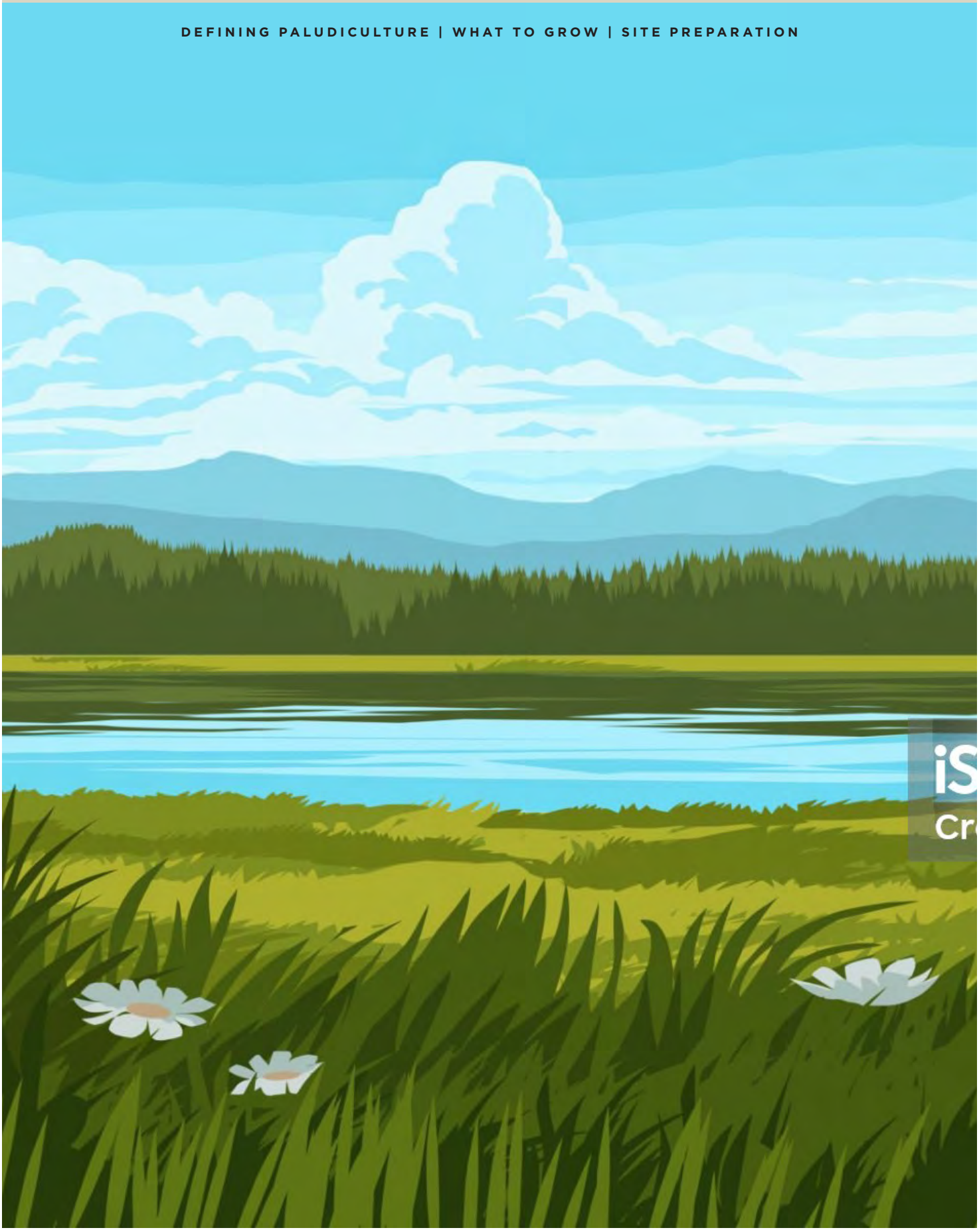
HOLKER ESTATE
CUMBRIA

Paludiculture

savills

DEFINING PALUDICULTURE | WHAT TO GROW | SITE PREPARATION



> **Paludiculture, or farming on rewetted peat, combines the environmental benefits of reducing greenhouse gas emissions with the economic benefits of growing of crops on lowland peat soils**

Peatland at Holker Farms

What is paludiculture?

Farming wetlands through systems like paludiculture could keep lowland peatlands productive and profitable while cutting down on carbon emissions

Q What is the difference between peatland and wetland?
Wetlands are ecosystems where water saturates the soil, either permanently or seasonally. Peatlands are a specific type of wetland formed in waterlogged conditions, where dead plant material accumulates and forms peat. Consequently, peatlands are rich in organic matter and play a vital role in carbon storage.

Q Where can peatland be found?
In the UK, there are three main types of peatland: blanket bogs, raised bogs and fens. Blanket bogs are often found in upland areas, fed primarily by rainfall and are more acidic and nutrient-poor due to limited mineral input. Raised bogs and fens are usually found in lowland areas, which are often drained and used for agriculture because they are mineral-rich.

TOP THREE TAKEAWAYS

1. **Know the market** Paludicuture and arable crops have very different needs
2. **Know the site** Ongoing research, good site preparation and regular site visits are key to success
3. **Know the numbers** Optimising crop selection and understanding routes to market are essential

Q Why peat?
Peat soils are very fertile. Over previous centuries, swathes of lowland peat have been drained to allow crops to be grown. In 2020, drained agricultural peatlands in England emitted 8.5 million tonnes of carbon dioxide equivalents, accounting for about 3% of England's emissions. Carbon is released when peatland dries out. According to Defra, only 13% of England's peatlands remain in a near-natural state and for lowland peatlands, this figure drops to less than 1%.

Q What is paludiculture and why should we explore the opportunities?
Rewetting peat, typically by blocking drainage, prevents it from drying out and thus stops the emission of carbon dioxide. Paludiculture, or farming on rewetted peat, combines the environmental benefits of reducing greenhouse gas emissions with the economic benefits of growing crops on lowland peat soils. The water level is often closely controlled to balance peatland preservation and agricultural productivity. When done correctly, it can also provide additional benefits such as improved water quality, flood resilience, and enhanced biodiversity.

8.5 million
In 2020, drained agricultural peatlands in England emitted 8.5 million tonnes of carbon dioxide equivalents

13%
According to Defra, only 13% of England's peatlands remain in a near-natural state

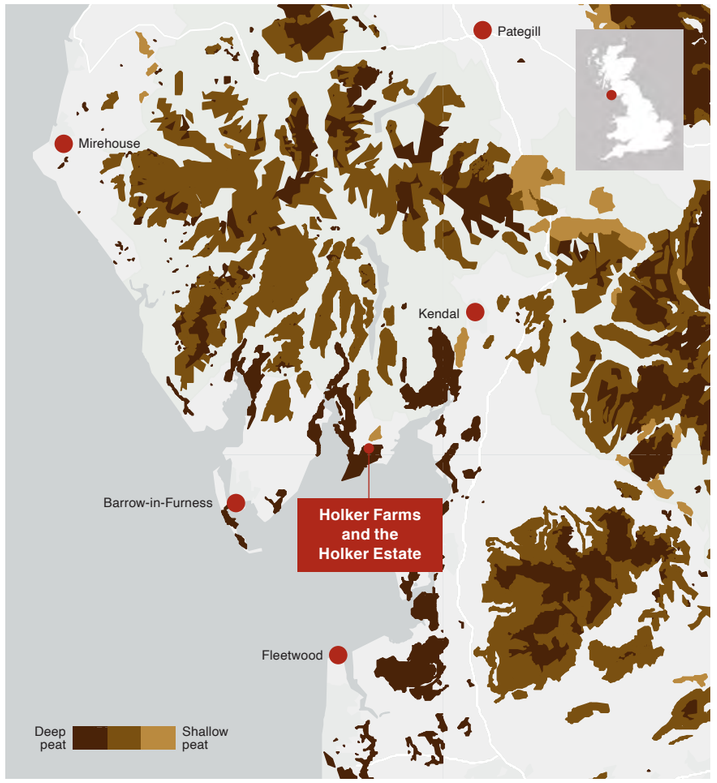


figure 1

Source Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS

Q What is being done to help?
In 2022, the government announced the Paludiculture Exploration Fund (PEF) to address barriers to making commercial paludiculture a reality. Using funds from the PEF, Holker Farms commissioned Savills Rural Research to review paludiculture opportunities. The government has pledged "to invest £400 million in capital, from the Nature for Climate Fund, across 2024-25 and 2025-26 for tree planting and peatland restoration" with the aim of meeting net zero targets.

Q What is happening at Holker Farms?
Holker Farms is responsible for almost 7,000 hectares on the west coast of England to the east of the Leven Estuary. A carbon audit identified that the main area of focus should be the peatland. The business would like to identify commercial opportunities to meet the aims of reducing carbon emissions from the peatland and ensuring resilience and profitability for the future.

Next steps for Holker Farms

Following the research project conducted by Savills, which is outlined in the following pages of this booklet, the next steps for Holker Farms to pursue the opportunities for paludiculture are:

1 Conduct a trial with robust statistical analysis and well-defined objectives. The industry relies on statistically replicated randomised trials to evaluate concepts and it is essential to adopt these methodologies.

2 Review the payments available under the Countryside Stewardship Higher Tier scheme (CSHT) and carbon credits within the Peatland Code to begin the journey of peatland restoration and carbon sequestration. It is likely that an application for the land wetting payments, available under the CSHT scheme, of up to £1,409 per hectare per year on cropped or arable peat, and up to £1,381 per hectare per year for grassland, plus any carbon credits, would provide a higher and more assured return until paludiculture options are proven. Both of these payments require the water level to be raised to "near the land surface" but lower payments may still be made for raising the water table to a lower level.

3 Liaise with BeadaMoss regarding the production of *Sphagnum* moss, specifically looking to understand the irrigation demand.

4 Liaise with Ponda regarding the production of *Typha latifolia*, specifically looking to understand the importance and practicalities involved in the management of the water table to 10 cm of the soil surface.

72%

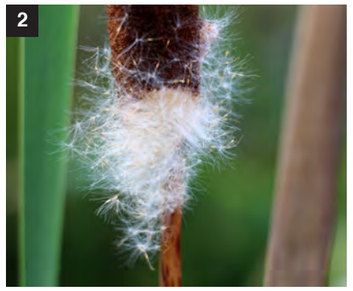
Sphagnum moss and the use of *T. latifolia* for fibre are the highest-scoring champion crops at 72% of the points on offer

£1.3k

The reported rate of approximate return per hectare for BeadaMoss

Know the market: champion crops

We look at the practical and economical opportunities for growing different crops in wetland conditions with an emphasis on sustainable land use and reducing carbon emissions



Champion crops

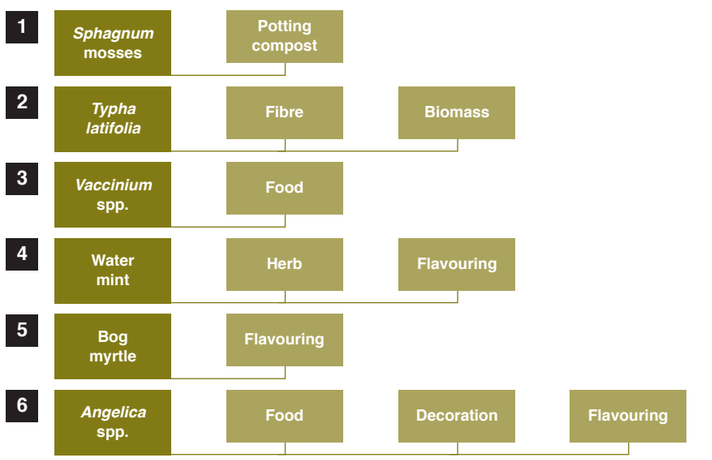


figure 2

Source Savills Rural Research

Savills initial review suggested 123 crops have potential for paludiculture. Six champion crops were identified for Holker Farms and were assessed further for their compatibility, with the aim of identifying two for in field trials.

Many of the champion crops are found on the neighbouring Site of Special Scientific Interest (SSSI). This is not a guarantee of commercial success, but is a good indication that, with suitable management, they will grow. Paludiculture crops have vastly different requirements compared to conventional arable crops. The final selection of champion crops was made using 15 parameters. Each parameter was scored, revealing *Sphagnum* moss and the use of *Typha latifolia* (*T. latifolia)* for fibre to be the highest-scoring champion crops at 72% of the points on offer. The use of *T. latifolia* for biomass placed third with 61%.

Stakeholder engagement confirmed that much of the trial and investigation work for peatland has focused on restoration rather than growing commercially viable crops. Commercial production is high risk without an established market and the estimated return on investment is currently likely to be under 10%.

CHAMPION CROPS

1 *Sphagnum* mosses

Sphagnum moss production is being driven by the proposed peat ban legislation to supply potting compost as a peat substitute. It is one of the few crops that allows continuous carbon capture. *Sphagnum* moss could be produced under the umbrella of BeadaMoss, an established market. The reported rate of return is approximately £1,300 per hectare (IRR 5%). *Sphagnum* can be cultivated for either commercial purposes or ecological restoration. It's crucial to decide on the intended direction early in the process.

2 *Typha latifolia*

T. latifolia would provide a favourable route to the commercialisation of existing reed beds if water levels could be expertly managed. Recent research suggests that to optimise carbon capture, the wetting of peat needs to be within 10 cm of the soil surface but not above, in order to minimise methane release. This presents challenges and requires further investigation. A route to market would be through Ponda (BioPuff®), who produce fibre for clothing from the down (seed heads). Biochar could be created from the biomass to capture carbon for the long term.

3 Novel crops

Myrica gale, Mentha aquatica and *Angelica* spp. could offer Holker Farms an opportunity to create a novel product with estate branding. Further research and on-site trials would be required. It would require active entrepreneurial input from Holker Farms and an industry advocate to support the development and marketing of the niche crop, such as that already established for *Sphagnum* moss and *T. latifolia*.

Vaccinium spp.

The *Vaccinium* spp. offer a food crop opportunity. *V. oxycoccos* (cranberry, marsh cranberry, small cranberry) have established commercial markets and Holker Farms is unlikely to compete with the existing producers. However, there is a European cranberry found in the neighbouring SSSI that is said to have distinct properties, which could be promoted to create a unique market position. Additionally, *V. oxycoccos* could be intercropped with *Sphagnum* moss.

1 Site of Special Scientific Interest

> **“Paludiculture crops have vastly different requirements compared to conventional arable crops. The final selection of champion crops was made using 15 parameters”**

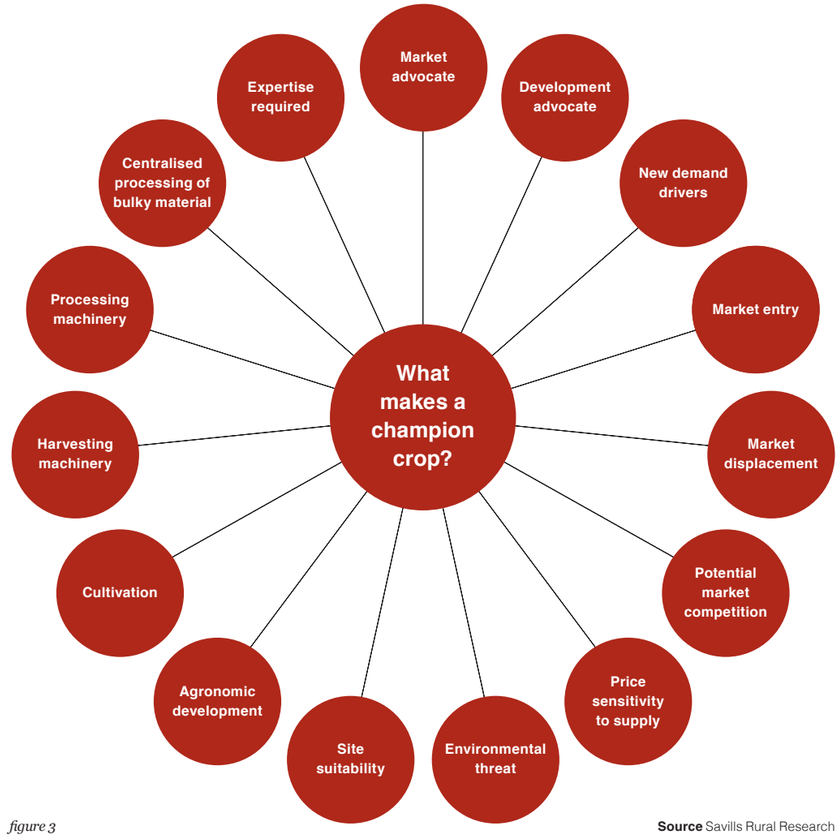


figure 3

Source Savills Rural Research

15

Number of parameters used to assess which crops had the most potential for paludiculture at Holker Farms

> **The ability to grow a plant is not a determinant of whether it is a commercial option, although growth alone may be sufficient to secure environmental targets** *Simon Ward, independent consultant*

Growing conventional crops with paludiculture at Rindle Farm

Know the site: paludiculture in action

Case studies provide the opportunity to look at lessons learned and thoughts for the future. Here Savills provides a summary of its research visits to a number of peatland sites

CARBON FARMING AT BIRCH HOUSE
This site targeted the propagation of *Sphagnum* moss for carbon capture, regeneration and sustainability of peatland, rather than the ongoing output of a commercial product. Nonetheless, lessons in the cultivation of *Sphagnum* moss and site preparation can still be learned.

Site preparation at Birch House was intensive, incurring a significant carbon and economic cost to remove historic nutrients from the area and enable *Sphagnum* propagation. This intense method of nutrient control may not be the only option for nutrient mitigation, depending on the site and less carbon- and cost-intensive measures should be considered.

HYDROLOGY AT MANOR FARM
The site at Manor Farm reaffirms the need for good site preparation, which includes both soil and water operational considerations. The establishment of *T. latifolia* is being explored using a drone, though the most effective method has yet to be confirmed. Transplantation from another site is being considered, which would be available to Holker Farms with the neighbouring SSSI. Manor Farm is working with Ponda for the commercial output.

CONVENTIONAL CROPS AT RINDLE FIELD
The crops grown here (pictured above) were a mix of food crops including celery, blueberries and market garden crops. The main lesson learned is that any paludiculture site needs to have a management programme in place whether the site is restorative or commercial. Three years into this trial and no harvest has taken place due to agronomic challenges such as nutrition and weed control. Interestingly, supermarkets that were contacted were willing to buy the produce from this site. If output can be achieved, this could be a viable opportunity. This site visit confirmed that commercial markets are still in their infancy and need further development.

HARPER ADAMS
The Paludiculture Symposium at Harper Adams demonstrated a range of research focusing on the relationship between greenhouse gas emissions and nutrients and the dynamics of water in paludiculture farming systems. A separate event investigated the utility of technology in achieving paludiculture, including:

- Using drones to plant crops.
- Various tyre and track technologies to enhance access to sites.
- Specialised machinery, such as amphibious harvesters, to facilitate productivity.

6-10
Number of years before *T. latifolia* needs replanting

0-50
Rindle Field is experimenting with water levels from ground level to 50 cm below ground to find the optimum for growing conventional crops

Know the numbers: industry advocates

For the gold and silver medal position of champion crops, *Sphagnum* moss and *T. latifolia*, the two industry advocates are BeadaMoss and Ponda

BEADAMOSS
BeadaMoss undertakes *Sphagnum* farming primarily as a means of peatland restoration, providing restoration projects with micro propagated *Sphagnum* moss. Additionally, BeadaMoss are presently researching the use of *Sphagnum* mosses as a sustainable peat alternative and a feedstock for carbon farming.

Sphagnum grown by BeadaMoss is currently cultivated within a nursery facility with the aid of solar photovoltaics, ground source heat pumps and heat recirculation. Trials are underway to optimise growth with fewer controls exerted over the crop. Potential growers should be aware of local conditions, particularly those near protected sites where the introduction of non-native mosses may cause environmental issues between neighbouring sites.

PONDA
Ponda can provide contracts to grow *T. latifolia*. They will provide advice on the growing requirements such as planting density, optimal harvesting approaches and nutrient requirements. The first harvest is in year three, therefore the financial viability of the crop needs to take this into account.

Harvest takes place from August and the advice is to leave the biomass to improve future harvest years – replanting would be in 6-10 years.

Hydrology is the essential thing to know and control. Deer can be a pest and phragmites can invade and compete. Innovation continues with *T. latifoli*a and Ponda are researching future machinery requirements.

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PREPARING FOR PALUDICULTURE

We combine three main areas for those looking at paludiculture for the future:

1 Undertake full testing of the soil and water for nutrients and pH. The soil texture also needs to be assessed. Sampling may need to be intensive for crops requiring a particularly low pH.

While the location at Holker Farms is suited to the champion crops selected, the arable land may have excessive nutrient levels and too high a pH to be capable of a high yield without remediation. This was a lesson learned from the site visits undertaken (see opposite). At the Birch House trial site, the topsoil needed to be stripped before establishment of *Sphagnum* moss due to excess nutrient levels. For other crops, such as celery, higher nutrient concentrations are desirable for optimal yield and so crop choice could be amended accordingly.

2 The consistency of water supply needs to be investigated, including control and resilience in times of excessive or deficient supply and any implications for third parties of controlling the water and statutory conditions. Crop choice is once again critical as certain crops, such as celery, cannot tolerate falls in the water table as well as *Sphagnum* mosses.

If these aspects are satisfactory for Holker Farms, the cost of site preparation, including controlling the water table and levelling of the site, needs to be reviewed by water engineers. It is recommended that the aesthetic and environmental implications beyond the farm are discussed with interested parties.

3 For Holker Farms, the proximity to the SSSI might risk the introduction of alien genetic material even if it is from the same species. While there is unlikely to be a legal barrier to the introduction, it might be considered insensitive given the environmental significance. An opportunity is that the paludiculture site could provide a visitor point on several nearby trails and improve knowledge and awareness of paludiculture and the role it can play in reducing carbon emissions and provide a commercial output for businesses.

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