



Alternative Crop Options for Jersey (Part 3)

FINAL REPORT

Project Number: 17-003

December 2016

A report for States of Jersey Department of Environment

Author(s)

Paula McNamee - Consultant

Lucy Hopwood - Director, Lead Consultant: Bioenergy & Anaerobic Digestion

Disclaimer

While NNFCC considers that the information and opinions given in this work are sound, all parties must rely on their own skill and judgement when making use of it. NNFCC does not make any representation or warranty, expressed or implied, as to the accuracy or completeness of the information contained in this report and assumes no responsibility for the accuracy or completeness of such information. NNFCC will not assume any liability to anyone for any loss or damage arising out of the provision of this report.

NNFCC

NNFCC is a leading international consultancy with expertise on the conversion of biomass to bioenergy, biofuels and bio-based products.



NNFCC, Biocentre,
York Science Park,
Innovation Way,
Heslington, York,
YO10 5DG.

Phone: +44 (0)1904 435182
Fax: +44 (0)1904 435345
E: enquiries@nnfcc.co.uk
Web: www.nnfcc.co.uk

Contents

1	Introduction	6
2	Jersey Resource Assessment.....	7
2.1	Agricultural Resources.....	7
2.1.1	Land	7
2.1.2	Crops	7
2.1.3	Equipment	7
2.1.4	Employment.....	8
2.2	Glasshouses	8
2.3	Exports.....	9
2.4	Environmental Issues	9
2.4.1	Water Quality	9
2.4.2	Soil Quality	9
3	Alternative crop options for Jersey	10
3.1	Crops to address potato cyst nematode (PCN) problem.....	10
3.1.1	Trap Crops: Sticky Nightshade (<i>Solanum sisymbriifolium</i>)	10
3.1.2	Biofumigant Crops.....	10
3.2	Food Crops	11
3.2.1	Honeyberries (aka Haskap Berries)	12
3.2.2	Aronia Berries.....	13
3.2.3	Sea Buckthorn Berries (Sea Berries)	15
3.2.4	Goji Berries	16
3.2.5	Garlic.....	16
3.2.6	Gourmet/Speciality Mushrooms	18
3.3	Herbs and Plants.....	19
3.3.1	Tea plants (<i>Camellia sinensis</i>).....	19
3.3.2	Chamomile	21
3.3.3	Hibiscus	23
3.3.4	Elderflower/Elderberry	23
3.3.5	Lavender	25
3.3.6	Echinacea	26

3.3.7	Mint.....	26
3.3.8	Quinoa	28
3.3.9	Fruit (for Fruit Ciders)	28
3.4	Cannabis Sativa (Hemp and Marijuana).....	29
3.4.1	Hemp.....	29
3.4.2	Hemp with High Cannabidiol (CBD) content	30
3.4.3	High-THC Cannabis (Marijuana)	33
3.5	Energy Crops.....	33
3.5.1	Switchgrass.....	34
3.5.2	Reed Canary Grass.....	35
4	Conclusions.....	36
5	Appendix.....	37
5.1	Vegetables grown outdoors.....	37
5.2	Industrial Hemp Industry.....	38

Table of Figures

Figure 1 – % of Vegetables grown outdoors on Jersey in 2014.....	37
Figure 2 - % of crops grown in glasshouse on Jersey in 2014.....	37
Figure 3 – Uses for Industrial Hemp	38
Figure 4 – Hemp Cultivation Area in the EU 1993-2015	38

1 Introduction

This report was commissioned by the States of Jersey Department of Environment following an earlier report, presented to Jersey by NNFCC in March 2015 which considered specific non-food crop options and concluded there existed a number of high-value non-food crop opportunities, to support or integrate with existing agricultural practices on the island.

The focus of the initial research was to review the position with regard to non-food crops and to identify specific needs and / or opportunities for crops in Jersey that could be taken forward at commercial scale. The greatest market opportunity was apparent in novel oils for manufacture of personal care products. Within this sector, six crop species were identified as being highly suitable in terms of climate, agronomy, market, branding and local use potential, these were:

- Hemp
- Calendula
- AhiFlower
- Evening Primrose
- Camelina
- Borage

Following interest from the agricultural sector on Jersey, a subsequent report was commissioned (Part 2) to provide further information on the priority options identified in the previous report, developing the business case and collating specific market data, describing the likely value chain on Jersey, and providing actions and suitable contacts for follow-up.

Following a period of continued interest from the agricultural industry on Jersey, the scope of this additional piece of work (Part 3) was defined to cover a broader range of crop options, not solely focussing on non-food markets but with a view to identifying niche and novel high-value opportunities for Jersey at the brink of commercial expansion, giving the agricultural sector on Jersey an opportunity to become a market leader.

This report presents the findings of this research; describing the nature, scale and value of each opportunity and considering the potential of each crop group for Jersey specifically. Contacts are provided where available, to enable follow-up.

2 Jersey Resource Assessment

2.1 Agricultural Resources

2.1.1 Land

The total area of land used for agriculture on the island of Jersey in 2014 was 34,411 vergées, which covers 53.3% of the land on the island (the total area of Jersey is 64,612 vergées)¹. The percentage of agricultural land farmed by the actual land owners was 21% meaning that 79% of agricultural land is rented.

Most of the holdings on Jersey are between 1-10 vergées in size (48%). The next most abundant holding size range is between 25 < 50 vergées (25%) followed by 50 < 75 vergées (9%). However, the majority of the smaller holdings do not claim Single Area Payments (SAP) and Quality Milk Payments (QMP) which serve as indicators of commercial agricultural activity. The area of agricultural land which is irrigated is 1,911 vergées.

In 2013 (as disaggregated statistics for 2014 are unavailable) the amount of land uncultivated was 1,831 vergées (5.2%). Owing to Jersey's small size and high demand for agricultural land, there is very little marginal land on the island. The marginal land that is present on the island is mainly côtils or rough grazing for livestock. Côtils are steep sloping fields that cannot easily be managed using farm machinery such as tractors, but are winch ploughed and hand dug at very high early returns. The marginal land used for grazing accommodates the heifers on the island and around 200 beef cattle.

2.1.2 Crops

The growth of potatoes dominates Jersey's vegetable productions with the area of land dedicated to all potato varieties in 2014 was 18,036 vergées (52% of total agricultural land). Of this land, 17,212 vergées were dedicated to Jersey Royals. Other vegetables grown outdoors include cabbage, top fruit and courgettes. The distribution of vegetables grown on agricultural land can be found in the Appendix.

2.1.3 Equipment

Most agricultural equipment is relatively small to cope with the associated infrastructure, which includes narrow roads and small fields. Conventional equipment for cereal, potato and grassland production is available.

¹ <http://www.gov.je/SiteCollectionDocuments/Government%20and%20administration/R%20-%202014%20Agricultural%20Stats%20DM%2028102015.pdf>

There are two modern combine harvesters on Jersey (+10 years old), one of which is owned by a local contractor.

2.1.4 Employment

In 2014, there were 1,582 agricultural workers during peak season on the island, the majority of which were seasonal or casual workers (59%). Full time workers comprised 32% of the farm labour work force, equating to just over 500 workers. Most agricultural workers are skilled in basic production of potatoes, cereals, grassland and livestock and the majority of the full-time workforce are capable of operating conventional agricultural equipment.

2.2 Glasshouses

The total area of glasshouses in 2014 was 225,470m². A breakdown of the age and some features of the current glasshouses are presented in Table 1. The majority of the glasshouse space on the island is over 15 years old (86%) with only 3% of the glasshouse area built in the last 5 years. Just under a quarter of the glasshouse space is heated and 11% of the space has not been cropped in the past 12 months.

Table 1 – Glasshouse area on the Island of Jersey, 2014².

	m ²	% of total glasshouse area
Glasshouses under 5 years	5800	3
Glasshouses 5-10 years	12	0.01
Glasshouses 10-15 years	26019	12
Glasshouses over 15 years	193639	86
Total Glasshouse area	225470	-
Heated area	50687	22
Not cropped in last 12 months	24150	11

Glasshouse production is often seasonal and typically used for extending growing seasons and overwintering higher value specialist crops, such as herbs, fruits or vegetables. Due to the nature of their use, glasshouse facilities often remain unused for significant periods and could provide an opportunity above and beyond the agricultural land described above.

² <http://www.gov.je/SiteCollectionDocuments/Government%20and%20administration/R%20-%202014%20Agricultural%20Stats%20DM%2028102015.pdf>

2.3 Exports

Potatoes comprised 94% of the total vegetable exports during 2014 (31,393 tonnes exported). Other outdoor grown vegetables exported from the island in 2014 included beans, cauliflower and courgettes.

2.4 Environmental Issues

2.4.1 Water Quality

The island of Jersey is reliant on its surface waters and groundwater (which is replenished from rainfall) for drinking, irrigation, industry and recreation³. As a result, any water quality issues may pose a threat to human health and the wider environment.

Jersey waters are susceptible to contamination from agricultural practises. High levels⁴ of nitrates are prevalent in some of the island's streams as a result of run-off and seepage in to waterways from farms using nitrogen fertilisers³. Extensive use of pesticides (particularly herbicides) also pose a threat on the island as chemicals deriving from these sources have been detected in watercourses³. Jersey waters located close to areas where slurries are spread are also at risk of bacterial contamination.

2.4.2 Soil Quality

The majority of local soil on the island derives from extensive drift deposits of loess (Aeolian sediment), which have created a thick, rich layer of soil on which to farm. Some of the soil on the island derives from the underlying bedrock (these can mainly be found along the north-coast edge, north-west headland, south-west headlands and steep valley slopes). These soils are more acidic and thinner in their coverage in comparison to the loess deposits, and require irrigation where there are cultivated for farming.

As an island, Jersey soils may be susceptible to erosion from water or wind factors. Furthermore, with annual planting and harvesting of Jersey Royals, this may also contribute to erosion of soil from the potato fields. As the majority of farmland soils are glacial drift deposits, erosion is particularly problematic if prevalent.

³<https://www.gov.je/SiteCollectionDocuments/Industry%20and%20finance/R%20Condition%20of%20Jersey%27s%20Environment%2020050101%20SW.pdf>

⁴ above the maximum value of 50mg/L allowed by the Water (Jersey) Law 1972 (as amended))

3 Alternative crop options for Jersey

3.1 Crops to address potato cyst nematode (PCN) problem

With a prevalent PCN problem on the island, there are crop options such as trap crops and biofumigant crops that can address the problem without the use of nematicides which as a result of changes to EU legislation are becoming more difficult to licence or obtain.

While these crops do not yield any financial rewards directly, their cultivation can firstly address the problem at hand without risk of adding any chemicals to the land which may reduce water quality issues and also result in improvement to soil following which potatoes or other crops can be grown thereafter.

3.1.1 Trap Crops: Sticky Nightshade (*Solanum sisymbriifolium*)

Solanum sisymbriifolium also known as Sticky Nightshade is a metre tall annual herb and a member of the Solanaceae family, the same as potatoes. The plant produces white flowers and later in life small, round red fruits which look like cherry tomatoes. Both the flowers and fruit are sticky to touch, which gives the plant its colloquial name.

It is a trap crop that can be grown on soil with a prevalent potato cyst nematode problem. The roots of the herb are similar to the potatoes however they are poisonous to the nematode. The sticky nightshade stimulates the PCN eggs to hatch however once the young nematodes try to feed on the plant's roots, they become poisoned and die. The result is that the potato cyst life-cycle is broken and potato crops can eventually be cropped successfully in this soil. Using trap crops can avoid or at least reduce the need for nematicides to be used which could reduce pressure around water quality. This method has been widely used in Jersey for nearly 10 years.

3.1.2 Biofumigant Crops

There are a number of biofumigant crops that can be used on the island, with brassicas a common type which address PCN issues and also improve skin finish and tuber quality. The crops function by releasing a chemical compound called glucosinolate (GSL) after planting which transform into isothiocyanate (ITCs) in the soil. The ITCs then allow the potato cysts in the soil to hatch before killing the eggs contained within.

In order to liberate GSL from the biofumigant crops, they are grown to the mid flowering stage followed by macerating and incorporating the biomass into the soil. The release of GSL and other enzymes from the plant cells produces ITC volatile gases after water has been added; therefore, water is essential for effective bio-fumigation.

Biofumigant crops which can effectively be used include Indian mustard and Oil Radish.

Potential for Jersey

Growing trap crops and biofumigant crops on the island of Jersey could help manage the PCN problem in combination with other proposed crop options. The growth of Indian mustard would also compliment the potato growing pattern on Jersey as the crops are planted in late summer/early autumn following potato harvest.

These crops however offer no additional value to Jersey, so although they present a potential solution to reduce the current problem, they do not offer alternative market opportunities and could not substitute Jersey Royals where production is no longer viable.

3.2 Food Crops

While the first piece of work conducted by the NNFCC for the State of Jersey focussed predominantly on non-food crop options, the scope for this second phase of work has been broadened to include investigating potential high-value, niche or novel food crops that can be grown. As a number of different food crops such as fruit and vegetables are already grown on Jersey, the experience of growing speciality food crops is already present. In addition, food crops grown on Jersey could supply local markets or benefit from the existing export infrastructure in instances where produce are supplied off the island.

While the market for some food crops may offer comparatively lower returns than the lucrative Jersey Royal (in addition to facing market saturation), there are a number of food crops on the brink of commercialisation that can be explored, which command high retail prices and compliment the direction in which consumer tastes and trends are heading. There is, at present time, a large consumer focus on healthy food products as well products with unique and different flavours. Furthermore, changes in consumer behaviour are apparent in which increased awareness of the health benefits of functional foods compliments an increased willingness of consumers to want to purchase products of a higher quality. The generation who are the driving force behind this consumer focus are the millennials group (aged 18-34 in 2015), who are currently the largest generation in the UK (and in the US).

The way in which consumers, in particular the millennials age category, are purchasing their groceries is also changing. Where 'weekly big shops' at large supermarket chains used to be the main method of grocery shopping, there has been a recent rise in consumers shopping in smaller supermarkets and inner city shops for their food. This increases potential for smaller food and farm businesses to introduce their products to these retailers where consumers can buy non mass-produced higher quality products. Furthermore, internet shopping continues to dominate all retail sectors where the correct marketing and SEO strategies can enable small businesses to run successful businesses online.

Considering the direction the market is heading, a number of potential food crop options are presented below. There is a particular focus on 'Obscure berries' for their superfood health market potential as well as gourmet food products.

3.2.1 Honeyberries (aka Haskap Berries)

Honeyberries are the seedless fruit of the perennial honeysuckle species *Lonicera caerulea* which is a thick upright bush. The honeyberry fruits look like an elongated or oblong version of a blueberry and taste like a cross between a raspberry, a blueberry and a blackberry with added 'zing'. Honeyberries are more acidic and flavoursome than blueberries which make them ideal for processing where they can be used to produce jams, jellies and sauces. Honeyberries are also high in anti-oxidants and vitamin C. Furthermore, a recent article⁵ revealed Innocent Drinks also expressing interest in this 'superberry'.

Honeyberries are a relatively new fruit to the market however their health benefits, vibrant colours and similarity to other berries could make their integration easier. Market trends have shown that one of the key categories where millennials are spending more money is in the fresh fruit and vegetables market (37%).

Growing Honeyberries

Honeyberries are considered a cold climate plant which is planted in autumn. As hermaphrodite plants, more than two cultivars should be planted (in equal amounts), with four to six cultivars per acre recommended depending on orchard size to obtain a high fruit yield. Honeyberries can be planted as 'semi-dormant' plants in prepared orchard plots (in rows) and 50cm apart from each other in the rows to allow wind and insects to pollinate. Honeyberries are extremely winter hardy and require around 1000 hours of 'chilling' (dormancy) over the winter months when all of the plant's energy is diverted to root growth. Spring *orchard* planting should be avoided as it disturbs and retards early growth and conditions can often be too wet for establishment, to avoid the young shoots rotting.

Other methods of planting honeyberries include planting young plug (5cm) plants in the spring in 3-11 litres pots, growing them through the season and planting a larger plant in late September-early October. This maximises early growth and eliminates weeding requirements in the critical first growing year. Depending on the honeyberry variety, the berry will ripen between June and July. Honeyberries are easy to detach from the pedicel and can be harvested both manually or with a berry-picking combine. Honeyberry yields per acre are between 8,000-12,000 pounds (from 1,000 plants per acre).

⁵ <http://www.producebusinessuk.com/supply/stories/2016/03/02/why-honeyberries-could-be-the-next-soft-fruit-to-conquer-the-produce-aisle>

Potential for Jersey

As a new berry, there is potential for Jersey to position themselves as a key producer and front runner in the honeyberry market. The plant is already being investigated by the Plant Health Laboratory and forms the first 'Alternative Crop' trial to be planted in Jersey under the new Rural Economy Strategy 2017.

With increasing consumer focus on healthy superfoods and exploring new flavours and tastes, the potential for honeyberries is significant. As honeyberries can be harvested by hand, in the initial stages of a honeyberry orchard this method of berry collection could be used primarily while the orchard becomes fully established. As fruit and vegetables are currently exported off the island, the infrastructure is already in place which honeyberry growers could make use of. Furthermore, as honeyberries can be used as an ingredient in other products (e.g. honeyberry gin) the potential to penetrate different market sectors either on- or off-island is possible. Integration with other on-island enterprises, such as drinks and other food industries who could utilise honeyberries as a novel ingredient or flavouring offers great potential.

Honeyberries could be sold to island retailers and businesses on a small scale or exported to the UK and EU on larger scales. As punnet fruits such as strawberries are currently exported from the island, the infrastructure is currently in place which would help facilitate this. As a unique berry, it provides an excellent marketing opportunity to brand honeyberries as a product of Jersey. As a new berry, global supply is low and thus attracts premium pricing from £3.50 to £6.50 per kg. Frozen berries can attract a higher price of £5 to £8 per kg.

Growing honeyberries on Jersey could utilise the glasshouse or polytunnels during initial growth stage in pots before transfer to outdoor fields.

Useful contacts

- A full growing guide for honeyberries can be purchased from <http://www.lovehoneyberry.com/>
- Arbuckle's, Scotland's first honeyberry farm - <http://www.arbuckles.co.uk/>

3.2.2 Aronia Berries

Aronia berries, also known as Choke berries, are dark round juicy berries which derive from the hardy Aronia shrub. Aronia berries can be used in a wide range of products including juices, jams, jellies, cakes, desserts, yoghurts, ice creams and smoothies. They can be readily frozen, dried, powdered, and chocolate covered or candied. Aronia berries are considered a health product owing to the berries anthocyanin, antioxidant and polyphenol contents amongst others. Commercial uses include medicinal remedies, natural food colouring, health

and well-being nutritional supplements, natural cosmetics and diabetic energy foods. It is also used as a food colourant in Haribo sweets. It is not necessarily considered a punnet fruit due to its zesty flavour however it can be used in all applications listed above.

Regarding medical use specifically, Aronia berries and products are also sometimes consumed by pancreatic cancer patients undergoing chemotherapy as laboratory tests have shown that Aronia can halt the growth of cancer cells⁶. As a food ingredient it can be found in several popular food and drink products.

Similar to honeyberries, the Aronia berry market is still in its infancy due primarily to the fact that people are unaware of the berry's existence. The only large Aronia berry plantation in the UK's primary export is Aronia juice and the business operates exclusively online (www.aroniaberriesuk.co.uk).

The greatest potential market for Aronia berries is at local markets and online while the berry's familiarity is still in infancy. It could also be supplied to high-end restaurants and caterers who can utilise it as an ingredient and flavouring in many common dishes.

Growing Aronia Berries

Aronia berries prefer neutral to slightly acidic well drained soils located in full sun. Irrigation may be required however as the Aronia shrub is not very drought tolerant. Bare-rooted seedlings are planted in spring after the threat of frost has passed although containerised Aronia can be planted in to mid-summer as long as adequate moisture is available.

For Aronia, labour requirements are estimated at 120 - 150 hours to establish one hectare. To produce 8 tonnes using a mechanical harvester, annual labour equates to 15-25 hours for production, 65 hours for harvest and 65 hours for packing. Hand harvest of Aronia berries requires around 1 hour for every 7.5 kilograms harvested.

In the UK, the single largest Aronia berry plantation was established from cuttings from Eastern Poland at a cost of around £1.30 each. Growth from cuttings to full size berry bush will take about three years. Once established, Aronia plants will yield an average 4,000 berries/plant. Although they can be hand harvested, as the berries weigh around 1g each, picking large amounts may be inefficient. One hectare will accommodate around 1,800-2,000 shrubs.

⁶ <http://www.nhs.uk/news/2014/09September/Pages/Berries-boosts-chemo-for-pancreatic-cancer.aspx>

Potential for Jersey

Growing Aronia Berries on Jersey would complement the growth of other superberries mentioned above, where a Jersey superfood health value chain could be established.

Useful contacts

Andrew Tickle (UK Aronia Berry Farmer): <http://www.aroniaberriesuk.co.uk>

3.2.3 Sea Buckthorn Berries (Sea Berries)

Sea Buckthorn berries, or Sea Berries as they are otherwise known, are a small orange-red round to oblong fruit rich in omega oils, vitamins A-E and K and Carotenoids and Flavonoids. The berries can be used in the culinary, healthcare and cosmetic sectors. For example, one culinary use is to extract the juice from the berry which can be consumed neat, sweetened or blended in combination with other fruits in smoothies, nectars and cordials. Oils, which can be extracted from the pulp or seed, are rich in essential fatty acids which have applications in skincare or general health products. The oils and other fruit extracts have been used in traditional Chinese medicine for centuries.

The Sea Buckthorn market, similar to the Haskap and Aronia berries, is a relatively new market in the UK as consumers lack awareness of the berry. Retailing of the berry has in the past few years been largely on-line or in specialised health shops. Awareness is increasing however as the berry and other superfoods have become 'on-trend'.

In the UK, there are currently only four Sea Buckthorn plantations producing at large-scales. Estimations or worldwide production reveal that China is the biggest producer of Sea Berries (est. 600,000 ha) followed by Russia (est. 2,000 ha). The UK currently has around 15 ha of Sea Berries growing. Sea Berries require adequate soil nutrients for a high yield of good quality fruit and respond well to phosphorus fertilisers.

Growing Sea Buckthorn Berries

In the UK, berry yields range from 5-10 tonnes/ha. At present time, labour intensive harvesting procedures can often represent between 50-75% of the overall growing costs owing to lack of development in effective harvesting methods - as the sea buckthorn is not a 'true berry' there is no abscission point on the fruit making the Sea Berries cling onto the peduncle and not separate easily. The window for harvest is around a fortnight in the early summer and hand harvesting is slow (~1-2kg/person per hour). Other methods of harvest include vacuum harvesting or placing a tarp under the bush and beating with a stick.

Potential for Jersey

The potential for Sea Buckthorn berries on Jersey is similar to honeyberries and Aronia berries, whereby the establishment of a superberry value chain could be established.

3.2.4 Goji Berries

Goji berries (or wolfberries) are the red fruit of a hardy, perennial deciduous shrub (*Lycium barbarum*) which have risen in popularity in recent years. The berries produced can be eaten fresh, cooked or dried and are considered a superfood due to their vitamin C, B2 and A content in addition to their iron, selenium and antioxidants contents. The Goji berry plants hardiness derives from its toleration, once established, of wind, salt-laden air and drought. As a result, goji berries could be grown on a variety of land areas on Jersey, including the coastal regions.

No large-scale goji berry plantations are currently established in the UK. In reviewing various goji berry products (dried berries, extract) currently on sale in the UK, most of them are grown in China.

Potential for Jersey

Unlike the Honeyberries, Aronia berries and Sea Buckthorn Berries, there appears to be greater awareness of goji berries as some goji berry products (in particular dried berries) are currently on sale in the UK. As goji berries in the UK are sourced from abroad, there is potential for Jersey to establish a high-quality, locally-produced goji berry which could be dried and sold on island or exported.

3.2.5 Garlic

Garlic belongs to the genus *Allium* and is native to central Asia. Used mainly in culinary applications, garlic is a popular ingredient in dishes worldwide. China is the largest single garlic producing country in the world (accounting for around 42% of production in 2012) where around 20,000,000 tonnes of garlic are produced annually. China and the United States are the largest suppliers of garlic while North America have the largest demand (47%). Europe has a 17% share in global garlic demand.

Garlic is only produced on small scales in the UK however some relatively large garlic plantations are emerging. These include the largest UK producers, the South-West Garlic Farm in Dorchester (13 acres) who sell to restaurants, farm-shops and delicatessens as well as big outlets in Bristol and London. The farm also produces speciality 'black garlic' which is considered a superfood and has been awarded two-stars at the Great Taste Awards 2014. Other larger-scale producers in the UK include the Garlic Farm on the Isle of Wight where garlic has been grown for the past 50 years. The Garlic Farm sells a range of garlic and garlic

based products (e.g. butters, oils, sauces, hampers and gifts) at their farm shop on the island and online at premium prices.

Growing Garlic

Garlic and 'Gourmet garlic'⁷ are easy crops to grow and have the benefit of taking up very little space during growing. There are over 600 varieties of garlic, some of which are very adaptive, having the ability to withstand very cold winters. Regarding taste, gourmet garlics have unique flavours which make them popular with chefs.

Garlic crops are propagated from cloves which can be purchased or saved from a previous harvest (once a garlic farm is established). Replanting 'held-back' bulbs has the added benefit of allowing farmers to continue to grow the varieties that work best in their microclimate as well as being free of disease. Another method of growing garlic for free is to save and plant the bulbils⁸ although this process is variety dependent. Although this method will take 2-5 years to obtain full size bulbs, a high yield will be produced.

Garlic grows best in fertile, well-drained loamy soil and depending on the variety, are planted at various times of the year: in the UK, some varieties are planted during Autumn (October and November) and harvested in summer while others can be planted in spring and harvested late summer, allowing farmers greater flexible for spreading labour throughout the year. Garlic grows best in sunny areas which are well drained and contain alkaline soils- garlics do not thrive in acidic soils and so lime application may be required if soils are acidic.

Potential for Jersey

The garlic market is very well established with imports from abroad the main source garlic consumed in the UK. This opens up opportunity for high-end, domestically grown garlic which compliments the direction of consumer tastes and preferences for high-quality, rich-flavoured products. On Jersey, autumn planted garlic could be planted on farmland or under polytunnels as an alternative to potatoes as their growing and harvest cycles are matched, providing a break in potato growth and extending the rotation. Furthermore, spring planted varieties could be planted following a potato crop and harvested in late summer. Following harvest, garlic could be used on the island, for sale to restaurants and other catering outlets as well as through farmer's markets where high-end local produce could be marketed in similar manner to the Garlic Farm products. Garlic could also be exported off the island for mainland UK retail.

⁷ Some gourmet garlic varieties include Rocambole, Porcelain and Purple Stripe with each having their own unique flavour, taste, and uses

⁸ Small, secondary cloves found scape of hardneck garlics, or along the false stem of softnecks.

Useful contacts

Marshalls Seeds: <http://www.marshalls-seeds.co.uk/how-to-grow-garlic-ggid102.html>

The Garlic Farm: <http://www.thegarlicfarm.co.uk/growing/tips-and-advice>

Garlic World: <http://www.garlicworld.co.uk/grower/page5.html>

3.2.6 Gourmet/Speciality Mushrooms

Global mushroom production is dominated by China who are the world's largest producer (~48%) followed by the EU who are the second largest producers (~29%). As mushrooms are a perishable item however, the global movement of mushrooms is somewhat limited to 'neighbouring' countries.

The highest valued mushrooms are 'Gourmet or Speciality mushrooms' which include the oyster, shiitake and portobello varieties. Associated with fine dining, gourmet mushrooms command the highest retail prices and thus produce high returns per area grown. Although mushrooms can be eaten fresh or dried, gourmet mushrooms are mostly grown for fresh-market sales and as a result, their production is mainly performed by small operators who tend to focus on local markets. Nevertheless, in their dried form, the consumer can re-hydrate the mushrooms (using water or wine) creating a much more flavoursome mushroom than the original whilst also prolonging its shelf-life.

Growing Mushrooms

Growing mushrooms first involves investing in spawn which is the fungus tissue used to propagate mushrooms. Spawn comes in various forms such as grain mixes, sawdust and in wooden dowels called plugs. To grow mushrooms from the spawn, a suitable substrate is required. A common substrate is an inoculated⁹ (removal of all types of fungi) hardwood log. Other substrates can include paperback books (less than ten years old) and toilet rolls.

The spawn has to be introduced to the substrate, following which it should be kept somewhere cool, out of the sun and wind as mycelium begins to form. Following this, the mushrooms will begin to grow and require very little input beyond the introductory stage.

Potential for Jersey

As gourmet mushrooms are mainly grown for fresh supply, there is potential for establishing mushroom production on Jersey to supply local upmarket restaurants on a very regular basis. Furthermore, freshly grown mushrooms could be sold at farmers markets and via other

⁹ Wood inoculation can be performed via heat treatment (with water or steam) or even microwaving

retail outlets on the island. In terms of export to the UK and other nearby European countries, this is also possible for freshly grown mushrooms. As shiitake and oyster mushrooms are the most well-known of the speciality variety and they are consequently the easiest to market and therefore immediate options for Jersey. However, other less-known varieties are growing in popularity enabling Jersey to begin production of emerging speciality varieties.

Although mainly sold fresh, gourmet mushrooms can also be sold or exported in their dried form provided drying facilities are available as dried mushrooms are much less bulky (7kg of fresh mushrooms yields 1kg of dried mushrooms). Dried gourmet mushrooms are also a great gift idea and packets of dried mushrooms could be sold to tourists as a holiday gift, or marketed off-island as “produce of Jersey”.

3.3 Herbs and Plants

Herbs and plants can be grown for a wide range of applications including culinary, health-related and medical applications. With an increase in consumer’s focus on health foods, selecting to grow herbs and plants for this market segment offers real opportunities. Selecting to grow herbs and plants that can be sold into a variety of markets as a variety of products also maximises the potential rates of return.

In part one of the work which NNFCC carried out investigating non-food crops for States of Jersey, a number of medicinal herbs were highlighted as potential crops which could be grown. It was outlined in part one of the project that during the early years of production of medicinal herbs, it is recommended to confine activities to traditional herbs instead of the herbs that are currently ‘in demand’ as by the time a grower has sourced seed, grown and harvested the crops ready for market, the market conditions may have changed. Nevertheless, growing medicinal herbs can be very lucrative as an array of products can be produced from them and the herbal medicines market is reportedly increasing.

In this second part, the list has been expanded with a focus on herbs and plants that can be used for medicinal purposes but also in the health foods sector- in line with the change in consumer trends outlined in Section 2.2 and the broader scope of this follow-on research.

3.3.1 Tea plants (*Camellia sinensis*)

Camellia sinensis is the evergreen bush from which fresh tea leaves are produced and can be processed to make up to 300 types of white, black and green tea. The bush is native to China and Southeast Asia however is now cultivated across the world in subtropical and tropical regions. Despite dominance of tea-growing in these regions, *Camellia sinensis* can be grown in temperate climates.

Tea is the world's second most consumed beverage (after bottled water) with a retail value of 43.1 billion US dollars in 2014. In Western Europe, the UK is the greatest tea consumer with a share of around 63%, with black tea being the preferred variety. Black tea is also the main variety consumed in Poland, Belgium, the Netherlands and Denmark while Portugal, France, Germany and Austria prefer fruit and herbal teas. Although black tea is the current tea of choice in the UK, consumption of black tea is actually declining having fallen 6% over the past five years while the green and herbal fruit tea markets are increasing as consumers (predominantly the millennials) are seeking newer alternatives to traditional products.

The speciality market for 'high-end' teas is also increasing. In 2012, Starbucks acquired the speciality tea and accessory retailer 'Teavana' for \$620 million. The company has 400 locations across the Americas and the Middle East. Furthermore, although the black tea market is decreasing in the UK, globally the white tea market is increasing with China, who are a large tea producing and white tea drinking nation, now being net importers of white tea.

As mentioned above, *Camellia sinensis* can be grown in temperate climates. The UK's first tea plantation was set up in the Highlands of Scotland in 2011 as 'The Wee Tea Plantation'. Since then, a UK alliance has been formed under 'The Scottish Tea Growers Association' banner, and currently includes around 15 tea growers from all over the UK, with a target of 28 gardens by the end of spring 2017. Currently, 4 gardens are producing tea for market which is sold under 'The Wee Tea Company' brand. Of the producer gardens, the tea plants are sold out for the next four years and have included a whole range of customers, domestically and abroad including Nicola Sturgeon, First Minister of Scotland and the Queen.

Growing *Camellia sinensis*

Camellia sinensis can be purchased as seeds for cultivation and or as young plants. *Camellia sinensis* seeds are sown in the spring (where evening temperatures are >12°C) and require acidic soils and lots of water for growth. The seeds are best planted in pots indoors with lots of sunlight following which they will sprout in four to six weeks. Seedlings should then be planted in a partially shaded spot in sandy slightly acidic soils of pH 5-6 (which may suit them to the headland and coast soils). It is important to note that from the seed, *Camellia* plants can take up to three years to begin production however the plants can live for up to 70 years. Table 2 shows the cost of *Camellia sinensis* plants from Plants4Presents:

Table 2 – The cost of *Camellia Sinensis* plants in 1L and delivery to Jersey from Plants 4 Presents (as of September 2016)

	Cost 10+	Cost 100+	Cost 500+	Cost 1000+
<i>Camellia Sinensis</i> in 1L Pot	£15.00	£8.50	£7..50	£6.40
Delivery to Jersey	£12.00	TBC	TBC	TBC

Different tea varieties require different degrees of processing. Producing white or green tea is a simple process. The tea leaves are harvested in spring and summer following which they are steamed (using a steamer or placing the leaves in a colander over boiling water for two minutes). The leaves wilt following which they doused in cold water. The leaves are then rolled in to cigar shapes and then oven-dried at 100°C for 10-12 minutes, turning them half-way through. These fresh leaves can be used to make tea or further dried to make the leaves very dry and crispy for storage and future use. The seeds of *Camellia sinensis* can also be pressed to yield a sweet seasoning or cooking oil.

Potential for Jersey

Tea drinking culture is evolving to a position where fruit and herbal teas are on trend and set to increase. Furthermore, consumers are gravitating towards high-end quality tea products. As a result, there is potential for tea to be grown on the island where a small-scale plantation could produce high quality green and herbal tea products which is where the market is headed. Also, combining tea production with some of the berries described at 3.2 could deliver a niche range of novel fruit teas unique to Jersey.

In terms of growing *Camellia sinensis* on the island, the glasshouses on Jersey could be used for the initial growth of the plants before transfer to fields.

The current president of the Scottish Tea Growers Association explained when contacted during this research that tea plants would grow very well on the island of Jersey and he would be happy to discuss potential opportunities.

Useful contacts

The Wee Tea Plantation: <http://www.weeteaplantation.com/>

The Wee Tea Company: <http://weeteacompany.com/>

Plymouth Tea – A member of the Scottish Tea Growers Association:
<https://www.plymouthtea.co.uk/>

Plants4Presents (<https://plants4presents.co.uk/>) have previously supplied tea plants to the 'Wee Tea Plantation'.

Teavana: <http://www.teavana.com/us/en/home>

3.3.2 Chamomile

Chamomile is a perennial plant belonging to the Asteraceae family and is one of the oldest and widely used medicinal plants in the world. The flowers of the chamomile plant can be

used to produce a variety of products with reported medicinal properties such as anti-inflammatory, antispasmodic and sedative properties amongst others. Chamomile flowers can also be dried and used in teas or ingested as a herb, or used as a source of essential oil which can be used in aromatherapy applications as well in toiletries and soaps.

The chamomile market is very well established. Teapigs, who are a high-end tea retailer, highlighted a current big focus on chamomile tea. Furthermore, Chamomile Strong Infusion is a product listed in Ransom Naturals top 20 selling products - a leading developer and manufacturer of natural products.

Growing Chamomile

Chamomile seeds are sown in spring/early summer and grow best in sunny environments with well-drained soil (however, they will tolerate some degree of shade). Seeds can be planted in shallow pots and then transferred outdoors after the last frost. Chamomile does not require a lot of fertiliser and unless the soil is very poor, fertilisers will not be required throughout the season. Flowers will bloom throughout the summer (June-August) and so there is no specific harvest time. Harvesting chamomile requires accuracy as it is only the flowers and not the stems that is required, so on small areas this is typically done by hand.

Average yields for chamomile are around 20-25t/ha for fresh flowers. The average oil yield per hectare is around 750kg.

Potential for Jersey

The potential for growing chamomile on Jersey is significant owing to the different market sectors chamomile penetrates. If tea-growing is established on the island, growing chamomile could compliment this, creating a large tea enterprise. Furthermore, chamomile grown on the island could also be used to extract essential oils, further diversifying the market for this crop and complimenting the part one recommendations which focussed on novel oils and applications.

Useful contacts

Ransom Naturals (developer and manufacturer of natural products and extracts to the Pharmaceutical, Healthcare, Cosmetic and Food & Drinks industries):

<http://ransomnaturals.com/>

Cottage Chamomile (Chamomile Essential Oil Producer in the UK who produce oils on farm using steam distillation): <http://cottagechamomile.co.uk/>

Teapigs: <https://www.teapigs.co.uk>

3.3.3 Hibiscus

Hibiscus is a flowering plant belonging to mallow family Malvaceae. The primary products of hibiscus are the fresh flowers, while the secondary products include dried and frozen hibiscus, juice and wine, sauces and syrups, tea and herbal medicines. Teapigs also referenced hibiscus as a key ingredient in the current herbal tea market.

China and Thailand currently dominate world hibiscus production while the highest quality hibiscus is currently grown in Sudan. The United States and Germany are the world's largest importers. Although production is dominated in the far-east, there are opportunities to penetrate the hibiscus market with better quality products and reliable production - the quality of the hibiscus from China is sometimes not up to standard owing to less stringent quality assurance measures.

Despite the potential for market penetration, the global hibiscus market is very volatile and prices can fluctuate dramatically. This is due to the fact the flowers grows easily in many places which can result in oversupply, having the knock-on effect of lowering prices, resulting in farmers switching crops which lowers supply the following year and causes prices to rise again.

Growing Hibiscus

Hibiscus is quite hardy and grows in most well drained soils. It can tolerate poor soil and requires 4-8 months with night-time temperatures above 21°C. Furthermore, it requires 13 hours of sunlight per day during the first 4-5 months of growth. Hibiscus also requires 5-10 inches of rainfall in the first 3-4 months of growth so irrigation is not uncommon.

Potential for Jersey

Penetration into the mass hibiscus market is unlikely owing to the scales of production that could be achieved on Jersey. However, there is potential for establishing hibiscus on the island of Jersey with a focus on locally sourced, high-quality products which can be distinguished from poorer quality imports. If cultivated for use in tea products, this would complement growing of Camellia and other plants and herbs grown for tea applications, establishing Jersey as a key UK tea producer.

3.3.4 Elderflower/Elderberry

Elderberries and Elderflowers both derive from the elder plant (*Sambucus nigra*), which is a herbaceous perennial. The flowers of the elder plant blossom before the fruit and so are harvested at different times in the year. Dried elderflower has also been used as a traditional herbal medicine for many years. Furthermore, elderflowers can be used for their flavour and

are commonly used as a drinks ingredient. Elderberries have a distinct fruity flavour and is a popular flavouring in alcoholic beverages such as cider. Most commercially grown elderberries are sold to processors for wine, juices, jams, syrups and pies although there is increased interest in elderberries in the health tonic industry.

Ransom Naturals, who are leading developer and manufacturer of natural products, rank 'Elderberry Strong Infusion' and 'Elderflower Strong Infusion' in their top 20 top selling extracts.

Similar to chamomile, the elderberry and elderflower markets are much more established and they can be found in a number of products currently on sale in the UK market including elderflower essence and cordial and elderberry extract.

Growing Elderflower/Elderberries

Sambucas nigra grow well in a variety of different soil types although moderately fertile soils with adequate surface and internal water drainage are best for commercial production. The plants grow best at pH 5.5 – 6.5 with moderate phosphorus levels and relatively high potassium demand. The Elder plant produces its flowers in late spring and berries in late summer/early autumn, with elderberry coming in to full production after 3-4 years. Under good growing conditions around 7.5 - 10 tonnes of fruit per hectare can be achieved.

Production costs for an irrigated small scale (1 hectare) elderberry plantation are estimated at £1,000 per hectare. Harvesting and marketing costs are around £1,800 per hectare with total expenses (variable and fixed) estimated at £2,400 per hectare.

Potential for Jersey

As a dual product plant, growing elder plants on Jersey could result in two value chains from one production cycle. As elderberries and elderflowers are key ingredients in the health foods markets, the elder plant on Jersey could be used to produce a host of health foods which could be sold on island as well exported. Owing to Jersey's small size and relatively small scales of production, the opportunity for upmarket products with a focus on small, local production could be capitalised upon.

Useful contacts

Ransom Naturals (developer and manufacturer of natural products and extracts to the Pharmaceutical, Healthcare, Cosmetic and Food & Drinks industries):

<http://ransomnaturals.com/>

Elderflower Farm in Lincolnshire: <https://www.belvoirfruitfarms.co.uk/elderflower/>

3.3.5 Lavender

Lavender is a genus of 39 known species belonging to the family Lamiaceae. Lavender has a unique aroma and is used to produce a number of products from its petals. These include dried lavender flowers, essential oils and natural body products including lotions and washes. Lavender can also be used to produce specialist lavender foods which includes biscuits, preserves and honey. The lavender market is very established in the UK, with several farms producing lavender on large scales. Details of some of the UK's lavender farms are listed below.

Growing Lavender

Lavender grows best in warm sunny climates. It is very difficult to grow from seed and so purchasing as seedlings or taking cuttings from existing plants represents the easiest way to grow lavender. Lavender is planted in spring (between April and May) and thrives in any poor or moderately fertile, free-draining soils. Lavender is ideal for chalky alkaline soils. Pruning of lavender is necessary however feeding is minimal, although potash will help flowers bloom. Lavender is harvested during August-October where yield of around 1.5-4 tonnes/ha can be achieved.

Potential for Jersey

While lavender could be grown on Jersey for the production of dried flowers, essential oils and body products, as there are currently a number of lavender plantations in the UK, the niche for local-produced, high-end lavender products is already filled. Nevertheless, the number of plantations signifies a market for lavender and lavender products and an opportunity to develop local products as "Produce of Jersey" is evident, generating marketable for the on-island retail and tourist industries.

Useful contacts

Mayfield Lavender: <http://www.mayfieldlavender.com/>

Somerset Lavender: <http://www.somersetlavender.com/visit/things-to-do>

Yorkshire Lavender: <http://www.yorkshirlavender.com/>

Cotswold Lavender: <http://www.cotswoldlavender.co.uk/>

Wolds Way Lavender: <http://woldswaylavender.co.uk/>

Downderry Nursery: <http://www.downderry-nursery.co.uk/>

3.3.6 Echinacea

Echinacea flowers, also known as coneflowers, are large daisy-like flowers. They can be grown for ornamental purposes (where markets exist for cut coneflowers) as well as cultivated for their root and plant material for medicinal purposes which are sold in a variety of forms including teas, tinctures and powders. In the case of Echinacea supplements (excluding tea and beauty products), it ranks amongst the top 10 herbs in most markets¹⁰.

The commercial Echinacea market is dominated by a handful of firms and large-scale producers. Prices received for Echinacea in the United States dropped in the 2000s from the 1990s, making their cultivation for medicinal applications uncertain at this time.

Growing Echinacea

Echinacea prefers light locations with bright sunlight and grows best in soils with good aeration, drainage and fertility and it commonly requires irrigation to achieve high yields. It can be planted from seed (in glasshouses) or as bare root seedlings or plugs in-field.

Potential for Jersey

As there are at present only a handful of companies producing Echinacea on large scales for mass markets, the opportunity to penetrate larger markets is limited. Small scale production is an option however, if the focus of production was primarily on upmarket, boutique products.

3.3.7 Mint

There are around 19 different types of mint which belong to the plant family Lamiaceae. Each variety of mint varies in its chemical content, aroma and end-use.

Four of the most commonly cultivated and well known types of mint include Japanese Mint (*Mentha arvensis*), Peppermint (*Mentha piperita*), Spearmint (*Mentha spicata*) and Bergamot mint (*Mentha citrata*) from which essential oils can be extracted and used as a flavouring. There are also health benefits attributed to peppermint in particular, including its ability to help reduce the effects of irritable bowel syndrome and other gastric ailments. As well as extraction of essential oils, peppermint leaves can be used, fresh or dried, as a culinary herb and as an ingredient in herbal teas.

The United States and India are two of the largest mint producers in the world, where they produce around 4,000 tonnes/year of *Mentha piperita* and 300,000 tonnes/year of *Mentha arvensis* respectively. In the United States, the oil production from peppermint can vary from

¹⁰ <https://www.uky.edu/Ag/CCD/introsheets/echinacea.pdf>

between 35-80 kg oil/ha. There are very few large-scale mint plantations in the UK; the largest is the 100 acre Summerdown Mint site in Hampshire who grow mainly *Mentha piperita*, peppermint for the production of 1.25 tonnes of peppermint oil per year in an on-farm distiller. The yields on the Summerdown farm are comparatively lower than typical peppermint oil yields; however, the farm owner Sir Michael Colmans attributes the success of his farm and products on the quality of his award winning peppermint and peppermint products he produces. Sir Michael Colmans notes that the peppermint flavours found in more tasteful *Mentha piperita* are losing ground to the harsher tasting and cheaper to produce *Mentha arvensis*. Sir Colmans further states that companies producing confectionary and toothpaste approach mint flavouring with the philosophy of 'do the best you can for this price' which has resulted in lower quality mint flavours in which 'a 'drop' of *Mentha piperita* is used in a larger batch of *Mentha arvensis*. Sir Colmans believes the market desire for higher quality mint products will only increase in response to the poorer quality mint products currently on sale.

Growing Peppermint

Peppermint is a perennial plant which grows well in most soil types (except heavy clays), in an optimum pH range of 6-7.5. Peppermint is also a very thirsty plant that requires moist conditions for growth. Peppermint grows best in cool to temperate regions - requiring long warm days and cooler nights to yield the right balance of oil compounds (less desirable compounds can be produced when conditions are too warm at night). The stems of peppermint grow 30-80cm tall and are quadrangular. Peppermint grows best above the 45th parallel owing to the amount of sunlight.

Peppermint is sown as seed in autumn or spring and is harvested from August to October. Fertiliser is required for good crop development and to maintain oil yield and quality with applications generally in the region of 280kg N/ha, 100kg P/ha and 125kg K/ha. Furthermore, in preparation for growing peppermint, the ground must be completely weed free so a pre-planting herbicide should be applied followed by a post-emergence application where necessary.

Potential for Jersey

Although the scales of production on Jersey are unlikely to fulfil the production capacities required by large companies requiring vast amounts of peppermint oil, there are opportunities for small-scale mint cultivation on Jersey. A small mint farm could operate in a similar manner to Summerdown mint, growing and distilling mint to produce small volumes of very high quality peppermint oil to make high-end peppermint products such as teas, neat oils and chocolates. As these are a rarity in the UK, the potential for a developing a "Product of Jersey" label is significant, to establish Jersey as a peppermint growing island, from which larger scales of production could follow. Furthermore, peppermint as a perennial

plant, offers the opportunity to prevent soil erosion on any areas of land which may susceptible.

3.3.8 Quinoa

Quinoa are tiny bead shaped edible starchy seeds. Although a seed, they are often prepared for consumption like whole grains. The seed is native to South America and is recognised by the United Nations as a 'Supercrop' for its health benefits such as being high in dietary fibre and gluten free.

Potential for Jersey

Quinoa is currently grown on large-scales in the UK by the 'British Quinoa Company'. In contacting the company, they said a lot processing equipment is required for cleaning the quinoa and scales of production would be uneconomic on the island. However, quinoa seeds can be planted on small scales and manually processed for local use. The small production rates on the island however would unlikely result in large revenues. Nevertheless, smaller scales of production could supply businesses and the catering industry on the island of Jersey, especially for those selling premium health products.

3.3.9 Fruit (for Fruit Ciders)

During the 17th-19th centuries, cider making on Jersey was a thriving industry and a key island export with apple orchards dominating Jersey's landscape. However, apple growth and cider production declined in favour of the more profitable Jersey Royals from the mid-19th century until now. Nevertheless, some cider producers do exist on the island (e.g. La Mare Wine Estate, La Robeline Cider Company) which source apples locally.

Expanding apple growth on Jersey for cider production (in addition to standalone fruit production) could be explored. This could be further diversified by growing different fruits to produce a variety of increasingly popular or new and novel fruit ciders. While cider markets forecast that traditional apple cider will continue to dominate over the newer fruit ciders, the fruit cider market is expanding with Smirnoff being the latest large brand to diversify into fruit ciders.

As apple growing and cider production are skills already available on the island, these could be utilised to expand the island's market. As a popular summer drink, producing fruit ciders on Jersey could prove popular with tourists with organised tours as well supply to local businesses and beyond.

Potential for Jersey

The marketing potential of apple and fruit ciders is also significant in terms of “Product of Jersey” credentials. Options for fruit cider flavours could include strawberry (which is already grown on the island) or incorporating the herbs and fruits listed in this report as cider flavours enhancing island circularity of products and developing a niche range unique to the island.

3.4 *Cannabis Sativa* (Hemp and Marijuana)

Cannabis Sativa is an annual herbaceous plant belonging to the genus *Cannabis*. Depending on the purpose of final use, different parts of the plant can be harvested. Currently, *Cannabis Sativa* plants can be cultivated for their fibres (from the stalk), their seeds (which can be consumed) or their leaves (which can be used medicinally or recreationally).

Two well-known varieties of the *Cannabis Sativa* plant are hemp and marijuana. A key difference between these two varieties is their tetrahydrocannabinol¹¹ (THC) content. THC is psychoactive compound, and forms as a resin on the leaves/flower portion of the plant. Marijuana plants typically have a THC content of 10-30% while hemp has a THC content of no greater than 0.3%.

3.4.1 Hemp

Hemp can be used in a number of applications (depending on which part of the plant is cultivated) with estimates that the global hemp market consists of more than 25,000 products¹². Hemp stalks can be utilised for their hurd (also known as the pulp), which is the soft inner core of the plant stem, and their bast fibres, which grow on the outside of the plant. Hemp hurd can be used to make building materials such as fibreboard or ‘hempcrete’ which is a bio-composite mixture of hemp hurd and lime used in construction. Both the hurd and fibres can be used to make paper while the bast fibres can be also be used to make textiles. These include twine, canvas, carpet and even car-parts (brake/clutch linings). The most common application for European hemp fibres in 2010 was for pulp and paper (55%). The next most common application was insulation material (25.9%) followed by press moulding for the automotive industry.

As well as the stalks, hemp can be cultivated for its seeds which can be consumed or used to produce hemp seed oil – this requires a slightly different variety, known as dual-hemp. According to a recent report from Technavio, the global hemp-based foods market is expected to post a compound annual growth rate (CAGR) of more than 20% during the

¹¹ THC belongs to a larger group of compounds called cannabinoids.

¹² <https://www.fas.org/sgp/crs/misc/RL32725.pdf>

period 2016-2020 indicating reasonable market expansion. The relative price index of hemp fibres has on average increased since 2012.

Hemp cultivation in the EU has increased rapidly in the past few years, from around 14,000 ha in 2012 to just over 25,000 ha in 2015¹³. In 2013, 15,700 ha were grown generating 85,000 tonnes of straw which were processed to 43,000 tonnes of shiv, 25,000 tonnes of fibre and 13,000 tonnes of dust used to make pellets (60%) and compost (40%). The main market for hemp shivs in 2013 was for horse animal bedding (45%). From 2010-2013, the production of fibre and shivs did not show any significant difference.

In 2013, 11,500 tonnes of hemp seed and 240 tonnes of flowers and leaves were processed for medical applications (THC/CBD), food supplements (CBD) and production of essential oils. Previously, seeds were seen as a by-product of hemp fibre production in the EU however in the past few years, production of hemp for seed exclusively has increased. The production of seeds from 2010-2013 increased by 92% (from 6,000 tonnes) driven by demand from the food market, with large supermarkets even now exploring the hemp market. The main market for hemp seeds are animal feed and food with comparatively smaller oil markets. Regarding seed for food, the tonnage increased from 1,000 tonnes in 2010 to 5,000 tonnes in 2013.

3.4.2 Hemp with High Cannabidiol (CBD) content

Although hemp has low concentrations of THC, certain cultivars have high amounts of a different type of cannabinoid called cannabidiol (CBD). CBD research has exploded in the past few years and the compound has been dubbed 'the poster child of medicinal cannabis in 2016'. Unlike THC, CBD is non-psychoactive and therefore 'feeling high' is not one of CBD's effects. CBD concentrations vary from cultivar to cultivar but in general it is found in the upper part of the plant in the flowers. Very recently it has gained prominence in the pharmaceutical and food supplement industries¹⁴. In the EU, the production of flowers and leaves from cannabis increased 3000% from 7.5 tonnes in 2010 to 240 tonnes in 2013.

CBD has only been legal in the UK since July 2015 and since its legalisation, a variety of CBD products are now being sold. The demand for these products derives from the reported medicinal properties of CBD which include antibiotic, analgesic, anti-depressant and anxiolytic as well as being researched for its neuroprotective properties. One UK based company selling CBD products from a variety of different brands¹⁵ is UKCBD (<https://ukcbd.com/>) with items including gels, transdermal patches, capsules, vaping liquids and crystals. Regarding CBD and clinical medical application, GW pharmaceuticals, a biopharmaceutical company who develop and commercialise novel therapeutics from its

¹³ <http://eiha.org/media/2016/05/16-05-17-European-Hemp-Industry-2013.pdf>

¹⁴ <http://eiha.org/media/2016/05/16-05-17-European-Hemp-Industry-2013.pdf>

¹⁵ ADD BRANDS

proprietary cannabinoid product platform recently announced second positive phase-3 pivotal trials for their CBD 'Epidiolex' product in the treatment of Lennox-Gastaut Syndrome which is a form of epilepsy.

According to a recent market study¹⁶ on cannabidiol, the CBD market is currently dominated by SMEs. The report also states that as a relatively new product, it has one of the greatest potential growths of the hemp products. Unlike marijuana, there are no specific security requirements for growing low THC (<0.3%) hemp in the UK however the Home Office does request that any plantations are sited sensitively and they are notified of its production¹⁷.

Growing Hemp

Hemp will grow on most soils suitable for conventional arable crops however acidic soils will reduce yields (if the soil is lower than pH6, lime must be applied before initial cultivation). Poorly drained and sandy soils should be avoided. Hemp seeds are drilled in late April to early May when the risk of frost has passed and the soil temperature is consistently above 10°C. Rows should be planted 12.5-25cm apart and seeds placed at a depth of 4cm. The final application of the hemp will dictate the seed rate. If cultivated for fibres, research¹⁸ has shown that no more than 80kg seed/ha is required. If non-textile fibre is the final application, 30kg/ha may be adequate.

Recommended N levels for growing hemp are around 80kg/ha prior to sowing or applied with the seed, plus an additional 80kg/ha should be applied as a top dressing when the crop has five pairs of new leaves. Phosphorus and potassium recommended levels are 160kg/ha and 80kg/ha respectively. The levels of fertiliser should be reduced if organic manure is applied.

Fibre and seed yields vary depending on variety. Fibre yields can range from 12 tonnes/hectare (low productivity) to 20 tonnes/hectare (high productivity). If cultivated for seed, an average seed yield is around 550-690 kg/hectare while a good yield is 890-1000 kg/hectare (high productivity). Around 20kg of seed is required to make 1 gallon of oil.

Details of hemp seed providers can be found in the Appendix.

¹⁶ <http://eiha.org/document/growing-markets-for-hemp-food-and-pharmaceuticals-potential-billion-e-markets-in-europe/>

¹⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480810/Hemp-_FAQs-Grower_notes-2014.pdf

¹⁸ Little difference in final yield observed between 60-100 kg/ha
<http://www.hoajonline.com/journals/pdf/2052-6237-2-1.pdf>

Potential for Jersey

As the hemp market has undergone growth in the past few years, it represents a market Jersey could penetrate. As a number of products can derive from hemp however, it is important farmers on the island select the right product to cultivate which will complement the facilities and infrastructure on the island as well as provide acceptable rates of return. Regarding cultivation for fibres, this presents an option however in order to produce the final product on-island it would require the correct machinery and facilities which can firstly harvest the shiv and then convert to usable products such as hempcrete. While the raw fibre material could be exported off island, the fibres are bulky relative to other hemp products and so other products may be better explored. These include hemp seeds, which are less bulky and fall under the health foods category which is currently on trend. The seeds can also be utilised for their hemp seed oil which, providing oil extraction facilities were available on the island as recommended in part one of this research, diversifies the seed-based product which could be produced.

The cultivation of hemp with high-CBD content could also be explored following recent legalisation in the UK. A number of products high in CBD can be sold at very high retail prices relative to the same product without CBD e.g. lip balms, creams, vaping liquids. Furthermore, as interest in CBD by pharmaceutical companies has emerged which have led to clinical trialling of CBD drugs, the demand for CBD-rich hemp may correspondingly increase.

Useful contacts

<https://ukcbd.com/>

<http://medicalmarijuana.co.uk/first-cbd-oil-in-the-uk-goes-on-sale/>

All of the hemp providers listed below are members of the European Industrial Hemp Association (EIHA):

<http://www.npk srl.com/>

<http://northeastheritage.com/tag/hemp-seed/>

<http://www.hempoland.eu/>

<http://hempflax.com/en>

<http://www.agropro.lt/en/>

<http://www.ihempfarms.com/>

3.4.3 High-THC Cannabis (Marijuana)

The global market for high-THC (0.3%) cannabis (commonly known as marijuana) is estimated at \$10-120 billion. While its market value makes high-THC cannabis very lucrative, it is illegal in almost all countries in the world in terms of its recreational use. However, high THC cannabis can be prescribed legally in several countries for medical purposes.

In the UK, high-THC cannabis is a Class B (intermediate category) controlled drug where producing, supplying, possessing, importing or exporting it requires a Home Office License¹⁹. On obtaining a license to grow high-THC cannabis in the UK, there are general requirements in place for growing controlled drug licensees. These include ensuring external doors and windows are fitted with secure locks, that stock is (where permitted) stored above ground level and the site has an alarm system with certain degree of police response to name a few²⁰.

The only licensed high-THC cannabis medical product available in the UK is Sativex, (produced by GW Pharmaceuticals) which is mouth spray used for treatment of spasticity due to multiple sclerosis.

Potential for Jersey

Despite its value, the legal status and strict medical application of high-THC cannabis in the UK limits the opportunities for Jersey currently. In contacting GW Pharmaceuticals they informed NNFCC that they currently grow or tightly control their entire high-THC cannabis supply to ensure strict quality control; although they now contract with one external party they are not currently looking for additional suppliers. If there is any change in the legal status or sourcing strategy for marijuana however, the glasshouse network on Jersey could be used to grown high THC cannabis.

3.5 Energy Crops

Energy crops are crops which are harvested exclusively for energy purposes. This requires the crop feedstock to undergo 'conversion' to release the chemical energy stored within. Conversion can be thermochemical (e.g. combustion) or biological (e.g. anaerobic digestion). In part one of this research, some energy crops were presented as opportunities (Short

¹⁹ <https://www.gov.uk/guidance/controlled-drugs-licences-fees-and-returns>

²⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526557/Security_Guidance_for_all_Businesses_and_Other_Organisations-_Final-_May_2016.pdf

Rotation Coppice and Miscanthus). Two additional options are presented below which could be explored for use on the island as part of a larger sustainability strategy.

While energy crops are not necessarily considered a 'cash crop' per se, they could potentially offer indirect financial benefits by replacing other forms of energy on the island and improving self-sufficiency. This may become significant if additional energy costs are the result of energy intensive processes attributed to some of the products listed in this report.

3.5.1 Switchgrass

Switchgrass (*Panicum virgatum*) is a warm season perennial grass native to North America. Historically, switchgrass has been used in North America as a cover crop and for forage. However, its application as an energy crop is very versatile as it can be used in direct thermochemical conversion (e.g. combustion), in cellulosic ethanol production as well as in anaerobic digestion systems (biological conversion). One of the key benefits of growing switchgrass for energy is that the grasses can be grown on marginal land and is adaptable to many soil types.

Growing Switchgrass

Switchgrass is established from seed using conventional drilling machinery and grows up to 1-3m tall depending on crop maturity. Establishment is slow however, taking up to 2-3 years, yet once established, Switchgrass will continue to yield for 10 or more years. Once mature, harvesting takes place annually from October to December and yields a maximum 14 tonnes of dry matter per hectare. Harvesting is undertaken with conventional grass mowing and baling equipment which is available on Jersey. It has low input costs (around £357/ha) and the gross margin should increase as the crop becomes more established.

Potential for Jersey

Without advanced ethanol production facilities on the island, direct combustion of the grass (in small-scale boilers) would be a better application for this grass. If AD facilities were developed on the island, switchgrass could be a potential feedstock. In conjunction with the tourism industry on Jersey, switchgrass could be co-digested with food waste from these hotels and restaurants to produce biogas via AD. This biogas could then be burned to produce electricity (reducing the reliance on interconnectors) and heat for local use, or upgraded to biomethane to be burned in heating systems (reducing reliance on imported fossil fuels for heat applications). These options would not only provide energy security but also contribute towards Jersey decarbonisation targets.

Growing energy crops on marginal land would ensure there are no land competition issues (with food production) as well as enabling land that would otherwise lay dormant to be

utilised, potentially maximising land-use on the island. Nevertheless, Switchgrass grows best on well drained soils of medium fertility. Switchgrass has a further added benefit of requiring low or no nutrient input and little or no irrigation once established.

3.5.2 Reed Canary Grass

Reed Canary Grass is also a perennial grass, naturally distributed throughout Europe and temperate regions of North American and Asia. Similar to switchgrass, reed canary grass can be used as energy crop and attains high yields on poor soils making it a good crop for marginal land. Also similar to switchgrass, establishment can take 2 years following which the grasses can be harvested using specialised equipment. Yields range from 3-7 tonnes/hectare.

As well as energy crop applications, the extensive rhizomatous root system of reed canary grass provides excellent erosion control, in particular along stream banks, shorelines and waterways. This grass therefore could be explored as an alternative on the former potato growing soils along the coast, if soil erosion is particularly problematic.

Potential for Jersey

Opportunities for reed canary grass are identical to switchgrass, as described above. However, reed canary grass requires a lot of nitrogen for reasonable yields to be achieved which may exacerbate the water nitrate problems and makes this a less attractive option for Jersey than Switchgrass.

4 Conclusions

As a result of this research it is clearly evident there are a vast range of opportunities for Jersey to diversify its agricultural activities and combine existing skills, knowledge and resources with new market opportunities to improve returns. The strongest opportunity, or combination of opportunities, lies within the super-food and health-food industries, linking production of berries or fruits with tea or cider production for example to develop opportunities which are unique to Jersey. Such opportunities are likely to attract a premium over conventional food ingredients as novel foods are currently on trend, with interest from leading brand owners increasing.

Due to the specialist nature of the planting and harvesting equipment for many of these alternative crops, the initial focus should be on small-scale where harvesting can be done manually, eliminating the need for investing in and importing specialist, typically larger scale, harvesting equipment until production, processing and the market starts to become established. This will also utilise available skills and labour resources on the island. Furthermore, some relatively low investment in new or upgraded on-island drying facilities would allow drying of a multitude of products, such as teas, herbs and berries to extend shelf lives and broaden the market and product potential.

5 Appendix

5.1 Vegetables grown outdoors

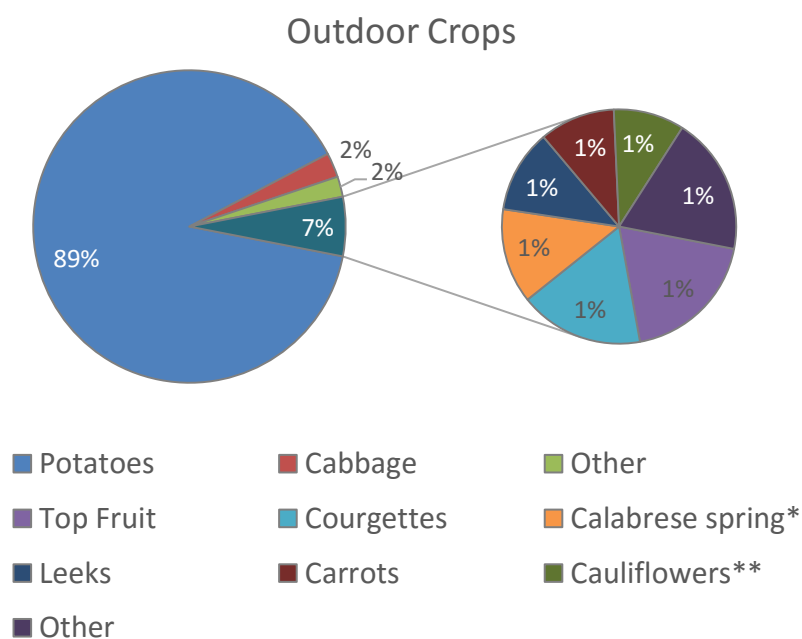


Figure 1 – % of Vegetables grown outdoors on Jersey in 2014

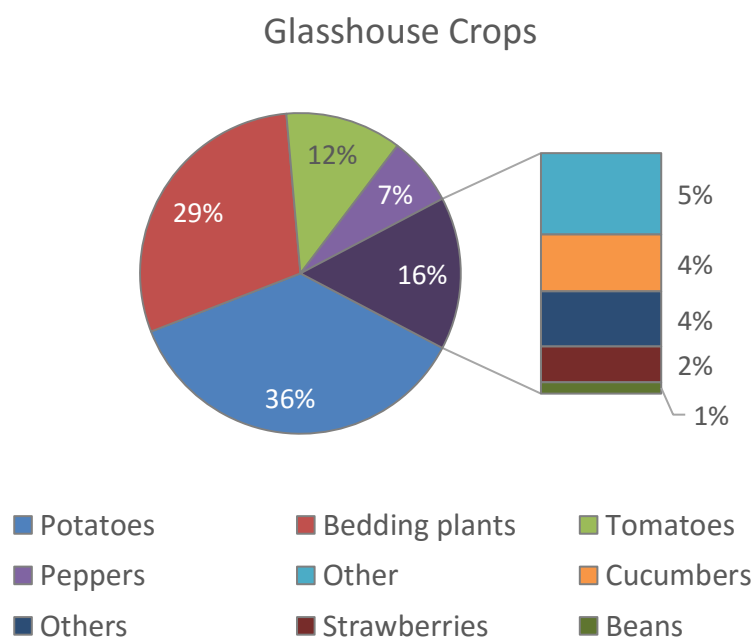


Figure 2 - % of crops grown in glasshouse on Jersey in 2014

5.2 Industrial Hemp Industry

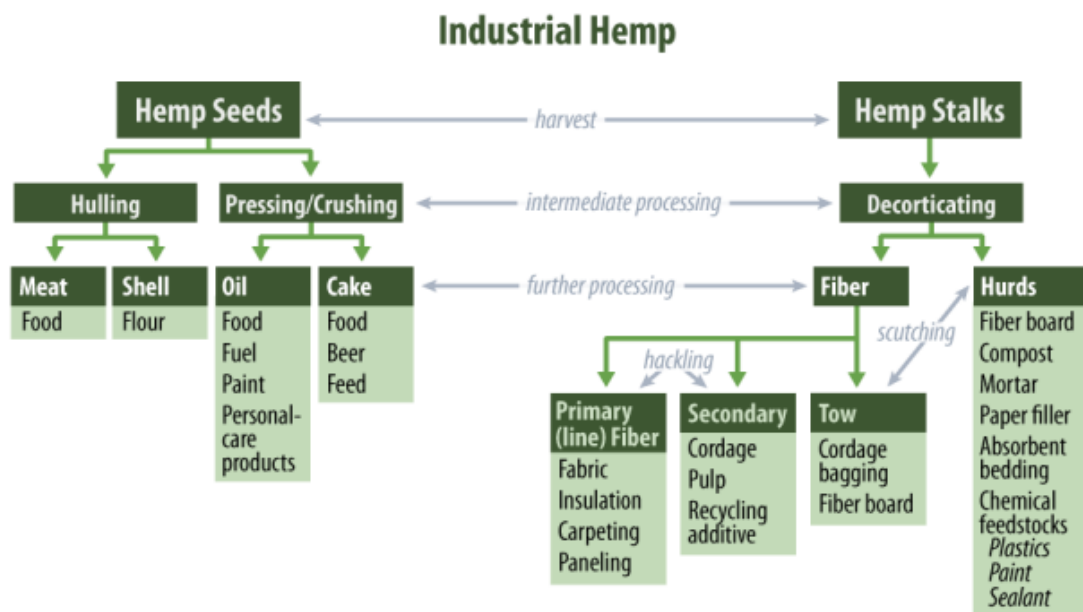


Figure 3 – Uses for Industrial Hemp²¹

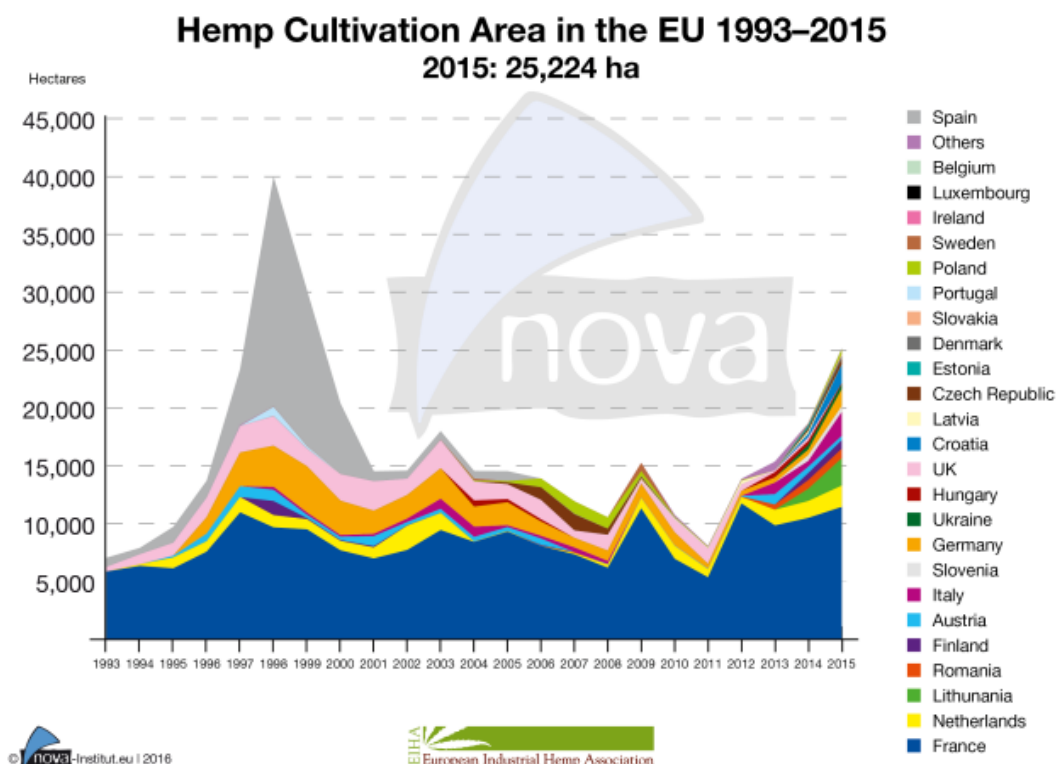


Figure 4 – Hemp Cultivation Area in the EU 1993-2015²²

²¹ <https://www.fas.org/sgp/crs/misc/RL32725.pdf>

²² <http://eiha.org/media/2016/05/16-05-17-European-Hemp-Industry-2013.pdf>

NNFCC

NNFCC is a leading international consultancy with expertise on the conversion of biomass to bioenergy, biofuels and bio-based products.



NNFCC, Biocentre,
York Science Park,
Innovation Way,
Heslington, York,
YO10 5DG.

Phone: +44 (0)1904 435182
Fax: +44 (0)1904 435345
E: enquiries@nnfcc.co.uk
Web: www.nnfcc.co.uk