



AVALON MARSHES

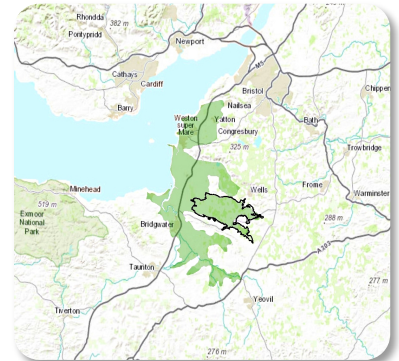
THE AVALON MARSHES

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www.avalonmarshes.org

Fact Sheet

What is the Avalon Marshes?

The Avalon Marshes is a part of the Somerset Levels and Moors – England’s largest lowland wetland. It is a low-lying region of northern and central Somerset, bisected by limestone ridges and hills. It covers almost 12,500 hectares (roughly fifteen miles by five miles) of the River Brue floodplain between Glastonbury in the east and the M5 motorway in the west. The River Brue is just one of the rivers that feed the wetlands of the Avalon Marshes.



Why are the Avalon Marshes important?



Wildlife

Many bird, wildflower and invertebrate species found in the Avalon Marshes’ natural habitats are very rare elsewhere in the UK.



Peat

Most of the valley lies on peat soils which store thousands of tonnes of carbon. Peat extraction is declining as a business.

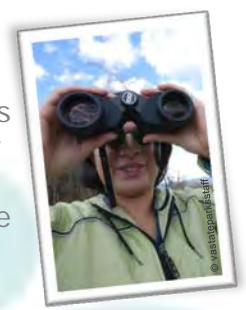
Food

Over 400 farmers produce beef, dairy and arable crops on the area’s fertile soils.



Tourism

Well over 70,000 tourists visit throughout the year to enjoy the natural areas, providing revenue for local business.



Archaeology

Amazing evidence of the area’s history has been preserved in the peat, including one of the world’s oldest known track-ways.



Water

Water connects the landscape, providing ‘wet fences’ and drinking water for livestock as well as habitat for wildlife.

Fact Sheet

What is a Wetland?

Wetlands are some of the world's most valuable ecosystems. They contain a disproportionately high number of plant and animal species and provide a huge variety of natural goods and services. Vital to humans throughout our history, wetlands include rivers, lakes, swamps and marshes, fens, wet woodlands and flooded forests, floodplains and even rice-fields. Wetlands also include coastal shore lines where the water is less than six metres deep at low tide which includes many coral reefs



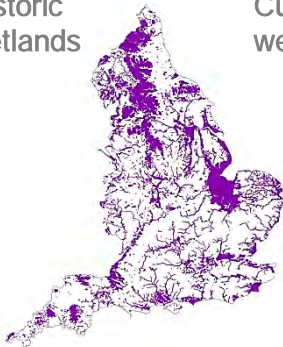
Where are Wetlands Found?

There are wetlands in every corner of the globe from the polar regions to the tropics. In total, wetlands cover about 6% of the Earth's land surface: that's 33% larger than USA.

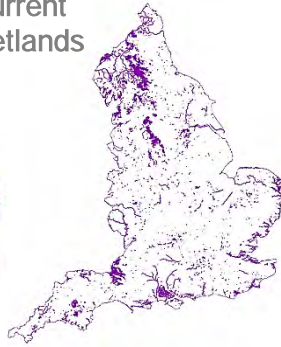
Why are Wetlands Important?

As well as playing home to a great variety of wildlife, wetlands are also economically important. They provide food, fresh water and building materials, and also provide services such as water purification, flood defence and erosion control. Large wetlands can even influence local climate. All this means that wetlands aren't just important for the people who live on their shores, but for all society.

Historic wetlands



Current wetlands



Then and now: drainage and overuse has seriously decreased the extent of wetlands in England from what we think it was 500 years ago. (Source: Wetland Vision)

Threats to the Wets

Despite their importance to us, people have taken wetlands for granted. These habitats are in serious decline through drainage, pollution, over-abstraction of water, canalisation (making the banks straight and steep) and damming.

We don't actually know how many wetlands there used to be in England, but it is estimated that we've lost 90% of all our wetlands. (Source: WWT).



Fact Sheet

Water, Water Everywhere

That water is one of the defining characteristics of a wetland is an obvious statement, and yet we mustn't overlook its importance to the landscape. Water plays a vital role in how wetlands function for nature and for people. Ditches, known as rhydes, criss-cross the Avalon Marshes, acting as both fencing and water troughs for cattle while also providing habitats for wetland species and keeping the peat soils wet and full of carbon. Maintaining the right water levels is vital – but different people don't always agree about the 'right' levels are.



Image © Dennism2

Managing Water Levels

The Avalon Marshes are a man-made landscape. Nearly all of the rivers and rhydes are man-made and, thanks to two large pumping stations and lots of sluices and weirs, the levels of the water can be controlled. Water levels tend to be kept higher in the summer to provide drinking water for livestock and 'wet fencing' and lower in the winter to increase the area's ability to cope with flood water. In general farmers like to keep the water levels lower than conservationists do.

Who Wants What: Water Levels in the Levels

AGRICULTURE

The favoured case for livestock farming is to have summer water levels moderately high (about 40 cm below ground level) so that the ditches have some water in them, but not so high that the fields are soggy and the best grass struggles to grow. In some places farmers want more drainage to help them grow high value crops like maize, which is fed to cattle. When livestock are moved indoors or to higher ground in the winter, water levels are then kept lower so that winter flooding is kept to a minimum.

CONSERVATION

Wetland wildlife, especially wetland plants, tends to benefit from higher water levels. In spring, having water levels at, or just below, ground level makes the ground soft enough for birds to probe with their beaks before the levels drop in time for the hay to be cut. In winter, flooded fields act as a magnet for thousands of wintering waterfowl, one of nature's spectacles. The other big benefit of keeping peat soils wet is that it stops the peat drying out and releasing large amounts of carbon dioxide.



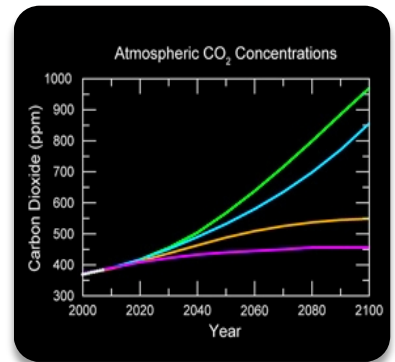
AVALON MARSHES CLIMATE SCENARIOS

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Why Climate Change is Confusing

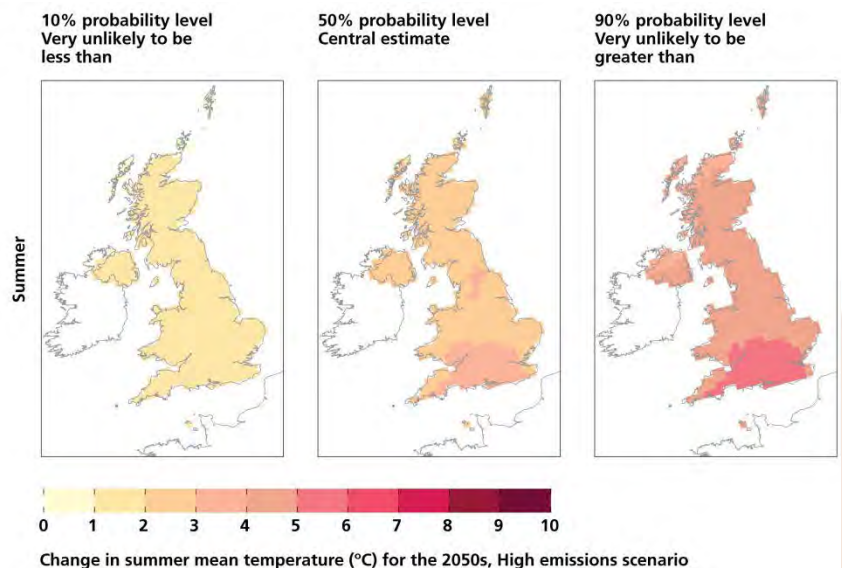
We know that the world's climate is changing. We know this is because we are increasing the levels of greenhouse gases in the atmosphere. What we can't tell is exactly how this is going to affect our climate here in the South West. There are so many different factors which affect our local climate - like the location of the jet stream; the strength of the Gulf Stream and even the health of our wetlands - that our projections of the future climate are very variable.



Climate Change Emission Scenarios

In 2009, the government produced a range of projections about how our climate will change based on how much greenhouse gas the world emits. They are called the UK Climate Projections (UKCP09). These projections looked at how temperature and rainfall might change if we emit lots of greenhouse gasses (high emissions), quite a lot (medium emissions) or not too much (low emissions). *To keep life simple, our research only used data from the high emissions scenarios.*

But even using just the high emissions scenario, we still cannot predict exactly what will happen to temperature and rainfall. The best we can do is come up with a range of estimates and say that it's likely to be somewhere in between. (Figure source: UKCP09)





AVALON MARSHES

CLIMATE IN THE MARSHES

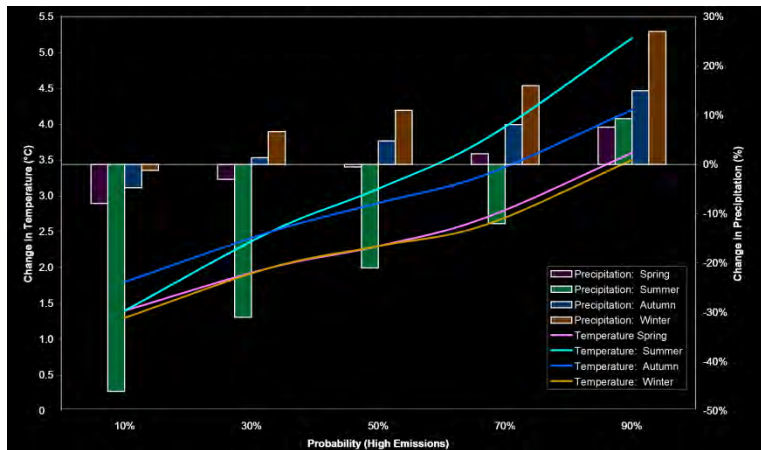
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How will Climate Change affect the Avalon Marshes? Focusing on temperature and precipitation (rain, sleet, snow etc.), all of the projections show that the climate will get warmer. It's not so easy to predict whether the climate is going to get wetter or drier. The general pattern is for drier summers and wetter winters). However, the impacts are very different at opposite ends of the spectrum. More summer droughts or more winter floods? We're probably going to get at least one of them...



Forecasts of Climate Change on the Avalon Marshes



To assess the impacts of climate change we used the high emissions scenario with the 10% and 90% probabilities*. This approach has two advantages:

- it allows the worst-case changes to be identified; and
- the 10% and 90% probabilities give changes at two ends of the spectrum.

Summary of Projected Climate Change Effects

Climate Change Effect	10% Probability				90% Probability			
	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter
Temperature	↑1.4°C	↑1.4°C	↑1.8°C	↑1.3°C	↑3.6°C	↑5.2°C	↑4.2°C	↑3.5°C
Water table	↓7.9%	↓46%	↓4.7%	↓1.2%	↑7.6%	↑9.3%	↑15%	↑27%
Freshwater Flooding	↓ Reduction in flood risk of up to 8%				↑ Increase in flood risk of up to 36%			

*See the *Climate Scenarios* factsheet for an explanation of what 10% and 90% probabilities mean.



Fact Sheet

What are Ecosystem Services?

Ecosystem services are the things that nature does which benefit people. Some of these services are easy to appreciate: providing us with food, fibre and fuel; creating wide open spaces and beautiful vistas which make us feel good. Other services which are provided by ecosystems are not so immediately obvious: climate regulation, improving air & water quality, preventing floods, forming new soil and cycling nutrients through the environment.



We can classify these services into four categories:



Provisioning Services

Products which nature helps us to make such as food; raw materials; medicines; fresh water (plants can influence the quantity of water available locally) and ornamental resources (e.g. flowers).



Regulating Services

Regulation of our natural assets such as air quality (e.g. trees produce O₂ and remove pollution); carbon absorption and storage; water levels and purity; erosion control; pests and diseases; pollination.

Cultural Services

Non-material benefits we get from nature such as aesthetic appreciation of the environment; recreational enjoyment; education (art, culture and science) and spiritual or religious benefits.



Supporting Services

Services which allow all the others to happen such as photosynthesis; soil formation; the movement of water from ocean to land; nutrient cycling and the maintenance of the gene pool.



Why it is Important to Think About Ecosystem Services

It can be easy to take lots of our ecosystem services for granted. If we concentrate too hard on maximising just one service, such as food production, we can reduce or destroy the environment's ability to provide us with many of the other services.



Fact Sheet

What is Biodiversity?

Biodiversity, short for biological diversity, is the term used to describe the variety of life found on Earth. This includes ecosystem, species and genetic diversity. The different elements of biodiversity have a strong influence on each other and we have only just started to understand the relationships between living things and their ecosystems. Think of an ecosystem as a woven carpet; if you pull on a loose thread it might only affect the thread and those closest to it or it might unravel the whole carpet.



Image © Emmanuel Keller

Biodiversity on the Avalon Marshes

The Avalon Marshes are very important in terms of the species and habitats that can be found there. Some of the areas are regarded as internationally important for the conservation of wetland species and habitats.



Birds

Huge flocks of waterbirds spend the winter in the Avalon Marshes. Species staying to breed include bitterns, marsh harriers, snipe, lapwing and the UK's first pair of great white egrets.



Invertebrates

Not everyone's favourite, but many species of invertebrate in the Avalon Marshes are found virtually nowhere else in the country. And who couldn't love the shining rams horn snail or depressed river mussel?

Water plants

Wetland plant species have been in massive decline across the UK due to loss of wetlands. However, many species thrive in the Avalon Marshes. Marsh pea is one of the rarer species.



Mammals

The water vole is Britain's fastest declining wild mammal and has disappeared from many parts of the country where it was once common. However, it still thrives in the Avalon Marshes alongside another wetland favourite: otters.





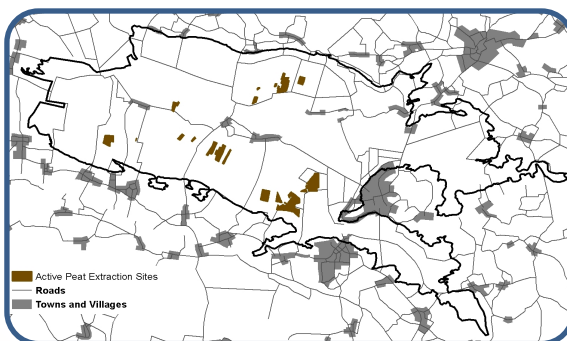
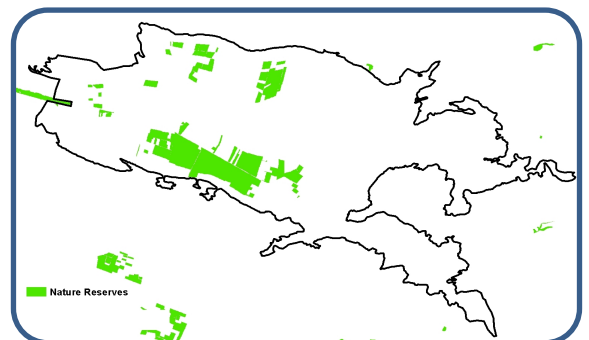
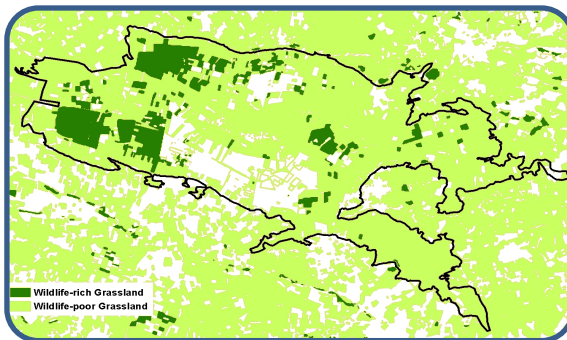
Fact Sheet

What Do We Do With Land?

We use land for all sorts of things. We put buildings on it; use it to grow food and timber; we mine it for minerals; we store water on it; we run, bike, scoot and drive on it. The way in which we use land, and the intensity with which we use it, has a big impact on the ecosystem services that we get back out. For instance we can add a lot of fertiliser and other chemicals to farmland and produce a lot of food, or add fewer chemicals which may result in less food but more wildlife, clean water and aesthetic beauty.



Major Land Uses in the Avalon Marshes



Major land use	Area (ha)	No. jobs
High intensity farming	4477	231
Low intensity farming	3675	284
Nature reserve / tourism	1400	280
Peat extraction	365	42
Buildings & roads	855	n.a



Fact Sheet

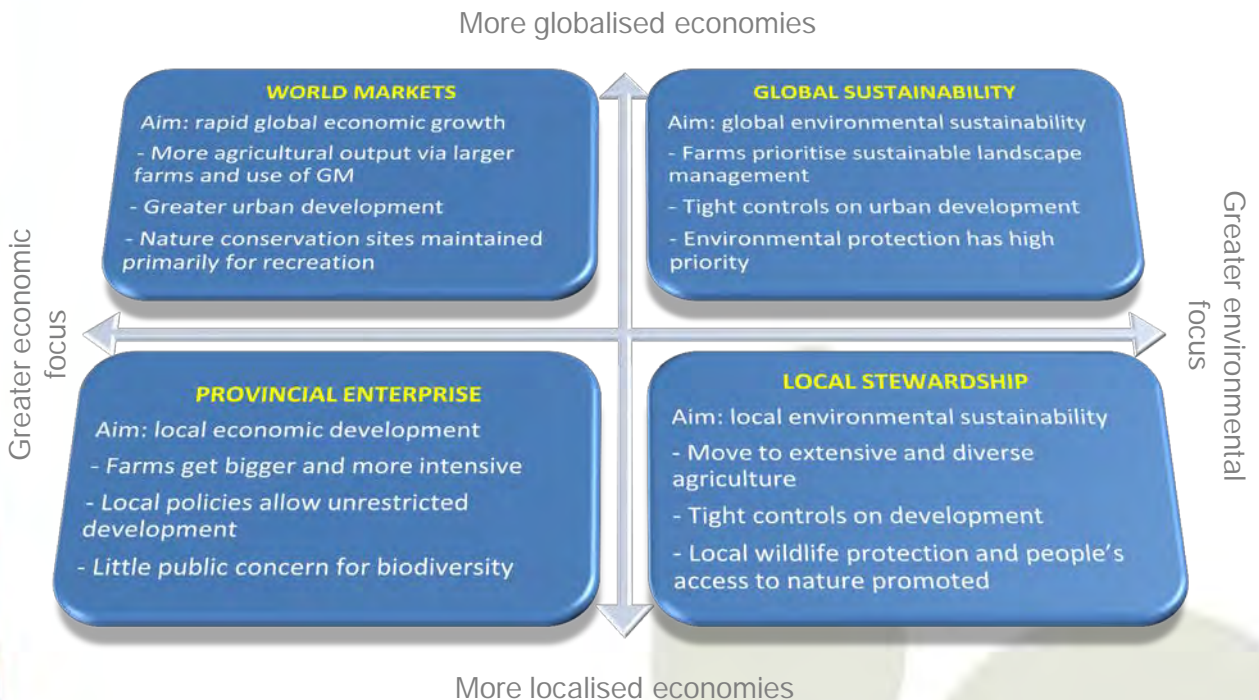
How will Society Change in the Future?

One of the major difficulties in working out what the impacts of climate change will be is that we can't be sure how our society will change over time. Our social and economic values and desires are continuously shifting, and we can't be sure how we will be viewing the world in 30 years time. Will consumerism still be as strong as it is today? Will we value ecosystem services differently? Will we ever get tired of watching reality TV?



Image © Lawrence Murray

Socio-Economic Scenarios



These scenarios are used as the basis for assessing the socio-economic impacts of climate change for the Avalon Marshes study.



Fact Sheet

World Markets Scenario

This scenario sees a move to large-scale farming with use of technology (such as GM crops) to improve yields while minimising environmental impacts. Farming becomes dominated by large farming corporations which have good social and environmental responsibility, but employ fewer people than would be the case on smaller farms. There is a focus on maintaining the quality of the environment, and improving it where possible.



Image © Peter Ashby Jackson

Measure	Change	Comments
Intensification: effect on high quality farmland	↑	New technology used to increase yields
Intensification: effect on poorer quality farmland	↓	Low quality farmland likely to be used for activities other than farming
Investment in water management	↔	Driven by the requirements (and funds) of large corporations and conservation organisations
Environmental responsibility	↑	Large farming corporations trade on their reputation
Social responsibility	↑	Large farming corporations trade on their reputation
Price of inputs	↔	Large farming corporation have strong buying power so can keep prices down
Price of food	↔	Increased outputs and control of costs mean prices remain stable
Management of existing nature conservation sites	↔	Increased focus on access/recreation, which provides little benefit for wildlife
Opportunity to increase the size or connectivity of wildlife sites	↑	Poor quality farmland may be made available by large corporations for other uses
Peat extraction	↓	Cheap imports from other countries, plus higher incomes from farming and tough planning controls make this a less profitable land use
Urban development pressures	↑	Greater demand for housing and commercial development



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PROVINCIAL ENTERPRISE SCENARIO

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Provincial Enterprise Scenario

This scenario sees a move to more intensive farming concentrated in a small number of large farms. Removal of government and EU restrictions allow farmers to maximise crop yields and, hence, profits via increased drainage and use of fertilisers and pesticides. Smaller farms find it difficult to compete allowing the larger farm owners to buy them out. Conservation sites come under pressure from agricultural intensification and development to meet regional needs.



Measure	Change	Comments
Intensification: high quality farmland	↑	Intensification and profit maximising drive farming choices
Intensification: poorer quality farmland	↓	Low quality land is no longer be farmed in favour of areas that are easier to drain and more productive
Investment in water management	↓	Overall management of the water regime is poorly coordinated, driven by the requirements (and funds) of the large farms and ad hoc partnerships
Environmental responsibility	↓	There is little concern for the environment
Social responsibility	↓	Farms will try and use skills that already exist rather than train local youth
Price of inputs	↑	Regional fluctuations and lack of buying power mean prices increase
Price of food	↑	Intensification requires more inputs and higher costs such that food prices increase
Management of existing nature conservation sites	↓	Sites may come under development pressure and are affected by pollution
Opportunity to increase the size or connectivity of wildlife sites	↓	Land used to meet regional development and food needs so is not available for conservation purposes
Peat extraction	↑	Peat extraction to meet regional demands could increase on low quality land
Urban development pressures	↑	Greater demand for housing and commercial development



Fact Sheet

Global Sustainability Scenario

This scenario sees a move to low input farming, aided by technologies which maintain yields while improving the environment. There is a tendency towards larger farms due to the economies of scale that can be achieved. Conservation organisations become increasingly involved in land management on a national scale, providing additional support to smaller farms. There is a focus on improving the quality of the environment through landscape-scale sustainable management.



Measure	Change	Comments
Intensification: effect on high quality farmland	↓	Land is used more sustainability with new technology used to help maintain yields
Intensification: effect on poorer quality farmland	↓	Environmental payments to farmers help to ensure that poorer quality land is used sustainably
Investment in water management	↘	Some management will continue on micro-scale, but use of large pumping stations may be reduced
Environmental responsibility	↑	Global and national targets set to encourage (and deliver) greater environmental responsibility
Social responsibility	↑	Opportunities for skills and training increased, more volunteer roles
Price of inputs	↑	Costs likely to increase as they include environmental costs that were not previously taken into account (but amount of inputs that are used decreases)
Price of food	↗	Food costs increase due to more sustainable production, but technological improvements and access to global markets help control the increases
Management of existing nature conservation sites	↑	Emphasis on sustainability 'everywhere' provides biodiversity benefits
Opportunity to increase the size or connectivity of wildlife sites	↑	Low productivity land is purchased or NGOs provide advice to help create wildlife corridors
Peat extraction	↓	Sustainability worries and addition of environmental costs onto the price of peat reduce demand
Urban development pressures	↓	Strong planning controls and emphasis on development in existing urban centres



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LOCAL STEWARDSHIP SCENARIO

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Fact Sheet

Local Stewardship Scenario

This scenario is driven by a move towards local environmental sustainability. There is a shift towards sustainable production but also taking into account local needs and requirements. Many small farms begin to specialise in processing their produce to sell finished goods, processed foods, butchered meats, etc. either in their own farm shops or through local co-operatives. There is a focus on protecting wildlife and greater demand for recreational activities in nature.



Image © David Goehring

Measure	Change	Comments
Intensification: high quality farmland	↓	Local sustainability is likely to reduce intensification
Intensification: poorer quality farmland	↔	More land is needed for mixed farming. Poor quality farmland is used for a range of different purposes
Investment in water management	↔	Water management is focused on catchment scale, run by local farmers to their particular benefit
Environmental responsibility	↑	Local sustainability is a key goal with local suppliers providing local markets
Social responsibility	↑	Specialised activities across different farms give local people the opportunity to become highly skilled
Price of inputs	↑	Costs likely to increase due to local supply/demand, but overall amounts of inputs should reduce
Price of food	↗	Possible increase in food costs due to more sustainable and smaller-scale production.
Management of existing nature conservation sites	↗	Emphasis on local sustainability with strenuous efforts to protect and enhance wildlife, although recreation pressures may increase disturbance
Opportunity to increase the size or connectivity of wildlife sites	↗	Linkages could be established through co-operatives and conservation organisations
Peat extraction	↓	Sustainability worries and addition of environmental costs onto the price of peat reduce demand
Urban development pressures	↓	Strong planning controls and emphasis on development in existing urban centres



Fact Sheet

Impacts on Provisioning Services

For each socio-economic scenario and both climate probabilities, this table shows which provisioning ecosystem services are projected to be impacted very positively (++) , quite positively (+) , not much (0) , quite negatively (-) and very negatively (--). For some services there will be both positive and negative effects (+/-) while for others it is unclear whether the effects may be a strong effect or not (0/- or 0/+). Each service is also categorised by its potential importance to the Avalon Marshes.

Ecosystem Service	Importance of Service	World Markets		Provincial Enterprise		Global Sustainability		Local Stewardship	
		10%	90%	10%	90%	10%	90%	10%	90%
Biochemicals, natural medicines and pharmaceuticals	Low	+	+	-	--	+	+	+	+
Biodiversity	High	-	+	--	--	++	++	+	++
Fibre production	Low	0	0	0	0	0	0	0	0
Food production	High	++	++	++	-	++	+	++	-
Fuel provision	Low	0	0	0	0	0	0	0	0
Peat for horticulture	High	-	-	+	-	--	--	-	-
Provision of freshwater (and availability of freshwater)	Medium	0/-	0/-	--	-	+/-	+	+/-	+
Renewable energy	Medium	+	+/-	+/-	+/-	+	+	+	+
Timber provision	Medium	+	0	+	0	+	0	+	0



Fact Sheet

Impacts on Regulating Services

For each socio-economic scenario and both climate probabilities, this table shows which regulating ecosystem services are projected to be impacted very positively (++), quite positively (+), not much (0), quite negatively (-) and very negatively (--). For some services there will be both positive and negative effects (+/-) while for others it is unclear whether the effects may be a strong effect or not (0/- or 0/+). Each service is also categorised by its potential importance to the Avalon Marshes.

Ecosystem Service	Importance of Service	World Markets		Provincial Enterprise		Global Sustainability		Local Stewardship	
		10%	90%	10%	90%	10%	90%	10%	90%
Limiting greenhouse gas emissions	High	-	+	-	+	-	++	-	+
Removing greenhouse gases from the atmosphere	High	-	+	--	++	+	++	0	++
Microclimate	Medium	-	+	-	+	-	+	-	+
Nutrient and sediment cycling	High	0/-	0/-	--	-	++	++	+	+
Pest and disease control	Medium	+	+	+/-	+/-	+	+	+/-	+/-
Water quality regulation	High	0/-	0/-	--	-	+	+	+	+
Water regulation (ability to control drainage and movement of water)	High	0	+	--	--	-	-	0	+
Water regulation (flood and erosion control)	High	+	+/-	-	--	+	+/-	+/-	+/-



Fact Sheet

Impacts on Cultural Services

For each socio-economic scenario and both climate probabilities, this table shows which cultural ecosystem services are projected to be impacted very positively (++), quite positively (+), not much (0), quite negatively (-) and very negatively (--). For some services there will be both positive and negative effects (+/-) while for others it is unclear whether the effects may be a strong effect or not (0/- or 0/+). Each service is also categorised by its potential importance to the Avalon Marshes.

Ecosystem Service	Importance of Service	World Markets		Provincial Enterprise		Global Sustainability		Local Stewardship	
		10%	90%	10%	90%	10%	90%	10%	90%
Aesthetics	High	--	-	--	-	0/+	+/-	+/-	+/-
Educational activities e.g. guided walks and school visits	Medium	++	++	+/-	+/-	++	++	+	+
Historic environment and heritage	High	-	+/-	--	0/-	0/-	+	0/-	+
Contribution to knowledge of heritage, biodiversity and conservation techniques	Medium	+	+	+/-	+/-	++	++	+	+
Physical and mental health and well-being	Medium	0/-	+/-	--	-	+	+	+	+
Recreation and tourism	High	+	+	-	-	++	++	+	++
Hunting and fishing	High	0	0	0/+	0/+	+	+	+	+



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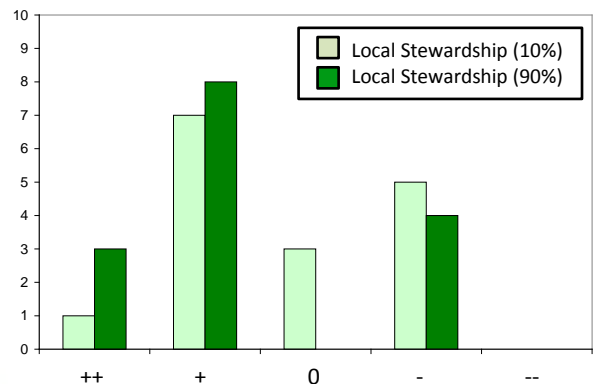
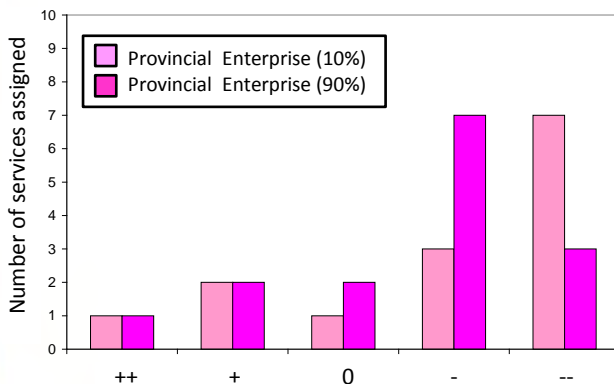
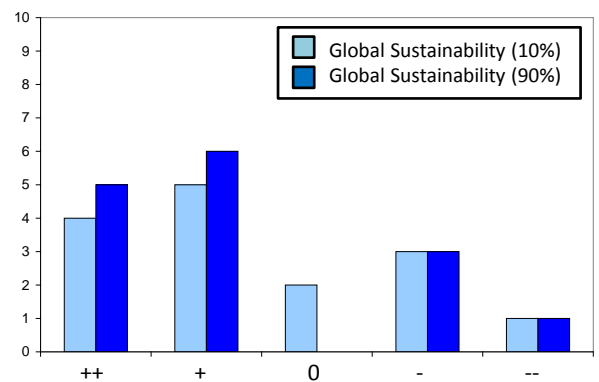
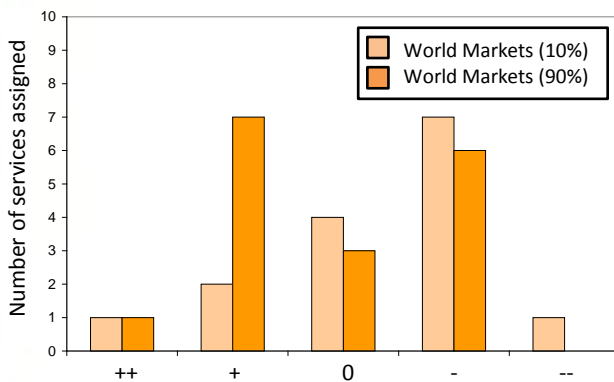
SCENARIO OUTCOMES

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Impacts on Ecosystem Services

For each socio-economic scenario and both climate probabilities, these figures show the number of ecosystem services which are projected to be impacted very positively (++) , quite positively (+) , not much (0) , quite negatively (-) and very negatively (--).



Fact Sheet

What is Peat?

Peat is a dark fibrous soil created when dead plants decompose very slowly in water-logged, acidic conditions. Peat accumulates very slowly, at a rate of around 1 mm per year. Marshes, swamps, floodplains and coastal wetlands may contain peat, however, where the peat soils are greater than 30-40 cm in depth, a distinctive variety of habitats is created including bogs and fens. These habitats can take many thousands of years to form. Since things decompose very slowly in peat, bogs and fens are fantastic at preserving archaeological remains.



Image © Fiona MacGinty-O'Neill



Why is Peat Important for Climate Change?

Peat contains huge amounts of carbon. Even though they cover just 11% of the UK, peat soils contain almost half of all the carbon locked up in soils. As long as the peat stays wet, it takes up much more carbon than it releases, which means that it helps combat climate change. However, if peat dries out then all that organic matter starts to decompose much more quickly and releases lots of carbon dioxide. The balance shifts from absorbing carbon to releasing it, exacerbating climate change.

Human Uses of Peat

Peat has a long history of being used as a fuel, flavouring and, more recently, in horticulture. While its extraction still occurs on the Somerset Levels, it's at a much lesser degree than it once was. The Government has set targets to phase out the use of peat by 2030 due to its importance as a carbon store and wildlife habitat.



Horticulture

Peat retains moisture and nutrients, which is great for growing plants.



Fuel

Peat is an excellent fuel and is still used in Ireland to provide heat and power.



Scotch Whisky

Some whiskies get a distinctive smoky flavour from barley dried over peat fires.



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DROUGHT AND FLOODING

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Too Much Water; Too Little Water

The Somerset Levels gained national prominence in the winter of 2013/14 when large areas flooded for many weeks. Severe flooding is an ever-present risk across these low-lying areas; it wasn't long ago that some people who lived in the Levels kept a boat tied up outside their house. Arguably, however, winter floods may not be as big a problem as summer droughts. As a rule, most wetland habitats and farming systems are better adapted to deal with flooding than drought.



Problems Caused by Severe Flooding

- Flooding of property and major roads can cause financial damage and severe emotional stress.
- Flooded land cannot be used for grazing livestock, decreasing food production and farm income .
- Cereal crops don't tolerate flooding.
- Summer flooding kills grass, destroying that year's hay crop and grazing.
- Some species, such as water voles and terrestrial invertebrates, may drown if they run out of refuge areas above the water.

Problems Caused by Severe Drought

- Ditch levels drop, so cattle have little to drink and can escape from the fields.
- Water stops flowing, which can cause pollutants in water to increase in concentration
- Carbon dioxide is released in ever greater volumes as peat soils dry out.
- Many wetland species cannot cope with prolonged periods of drought and have to move or perish.
- Important archaeological remains stored in the peat start to degrade.

Flooding Has Its Benefits Too

- Flood waters bring silt which makes fields more fertile.
- Winter floods are important for wintering waterbirds while splashy conditions in spring are vital for breeding waders.

Drought Has Its Benefits Too

- Everyone else's grass has shriveled, so that grown on the wetlands is worth more.
- Prolonged dry conditions are usually accompanied by fine weather, which makes us all feel better.
- Drought is great for making us appreciate how important water is, and why we mustn't take it for granted.