeds like dock
- Very heavy, causing pocking
- Require substantial housing that is not available
- Very expensive
- Very large and cannot be used for grass management in smaller areas
- Probably don't own enough land for them for a full year
- May damage trees and hedges due to size
- Manure is hard to collect

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Llamas



- Eat grass so good for grass management
- Provide valuable wool each year
- Feed the soil with manure
- Can trample edges and help manage invasive plants

- Extremely expensive to buy
- Need housing and weather protection
- Need extra feed beyond grass
- Not very resilient animals

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Bees



- Can provide honey – a source of sugar
- Very useful pollination support, especially given this is quite a windy site and so rapid pollination is helpful
- Wax is another useful by-product

- Wife is allergic to bees and wasps (although not against us keeping them)

7. Design from patterns to details



ANIMAL

PLUS

MINUS

INTERESTING

Goats



- Will eat roughage and invasive plants
- Small, so don't cause pocking
- Affordable
- Some breeds will eat grass
- Feed soil with manure
- Can be strip-grazed

- They escape a lot
- No breed will happily eat grass when alternatives are on offer, meaning they can't be used to manage grass length in line with the principle of letting them behave as they would naturally
- Need housing as they hate the rain
- Milk is not a useful product due to project principles

7. Design from patterns to details



8. Integrate rather than segregate



The following table sums up which of the different identified needs each identified animal could provide.

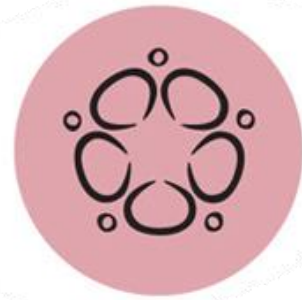
No provision

Some provision

Substantial provision

ANIMAL	Grass mowing	Soil feeding	Protein	Invasive plants	Soil pests	Orchard pests	Slugs & snails	Sweetness	Calcium	Manure	Weeds	Voles
Pigs	No provision	Some provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision
Sheep	Substantial provision	Substantial provision	No provision	Substantial provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	Some provision
Rabbits	Some provision	Some provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision	No provision
Chickens	Some provision	Substantial provision	Substantial provision	No provision	Substantial provision	Substantial provision	Some provision	No provision	Substantial provision	Substantial provision	Substantial provision	Some provision
Ducks	Some provision	Substantial provision	Substantial provision	No provision	No provision	No provision	Substantial provision	No provision	Substantial provision	Substantial provision	Some provision	Some provision
Guinea fowl	No provision	Substantial provision	Substantial provision	No provision	Substantial provision	Substantial provision	Some provision	No provision	Substantial provision	Substantial provision	Substantial provision	No provision
Geese	Some provision	Substantial provision	Substantial provision	No provision	No provision	No provision	Some provision	No provision	Substantial provision	Substantial provision	No provision	No provision
Cows	Substantial provision	Substantial provision	No provision	Some provision	No provision	No provision	No provision	No provision	No provision	Some provision	No provision	No provision
Horses	Some provision	Substantial provision	No provision	Some provision	No provision	No provision	No provision	No provision	No provision	Substantial provision	No provision	No provision
Llamas	Substantial provision	Substantial provision	No provision	Some provision	No provision	No provision	No provision	No provision	No provision	Substantial provision	No provision	No provision
Bees	No provision	No provision	No provision	No provision	No provision	No provision	No provision	Substantial provision	No provision	No provision	No provision	No provision
Goats	Some provision	Substantial provision	No provision	Substantial provision	No provision	No provision	No provision	No provision	No provision	Substantial provision	No provision	No provision

8. Integrate rather than segregate



Animal decisions

I can combine the information above with the principle of integrating rather than segregating – trying to find ways to maximise, or stack, functions provided by each animal rather than segregating each task and applying it to a separate animal. Doing so helps prioritise the choices for the different functions.

Animal 1: Sheep:

I will include sheep in the system.

They are the best grazers, alongside llamas and cows. However cows and llamas have significant cost implications, housing needs and are less suited to the smaller areas that need grazing.

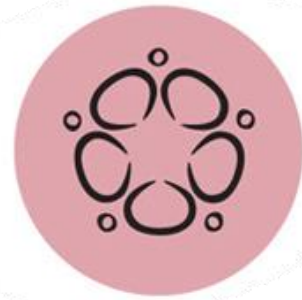
Although goats are good for invasive plant management they are not well suited naturally to grazing, breaking one of the principles of the project - to “harvest” the natural behaviours of the animals.

The sheep breed I have chosen (below) will eat bramble and dock leaves as well as grass, so will help control invasive plants and benefit from the diversity at the edges.

They can be moved to areas that need grazing easily, including small areas. They will also help to feed the soil as they graze.

To stay in line with my project principles above, I will have at least two sheep to start, as they need at least one other partner for mental health.

8. Integrate rather than segregate



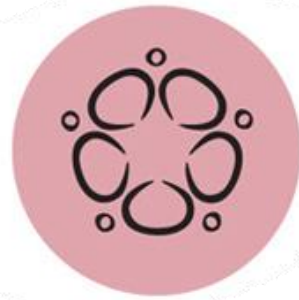
Animal decisions

Sheep continued

To make the sheep work within the system, I will

- **Use Welsh Black Mountain sheep**
 - These are a local breed, available for sale as a local biodynamic farm a few miles away.
 - They are a robust and resilient species, requiring no medicine, housing or additional feed, even in winter. However I will provide extra feed at times of poor weather, such as snow and will create a portable shelter for terrible weather.
- **Strip graze the sheep with regular moving:** To ensure they do not effect the diversity of the pasture or graze too low, they will be moved regularly, before the grass is very low, using a strip grazing method.

8. Integrate rather than segregate



Animal decisions continued

Animal 2: Chickens: I will include chickens in the system.

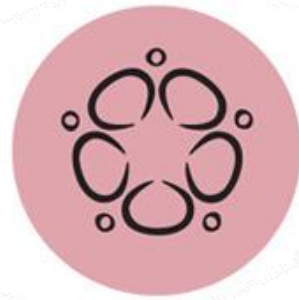
- Chickens are one of the few animals that provide both protein and calcium
- They also provide orchard pest control functions, weed suppression function and provide a good supply of manure as well as feeding the soil whilst foraging during the day.
- Chickens provide better-sized eggs than guinea fowl and provide eggs more regularly than geese
- Guinea fowl perform similarly to chickens, but as well as providing smaller eggs, they are noisier and tend to roost up trees, which isn't helpful
- Some duck breeds provide equivalent eggs to Chickens. Ducks are included in this selection (below) but Chickens are included alongside them as they perform excellent scratching habits, which are superb for management of pests in manure and the soil, and for the management of germinating weeds in prepared soil.
- **Chickens follow sheep:** Where chickens and/or sheep are not being put to specific uses on a particular piece of land, they can be rotated on the land following the sheep grazing. This will mean they scratch through the sheep waste on the land, removing parasites and reducing the chance of disease in the sheep.

10. Use & value diversity



- **I will use a mix of hybrids and pure breeds,** to get the balance between longevity of lay over years (from pure breeds) and consistency of lay over any one year (from hybrids). I will also use a diversity of breeds, for resilience of the flock.

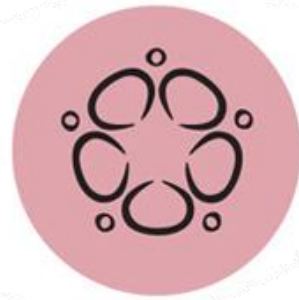
8. Integrate rather than segregate



Animal decisions continued

- **I will apply a mix of “contained foraging” and free ranging for chickens**
 - Chickens will be contained within a large electric netting area with full free access to the pasture and/or soil in that area. This gives them comfortable ranging and the ability to behave naturally, whilst protecting them from foxes.
 - When one or more of us is out on the land for a significant amount of time, we will let the chickens out to fully free-range. We will corn-train them to return to us when called, to ease re-housing, again using their natural instincts.

8. Integrate rather than segregate

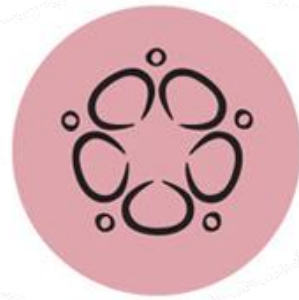


Animal decisions continued

Animal 3: Ducks: I will include ducks in the system, but not straight away.

- Ducks provide an excellent slug and snail management service naturally, as well as a very good number of eggs, which makes them worth having alongside chickens. They will also help to some degree with voles.
- Ducks naturally require a pond and so in line with the principles, will be provided with one. The ponds tend to be fertilised with their waste and this will be regularly harvested for watering down and use on crops, providing an additional yield.
- **I will use Muscovy ducks** as they are less messy (but still a bit messy) and better at laying eggs in coops, meaning they are less destructive of soil and their eggs are easier to find. They are also better at eating voles than other breeds.
- In line with the project principles, I will get a drake to accompany the females, as this makes them feel more secure.
- As with the chickens, I will allow the ducks to free-range when out on the land and will contain them in a large electric-netted run when not on the land.

8. Integrate rather than segregate

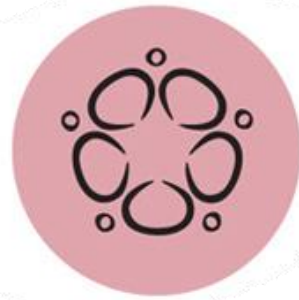


Animal decisions continued

Ducks continued

- I will create a rotating run system, as sketched below, to move the ducks on a regular basis and ensure no area of land is damaged by their generally soggy behaviour.
 - This system will give them constant access to the pond but will move them through three different areas and allow for them to be further moved on to the orchard, grain area and vegetable beds when required.
 - Although the system will mean I need to dedicate a sizeable area of land to ducks permanently, the yields of eggs, feathers, enriched water and slug management, are superb and more than worthwhile the investment of land. Alternative slug management systems brought in from elsewhere, like beer traps, organic-approved pellets or packets of nematodes, still require land-use and resources but these are “out-sourced.”
 - A planned wildlife pond in the middle of the vegetable area, to encourage frogs (which will also help with slug management) will be fenced off to keep ducks out, as they will frequent it and destroy the ecosystem

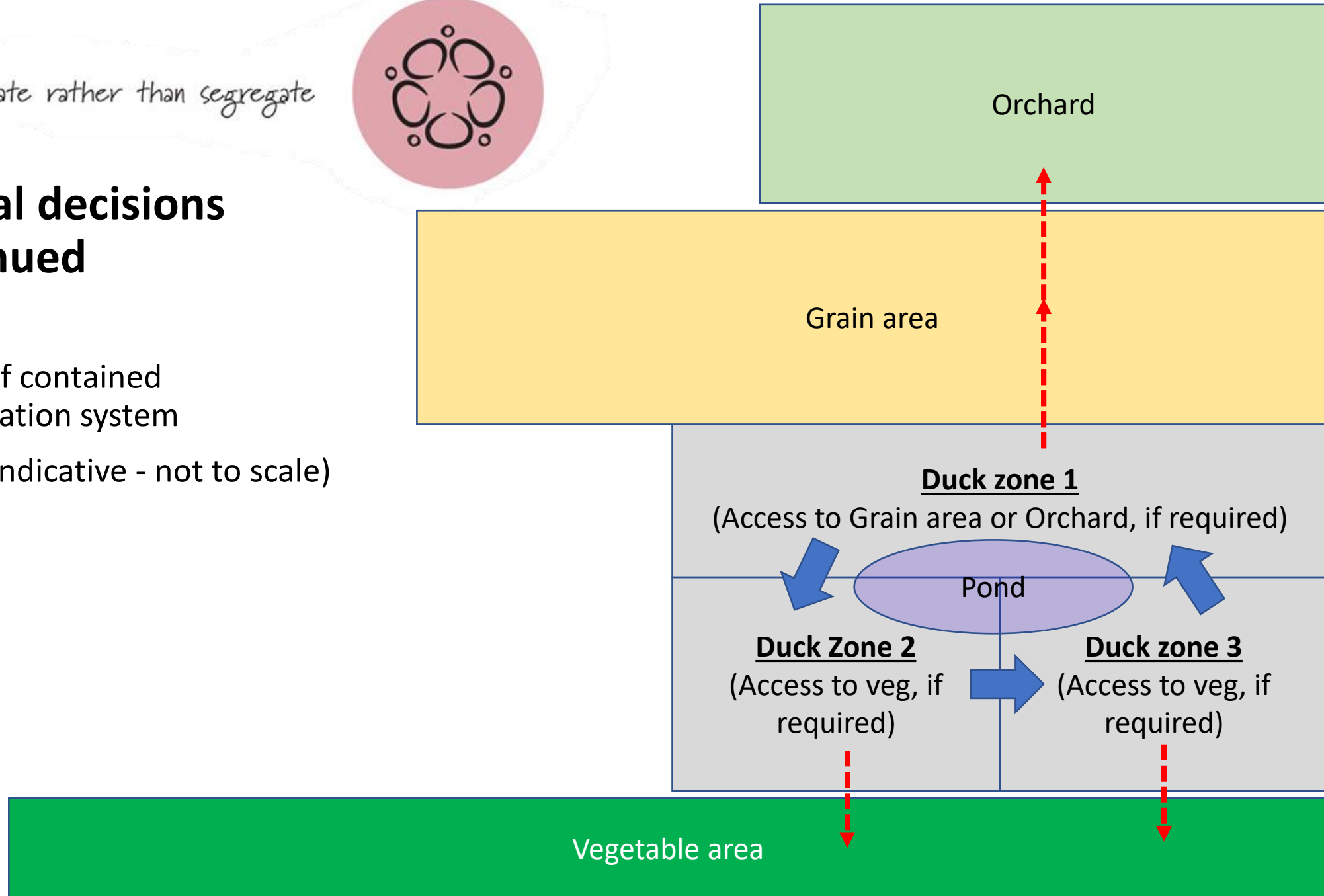
8. Integrate rather than segregate



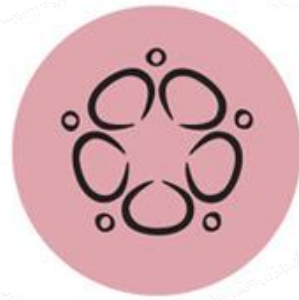
Animal decisions continued

Sketch of contained duck rotation system

(purely indicative - not to scale)



8. Integrate rather than segregate

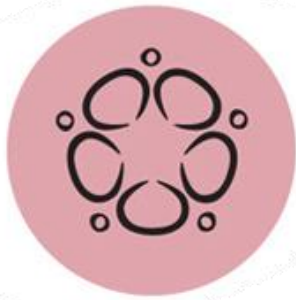


Animal decisions continued

- **Animal 4: Bees**

- Bees can only provide one of the necessary tasks required in my list, but are the only one that can provide a sugary product that we want to use for a variety of production.
- Bees also provide a set of excellent other yields, such as wax and pollination.
- Pollination in particular is very valuable as
 - (1) we are in a windy spot and blossom is at risk, no matter how good the windbreaks are. Rapid pollination will be valuable
 - (2) we are in an area of cattle and dairy farming and silage fields. Although there are lots of wildflowers around, the fields are largely deserts of pasture so natural bee numbers may be lower than optimum for food production
- In line with the principles of the project, I will use natural bee-keeping approaches, will not replace honey with sugar-water and won't remove all of the honey, ensuring there is always enough for the bees
- Because of the skilling-up required for natural bee care, and the expense of preparing materials, I will introduce bees in year two of the project (this year being year 1)

8. Integrate rather than segregate



Vole control – work with nature

Ducks and Geese will eat voles on occasion, but they won't catch enough to make a significant impact across the site and so again won't impact significantly on numbers. Other measures are needed.

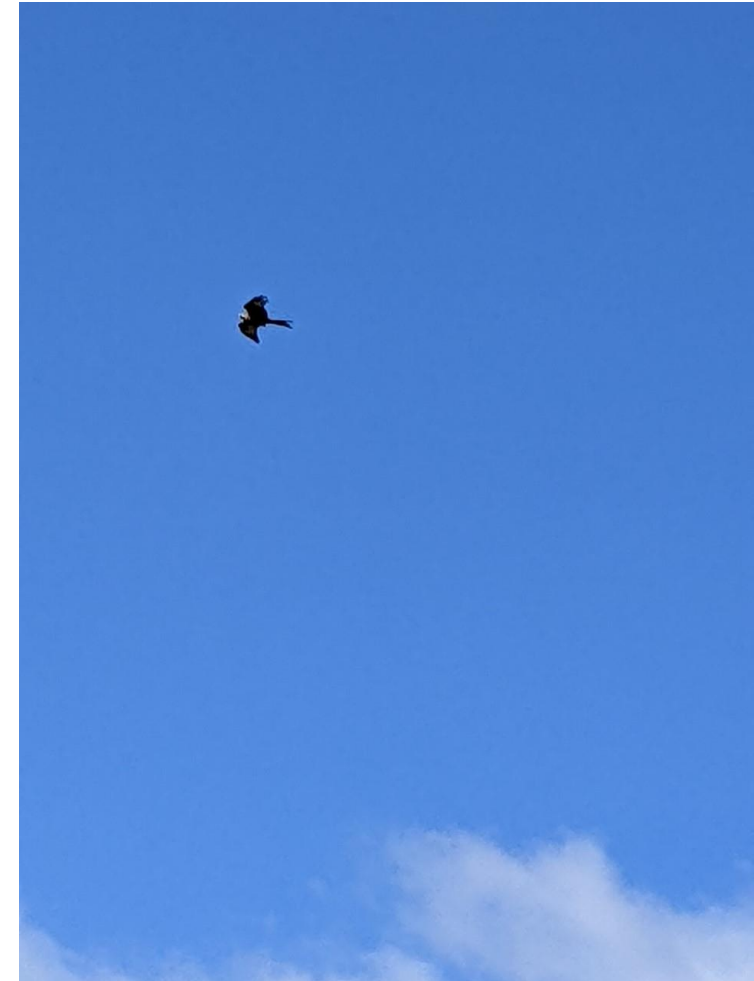
However, there are some excellent natural predators of voles around – red kites, foxes, buzzards and owls, all of which frequent the land.

Voles travel on the surface of the land as well as underground and these predators will catch voles more easily if they can see them easily.

The work of the sheep and chickens to get the grass short and maintain invasive plants like brambles will make voles more visible and hopefully assist in the control of voles.

Alongside this, we can take measures to further attract predators to the site. It isn't helpful to attract foxes, because of the birds on site, but the buzzards, kites and owls would all be helpful. We will design the site (broadscale and later on, but not for this design) to integrate wildlife pest control and attract these predators.

The first step of this is to integrate these predators in through the work of the sheep and chickens.



A Red Kite which was conveniently flying overhead when I was taking photos of the electric fencing and chickens, below.



Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships. It also highlights the yields of the animal system.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
Sheep	<ul style="list-style-type: none"> • Clean grass 	<ul style="list-style-type: none"> • Existing pasture, cleaned by <u>chickens</u> 	<ul style="list-style-type: none"> • Wool 	<ul style="list-style-type: none"> • Home use • Slug-repelling mulch • Insulation for coops
	<ul style="list-style-type: none"> • Water 	<ul style="list-style-type: none"> • Initially mains. In time, possibly from well dug to existing springs, pumped by wind 	<ul style="list-style-type: none"> • Shorter grass 	<ul style="list-style-type: none"> • Planned yield, used for access
	<ul style="list-style-type: none"> • Electricity for fence 	<ul style="list-style-type: none"> • Solar panels in house 	<ul style="list-style-type: none"> • Manure on land 	<ul style="list-style-type: none"> • Planned yield used for soil enrichment
			<ul style="list-style-type: none"> • Pests in manure 	<ul style="list-style-type: none"> • Input to <u>chickens</u>, who will peck at it for pests

6. Produce no waste



Obtain a yield

Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
<i>Sheep continued</i>	<ul style="list-style-type: none"> • Diverse hay 	<ul style="list-style-type: none"> • Harvested orchard grass, pollinated by bees 	<ul style="list-style-type: none"> • Waste from coops • Used batteries 	<ul style="list-style-type: none"> • Compost bins • Waste product – see notes below
Chickens	<ul style="list-style-type: none"> • Shorter grass (better for digestion and for performance of electric netting) 	<ul style="list-style-type: none"> • Sheep process 	<ul style="list-style-type: none"> • Eggs 	<ul style="list-style-type: none"> • For eating – provision of protein • Selling to visitors and passers-by
	<ul style="list-style-type: none"> • Insects and pests, scratched naturally 	<ul style="list-style-type: none"> • Sheep manure • Soil and orchard 	<ul style="list-style-type: none"> • Egg shells 	<ul style="list-style-type: none"> • Provision of calcium for family and birds
	<ul style="list-style-type: none"> • Water 	<ul style="list-style-type: none"> • As with sheep 	<p><i>Continued below</i></p>	

6. Produce no waste



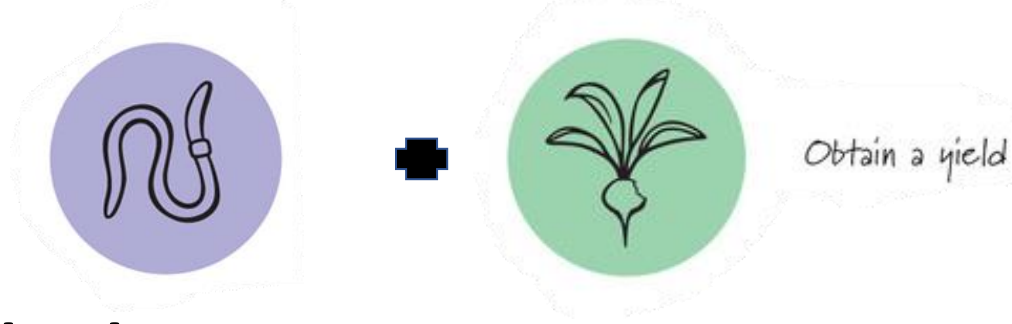
Obtain a yield

Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
<i>Chickens continued</i>	<ul style="list-style-type: none"> • Calcium 	<ul style="list-style-type: none"> • Chicken and duck egg shells, baked, crushed and resupplied • Shells collected from seashore when visited 	<ul style="list-style-type: none"> • Scratched land 	<ul style="list-style-type: none"> • Planned yield – weed management and pest control • In places will be over-sown for increased diversity of pasture
	<ul style="list-style-type: none"> • Feed – grains 	<ul style="list-style-type: none"> • Grown on site 	<ul style="list-style-type: none"> • Feathers 	<ul style="list-style-type: none"> • Will be used for crafts, bedding, or composted
	<ul style="list-style-type: none"> • Grit 	<ul style="list-style-type: none"> • The soil, which naturally contains a large amount of small stones and grit 	<ul style="list-style-type: none"> • Slug and snail control 	<ul style="list-style-type: none"> • Food growing improvements

6. Produce no waste

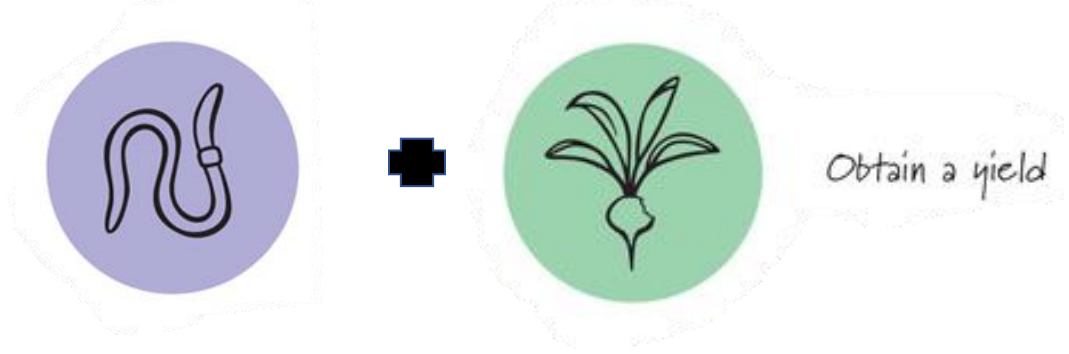


Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
<i>Chickens continued</i>	<ul style="list-style-type: none"> • Slugs and snails 	<ul style="list-style-type: none"> • Vegetable beds and other growing areas, ground 	<ul style="list-style-type: none"> • Orchard and soil pest control 	<ul style="list-style-type: none"> • Performance in those areas
	<ul style="list-style-type: none"> • Bedding 		<ul style="list-style-type: none"> • Used batteries 	<ul style="list-style-type: none"> • Waste product – see notes below
Ducks	<ul style="list-style-type: none"> • Slugs and snails 	<ul style="list-style-type: none"> • Vegetable beds and other growing areas 	<ul style="list-style-type: none"> • De-slugged areas 	<ul style="list-style-type: none"> • Yield of vegetables
	<ul style="list-style-type: none"> • Water for drinking 	<ul style="list-style-type: none"> • As with sheep 	<ul style="list-style-type: none"> • Feathers 	<ul style="list-style-type: none"> • Will be used for crafts or composted

6. Produce no waste

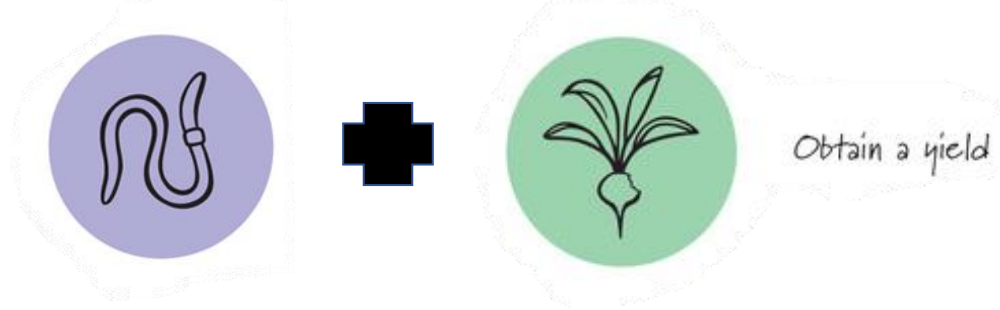


Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
<i>Ducks continued</i>	<ul style="list-style-type: none"> • Calcium 	<ul style="list-style-type: none"> • <u>Chicken and duck</u> egg shells, baked, crushed and resupplied • Shells collected from seashore when visited 	<ul style="list-style-type: none"> • Enriched water 	<ul style="list-style-type: none"> • Feed for vegetable beds • Feed for grains, for <u>chickens and ducks</u>
	<ul style="list-style-type: none"> • Feed 	<ul style="list-style-type: none"> • Grown on site 	<ul style="list-style-type: none"> • Eggs 	<ul style="list-style-type: none"> • For eating – provision of protein • Selling to visitors and passers-by
	<ul style="list-style-type: none"> • Water for pond 	<ul style="list-style-type: none"> • As with water 	<ul style="list-style-type: none"> • Egg shells 	<ul style="list-style-type: none"> • Provision of calcium for family and <u>birds</u>
	<ul style="list-style-type: none"> • Weeds 	<ul style="list-style-type: none"> • Vegetable beds and other growing areas 	<ul style="list-style-type: none"> • Used batteries 	<ul style="list-style-type: none"> • Waste product – see notes below

6. Produce no waste



Inputs and outputs

- The exercise above allowed me to identify a number of input and outputs. Below I've checked through that to see how each input relates to the outputs, of the same or other animals selected, and to identify any other efficiencies and relationships.

Animal	Required inputs	Inputs source	Outputs	Outputs can go to
<i>Ducks continued</i>	<ul style="list-style-type: none"> Lined pond 	<ul style="list-style-type: none"> Ducks will be used to line the pond through a natural puddling technique using their feet and manure 		
Bees	<ul style="list-style-type: none"> Water 	<ul style="list-style-type: none"> As With sheep 	<ul style="list-style-type: none"> Honey 	<ul style="list-style-type: none"> Kitchen use
	<ul style="list-style-type: none"> Hives 	<ul style="list-style-type: none"> Will purchase or build 	<ul style="list-style-type: none"> Wax 	<ul style="list-style-type: none"> Craft work, wood working
	<ul style="list-style-type: none"> Bee equipment 	<ul style="list-style-type: none"> Purchase 	<ul style="list-style-type: none"> Pollination 	<ul style="list-style-type: none"> Food production Diverse Hay, for sheep

6. Produce no waste



Creatively use & respond to change



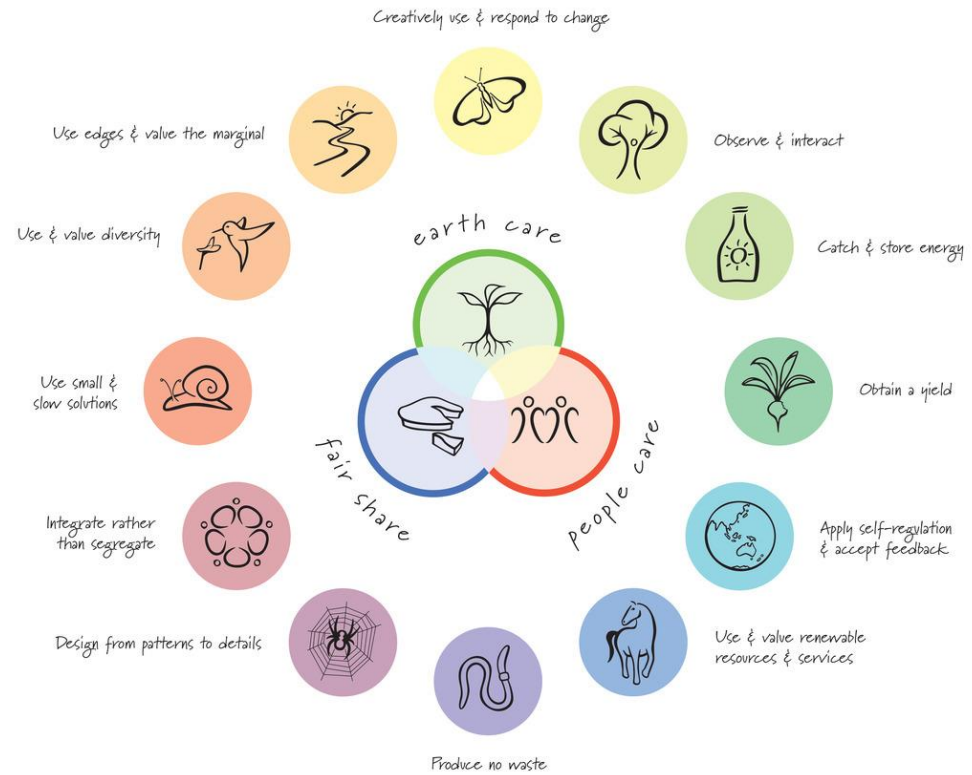
Electric fencing batteries

The only unused output from the animals system is the leisure batteries used to power electric fencing. However this is a significant negative output due to the toxic waste products in batteries and the damaging impacts of lithium mining. This cannot be a long-term solution for the site.

The challenge is to creatively intervene with this problem to find a better solution. The solutions I have identified to implement into the system to avoid this permanent waste product are the following. These will be integrated into the implementation plan later in the document:

- Installing mains electricity to a central point on the site. I will then link the fencing up to this external point using insulated lead-out cable, which will lead out along hedges and fences to the site of the fencing. This will then be powered by the mains electricity with solar panels, as planned.
- I will install more solid fencing on the site, where permanent fencing is needed, to allow some animal ranging without the use of electrics (although this is only possible when these areas need grazing).
- I will train the sheep to be used to the shocks in the fencing. As a result, the fencing will only need to be turned on about one day a week/10 days. This doesn't apply for chickens, who need the fencing for fox protection.

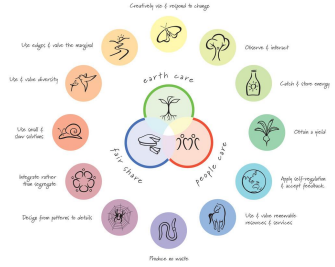
6. Produce no waste



Principles applied in inputs/outputs

Whilst doing the analysis and design work above, I have used a number of the other principles without specifically highlighting them as I go in the document, to keep the presentation simple.

The table below shows how some of the other principles were used, and how they were considered and applied:



Use renewable resources	Catch and store energy	Respond to change	Use small and slow solutions	Use edges and value marginal
Short-term: Solar panels will power the rechargeable lithium batteries	Harvesting and using manure from animals	I will get two sheep at first and then monitor their rate of “mowing” before getting more if needed	I will start with chickens, as I am most familiar with them.	The chosen sheep breed will eat and take nutritional value of the problem edge plants - bramble, blackthorn and dock
Medium term: Solar panels on house will power electric fences from a mains point (as above)	Cutting hay in orchard and using to feed sheep in poor weather	I will start with three female ducks and one drake and increase this number if needed and if the land can support it	I will get sheep second as I can integrate them easily and cheaply and the grass will need management in the Spring.	
Long-term: Wind pump may pump spring water to use for animals	Growing feed for chickens, including perennials like Siberian Pea		I will get ducks and bees later, due to the greater expense and, with bees, the need for additional knowledge	



Use small & slow solutions



Creatively use & respond to change



Implementation

Budget and approximate timeline

The budget for the animals system is as follows. Implementation timing of the system will be guided partly by availability of funds.

Phase 1: Chickens - Jan-Feb 2022:

- We have one coop. We need a second: £200
- We will have 5 pure breed layers, 5 hybrids and a cockerel: £ 200
- Electric netting and energizer system: £200

Phase 2: Sheep - March 2022:

- Cost of two lambs: £60
- Cost of electric fence and energizer system: £300



Chickens in electric netting area, in their third location since arrival at Delfryn



Creatively use & respond to change



Implementation

Budget and approximate timeline

Phase 3: Ducks - March 2023

- Cost of digging ponds (as part of larger digging project): £50
- Cost of electric netting and energizer system: £200
- Cost of ducks – Three ducks and a drake: £75

Phase 4: Bees - Summer 2023

- Cost of bee hive: £100
- Cost of bees: £50
- Cost of bee equipment: £100



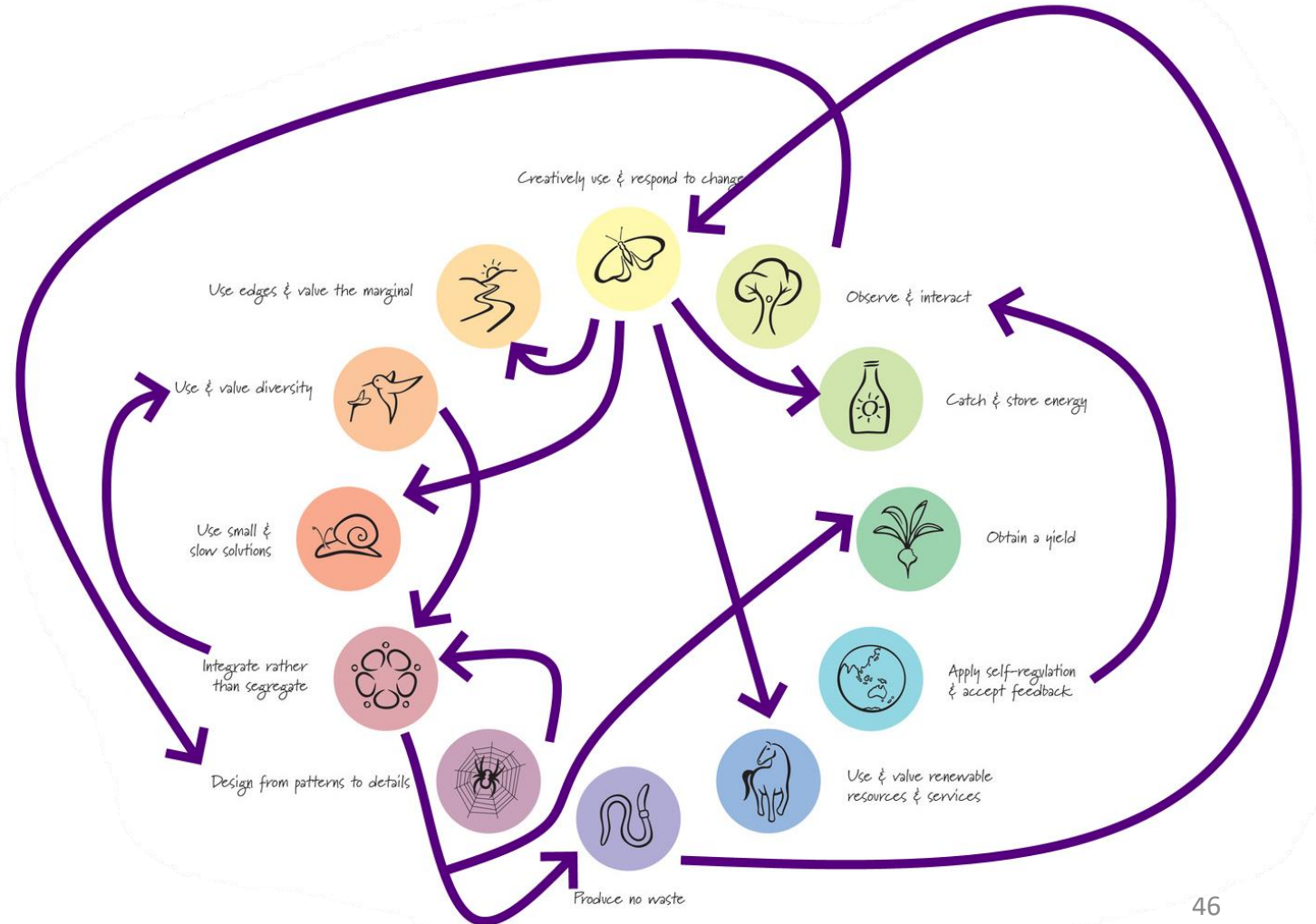
Two Welsh Black Mountain sheep that arrived to us from a local biodynamic farm on 12th March 2022, getting to work on the grass. They are contained by a portable electric fence.



4. Apply self-regulation & accept feedback

Evaluation and Learning

The image to the right shows the journey that I took through the principles, starting with “Accept self-regulation and accept feedback”.





4. Apply self-regulation & accept feedback

Evaluation of design

Check against issues to address

I set out to address the following problems through integration of animals in a system-design. As shown below, all the issues are address. What is pleasing is that they are achieved in a system-based way, and fully in line with the principles of the project. This includes the key principle that it is the habits of the animals that we supporting and harvesting.

- **Grass cutting:** Achieved with sheep and, less-so, chickens
- **Soil feeding:** Achieved with sheep, chickens and less-so, ducks
- **Need for complete protein:** Achieved with eggs from chickens and ducks
- **Managing invasive plants:** Achieved with sheep
- **Wire worm and other soil pests:** Achieved with chickens
- **Need for orchard pest management:** Achieved with chickens
- **Problem with slugs and snails:** Achieved with chickens and ducks
- **Desire for sweetness :** Achieved with bees
- **Calcium need:** Achieved with eggshells from chickens and ducks
- **Desire for manure:** Achieved with waste from chicken and duck coops
- **Weed management:** Achieved with ducks and chickens
- **Problem with voles:** Achieved with the help of sheep and chickens, supporting visiting wild predators



4. Apply self-regulation & accept feedback

Evaluation of design

Reflections - Ethics:

I used the ethics to steer the design of the fundamental ethical principles of the animal system. These fundamental systems were then applied repeatedly and very usefully throughout the design process.

I found having a set of fundamental project principles extremely useful. Throughout, they guided the nature of the design decisions and set the limits/boundaries of the process.

Because these project principles were set by the ethics, I can be confident that the project design as a whole was guided by the three permaculture ethics, which sat at the heart of every design decision as a result.

Reflections - Design learning:

Overall, I am happy with the design. I think it's achieved my aims, as set out below. There is room for tweaking, with the number and breed of any more sheep, ducks and bees, as I haven't committed to full implementation in one go (preferring to apply the principle of small and slow).

I have found the framework to be very useful (see below) and will use it further.

(continued below)



4. Apply self-regulation & accept feedback

Evaluation of design

Reflections - Design process decisions:

I made a number of very useful observations as a result of applying permaculture design to the process. In particular,

- Identifying leisure batteries as a waste product, pushing me to consider stronger solutions.
- Designing a duck rotation system to ensure that ducks could be integrated usefully to perform their function, whilst staying in line with project principles
- The PMI process really helped to prioritise which animals to select from a long list, based on the stacking of functions and matching habits with needs and site conditions.
- Vole solutions. The consideration of voles added value to the sheep's function of keeping grass low and also helped identify a need to further support the red kite, buzzard and owl predators.
- Waste: The Inputs-outputs process, which I always enjoy, helped double-check the process to ensure the process was as circular as possible.



4. Apply self-regulation & accept feedback

Evaluation of design process

Tools used:

- Framework: Remiarz web of principles
- Setting unique project principles aligned with ethics
- Site observation
- Sketched basemap
- Brainstorming
- PMI
- Cross-reference table
- Input/Output analysis



4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

At this stage, we still have the two Welsh Black Mountain sheep and the dozen chickens.

Impacts of the sheep:

- The sheep are excellent at taking the grass down to a lower level. We have moved them many times now. By monitoring their “mowing” on an ongoing basis, we are able to judge the moment when the grass is at a good length but when diversity on the land – in terms of plant diversity and diversity of lengths of the grass blades - is still there. Leaving them in one place for too long would reduce diversity but as yet we have achieved the right balance.
- They are happy to eat dock and bramble as well as grass and are having an excellent impact. They don't eat sedge or nettle.
- However, we are in Spring and the plants are growing fast, so we have decided to bring in two more to the flock. We originally brought in two to start small and slow, and grow as needed. We will bring in two more to see how they manage as a flock of four, over several months. In particular we need to see how they manage in late autumn, and winter, when the grass isn't growing.



4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

Image showing the impact the sheep can have when strip-grazed. Note the areas outside the fencing which is much longer. Also note the impact on the dock in the last picture.





4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

Impacts of the chickens:

- The chickens are superb weeders. We have moved them many times to trial their effectiveness in different spaces.
 - We placed them in an enclosed area in the orchard and they scratched the grass down significantly, and cleaned out the bases of the trees entirely.
 - We have had them straight on pasture, which has significant dock on it, and they have eaten and scratched the dock and weakened it substantially.
 - We have placed them on weedy and overgrown areas of soil which is otherwise ready for planting and after a week or so they have cleared it entirely, tilled the soil and broken down lumps, as well as clearing the soil of any sizeable pests.



4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

Right: Impact of the chickens on the pasture grass in the orchard (dry left-overs were then used to mulch the trees)



Above: Before and after shots of the impact on weeds in a food-growing area



4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

Challenges and learning from moving the animals:

- Sheep

- The sheep electric fence is excellent at holding the sheep in most of the time. They do escape from time to time but don't go far.
- However, when moving them, we need to wind the fence right back in around a coil and then position it into a new area. At this point, the sheep are not contained and they have learned to run wild. Twice now they have escaped on to the road and run up, and down, into gardens and fields. It's takes some chasing and herding to bring them back in. Whilst funny, it's not going to be a sustainable long-term habit!
- They are bucket trained but are not too interested in sheep nuts when they are free and can eat trees.
- To solve the problem, we need to buy sheep harnesses and train them to allow them to be put on. We can then lead the sheep to a new area and hold them there whilst the electric fence is erected again. A simple solution, but vital.



One of the sheep in the car on the way home after escaping up the road...



4. Apply self-regulation & accept feedback

Reflections on how it's going, May 2022

Challenges and learning from moving the animals:

- Chickens

- The electric netting we use for the chickens is superb at containing the chickens.
- We have not had any losses to foxes since we started this process and given that we know they are plentiful in the area we assume it must be effective at deterring them.
- However the fencing is very difficult to gather up without it getting tangled, is very heavy and it then clunky to erect again in a new location. Moved rarely this would be fine, but within a system for frequently moving the chickens, sometimes every week, it is not ideal.
- I will investigate alternatives but will also look at whether I can devise a system, and tool, for gathering the netting in and moving it more easily.

Another addition

We have had a serious rat problem this year and have considered how to harvest animal habits to our advantage to help with this. With that in mind, and because we'd like a dog anyway, we plan to get a jack russell terrier, or similar, when funds and capacity allow, as they are excellent ratter dogs.



4. Apply self-regulation & accept feedback

Reflections and review on how it's going, May 2022

Overall

Benefits are substantially outweighing the initial wrinkles and the system is functioning well. I am eager to bring it to its full set-up, with ducks and bees, as soon as possible as well as investigating more possibilities.

Next steps

- We still need to get the ducks and bees. Both will be in 2023 if we have the funds.
- We would benefit from another electric fencing unit for the sheep. That way we can split the four of them in to two flocks to manage different areas at a time, when needed.
- We would also benefit from more fencing of some form for the chickens, for the same reason.
- We will also be starting to use one of the coops, which has a small run included in its structure, to separate several chickens for short bursts of intensive weed-clearing on the vegetable patches. This will be happening from this month.

Review again:

November 2022. At this point we can monitor impact in slow grass season and can also assess our readiness for ducks.



4. Apply self-regulation & accept feedback

Evaluation of Remiarz Web of Principles

- My very strong view is that it is the principles of permaculture (however they are presented), and the three ethics, that make permaculture a unique, systems-based design approach and low-impact living guide.
- The various design tools (like PMI), frameworks (like SADIM), techniques (like keyline design) and features (like Hugelkultur) prevalent in permaculture are cogs in the wheel, or outputs of the machine, and many can be found outside of permaculture as well as within it. These are not what is unique about permaculture. The “machine” of permaculture is found in the systems-based application of the principles.
- It is very easy to become distracted by the tools, frameworks, techniques, features and lose sight of the fundamentals that should be guiding every element of a design – the permaculture principles.
- The Remiarz web of principles uncomplicates, and clarifies, the design process. Instead of following a separate linear, or non-linear design framework and looking to apply principles as you go, the Remiarz model merges the principles and the framework in to one. As a result, it becomes a very intuitive approach and brings to life an understanding of permaculture.
- It feels like this returns us to the core, raw focus on the essence of permaculture that was there at the start of permaculture’s journey.
- Typically, I have tended towards linear design frameworks because I find the web methods too abstract and loose to guide me usefully through an interrogative process. However, I have found the web of principles to be quite the opposite, probably because the permaculture principles sit at the very heart of the process.



4. Apply self-regulation & accept feedback

Evaluation of Remiarz Web of Principles

How the web of principles can be used

- For the most part, I have used the web of principles to design an animal-system, moving from principle to principle as seemed important at the time.
- Whilst working through a design thinking process, such as using the PMI process, I would sometimes be presented with a further question to answer during that process or problem to address. At this point, I returned to look at the full set of permaculture principles and considered the challenge in the context of the different principles. In doing so, each time, I was led down a line of analysis that identified the solutions I needed.
- At the end of any one process of thinking (for example, when I had completed the PMI) I would return to the principles again to consider where to go next. Sometimes there were obvious things that I had already identified during the process, which I could move on to address next. Other times, stopping to consider where I was in the process, whilst mulling the full set of principles, made it obvious where the next step would be.
- Because I could go back and forth and address issues and thoughts as they arose, the process didn't force me to try to answer everything at once, or try to retrofit thinking that had come up later, into a stage I had already written up in a linear process.



4. Apply self-regulation & accept feedback

Evaluation of Remiarz Web of Principles

How the web of principles can be used

- Another way the web can be used, which I only used briefly in the animals system design, is almost 3-dimensionally (although that does make it sound too complex and academic for what is an intuitive process).
- As well as roaming across the principles to create a design, such as an animals system, you can also pause at a point in the process and spiral down through the principles to address a specific challenge.
- In my case, I was presented with an issue with ducks. They were strong contenders for inclusion in the design, but the two most common ways to keep ducks – free-ranging or contained in a set fenced area – were both unworkable for my design or clashed with my project principles. I stopped at this point and focused just on the ducks, roaming again across the permaculture principles to consider options and ideas.
- Although overall, this pause is the application of the “pattern to details” principle, whilst looking at the detail I considered several of the other principles to help guide the development of the solution. I used the principles of “small and slow”, “integration”, “no waste” and “obtain a yield” in the thinking process which led me to the design of a rotating system around a central pond, with each “zone” allowing access points out to areas that would need attention from ducks.
- Once I had dived down in the web of principles to address this specific challenge, I could then move back up to the top level and continue roaming across them for the full design.



4. Apply self-regulation & accept feedback

Evaluation of Remiarz Web of Principles

Possible challenges with the web of principles

- I have a permaculture design certificate, have completed 10 permaculture diploma designs (and written up 6) and have fully practiced permaculture for around 8 years now. I have a growing confidence in and familiarity with the processes and thinking styles. It may be that someone coming to the web of principles at an earlier stage in their permaculture design journey would find some challenges that I haven't identified.
- The framework doesn't negate the need for the design tools like PMI, inputs-outputs, etc. Anyone using the framework would still need to apply whichever design process tools are appropriate for the analysis they are doing. However it may be that there is also a set of "key things to address" that could be identified for anyone using this framework, to make sure they do the full analysis necessary.
- For example, all designs require some form of survey (of land, of assets, of emotions). All designs require identification of some of the limits, boundaries and resources. All designs require some form of planning for implementation. All designs require consideration of the ethics as well as the principles, in a meaningful and practical way. Many frameworks ask that these are addressed in a linear way. This framework could perhaps set up checks that should have been addressed by the end of the process, freeing up the designer to choose when it is appropriate to address them.
- *Continued...*



4. Apply self-regulation & accept feedback

Evaluation of Remiarz Web of Principles

To help clarify what I mean, this feels like how I could explain the web of principles to someone that is new to it:

1. Start with your question – what are you trying to achieve?
2. Look over the principles, consider the questions that you need to answer and start answering them at whichever principle feels best.
3. Whenever you come across challenges you can't address with that principle, or when you have come to a natural end of thinking within that principle, return to the web of principles, consider again the questions that you need to answer and start answering them at whichever principle feels best to go to next.
4. You can move around the principles however you wish, back and forth, to design your solution. You can also pause to do a deep dive using the web of principles, to address a sticky problem within the design that you are stuck on. Sometimes you will find that you are thinking about more than one principle at once, which is also fine. Everything is connected, after all.
5. You don't have to use every principle in a design. However, you should make sure that by the end of your designing process, you've made sure the following are addressed:
 - Have you used the permaculture ethics to guide the best version of your solutions?
 - Have you been clear what the limits or boundaries are that you're working within?
 - Have you made clear what resources you have available and made sure that your design can be delivered with those resources?
 - Have you surveyed or observed your situation to make sure you know what you are dealing with?
 - Have you planned some way to at least start implementing the design?