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Gardening practices and food production in Iceland: history, botanical species, greenhouses and infrastructures

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Summary and overview

This report was put together as part of the winning project *Vaxtarhús* in the *C40 Reinventing Cities Iceland 2021* competition for site Sævarhöfði 31 within Bryggjuhverfi Vestur, Reykjavík. The project was undertaken by the multidisciplinary team *Circular district* consisting of members from VSÓ ráðgjöf, Reiulf Ramstad Arkitekter, M Studio Reykjavik, Íslenskar fasteignir and EIK Fasteignafélag and the authors of this report from the Agricultural University. The aim of the Vaxtarhús project was to purpose a redevelopment for the site by meeting sustainability requirements and ten key environmental challenges called for by *Reinventing Cities* (2021). One of the goals was to tackle the challenge of food insecurity and high-mileage food in Iceland. This was addressed by transforming the site into a food hub that will combine intensive indoor vertical farming, community farming and a low carbon Pikkolo Grocery distribution system. Vaxtarhús will become a center for food innovation and an educational and commercial guide in a sustainable urban development, addressing food innovation in a circular approach, from prototyping and production to distribution, restaurant establishment and compost treatment (Reiulf Ramstad, 2021).

The report was part of the contribution from the Agricultural University, providing necessary information on gardening practices, food production and food security from the past to modern times. It presents opportunities in food production and urban farming in Iceland while providing information necessary to put the project into proper context, given the relatively unique challenges of isolation, weather and environmental conditions on a volcanically active island in the middle of the Atlantic Ocean at northern latitudes.

Introduction

Iceland is an autonomous and wealthy island nation that effectively relies on other countries for approximately half of its food supply as well as necessary inputs for food production. The history of Iceland's shift from self-sufficiency to import-reliance reveals that as the country became more dependent on external food, the domestic agricultural sector weakened significantly. Following the trend in other developed countries, the government examined the Icelandic food insecurity in a report titled „The Icelandic Risk Assessment Report" (IRAR) (utanríksráðuneytið, 2009) which concluded that if food imports were discontinued, Iceland would be unable to feed its population. In this paper, we will make a short presentation of gardening practices and Icelandic food production in greenhouses and outdoors in terms of history, botanical species, greenhouse infrastructures and energy production.

Food Security

Today, Iceland gains most of its food externally as imports of vegetables have increased considerably since 2009, adding some challenges to local horticulture and greenhouse industry. Iceland is not unique in this regard. As countries develop, they tend to outsource agriculture, causing a decline in domestic food production and tend to convert farmland to other uses. This shift is beneficial and even necessary, adding diversity to the food supply and allowing government resources to be invested in more specialized industries. The main challenges for local production of vegetables in Iceland are competitive, as prices are considerably lower on imported vegetables (Erla Sturludóttir et al., 2018). However, domestic agriculture can still be an asset for countries that no longer rely on it for their food supply. In the case of Iceland, agriculture, and more specifically horticulture, has a myriad of benefits that warrant its continuation and support, including promoting sustainability, increasing food security, and benefiting consumers. Yet, the benefits of greenhouse agriculture also come at a cost (Bailes and Oddur Jóhannsson, 2011) with the main challenges being salary costs and high prices of electricity for lighting during the dark winter months (Erla Sturludóttir et al., 2018).

Most of the agricultural lands (66%) are in the south of Iceland followed by the capital area, west- and north-east Iceland (Erla Sturludóttir, 2018). Because of the geothermal heat used for greenhouses, production is greatly related to geothermal areas like the south and east. These areas are, at the same time, vulnerable because of volcanic activities which can affect yields by causing short term climatic change, flooding, acidic rain and ash fall. In the long run however, ash can have beneficial effects on the soil, adding valuable nutrients and improving the soil composition (Ng'ang'ga, 2018). In 2010, due to the eruption in the glacier Eyjafjallajökull, areas got flooded because of glacier melt water, croplands were blanketed with tephra and severely damaged. Livestock farmers lost cattle due to respiratory problems resulting from poisonous smoke and ash inhalation. It makes Iceland still more vulnerable in terms of food security (Butrico and Kaplan, 2018).

Given Iceland's sparse arable land and harsh climate, greenhouses provide the opportunity for more variety in crops, longer growing seasons and greater yields than could be achieved by traditional methods. Iceland already possesses and produces most of the resources needed for greenhouse operation and food produced this way is significantly less energy-intensive than their imported equivalents (Þórhildur Ósk Halldórsdóttir and Nicholas, 2016).

A brief history of horticulture in Iceland

Icelandic food culture is based on the knowledge of inhabitants and their adaptations to the local nature and weather conditions. Since the time of settlement, the food culture has evolved with the arrival of new food crops for growing, innovation in agriculture and increased foreign trade (Matarauður Íslands, 2021). In previous centuries, a monotonous diet of milk, meat and fish was supplemented with what people harvested in nature such as Icelandic moss, red dulse, roots of garden angelica, dooryard dock and scurvy-grass.

In the early 19th century, gardening grew in popularity. The state encouraged the establishment of vegetable gardens and the Danish agriculture society donated seeds to the first gardeners. Around that time potatoes and swedes got very popular and was a great food supplement for the country (Jónas Jónsson, n.d.). In 1880, the first agricultural school was established. New skills, methods of production and technology were taught. The Icelandic horticultural society was founded in 1885. The establishment was an important component in the fight for improved health and reduction in child death through improvements in dietary health (Garðyrkjufélag Íslands, 2016). The major limiting factor for outdoor cultivation is environmental conditions but low temperatures are moderated using geothermal water. Geothermal water has been used for centuries to prolong growing seasons for outdoor crop such as potatoes and grain by naturally warming the soil. In 1924, the first greenhouse was established in Mosfellsbær (Matarauður Íslands, 2021), marking the beginning of horticulture and vegetable production as an industry.

Organic farming has been practiced since 1930 when Sesselja Sigmundsdóttir started such production at Sólheimar in Grímsnes and was first in the Nordic countries to consciously pursue this practice (Sólheimar, 2021). In the beginning of the 20th century the first experimental plant stations and nurseries were established. With increased knowledge, vegetable gardens became the norm in most homesteads (Jónas Jónsson n.d.). As the share of external imports grew and dependence on domestic food produce decreased, gardening practices somewhat declined faced with competitive challenges such as better growing conditions and lower prices in other parts of the world. Imports are important to ensure food diversity but today environmental challenges, and the ever-growing threat of epidemics and economic crises increase importance of self-sufficiency with regards to food security. Emphasis has been put on an increased share of domestic food production along with raised governmental awareness and increased investments in domestic vegetable and fruit cultivation. Increased public environmental awareness has also led to a raised interest in growing food at home, foraging and buying local food. A recent report done at the request of the Minister of Fisheries and Agriculture (Erla Sturludóttir et al., 2021) shows that Icelandic food production has grown in recent years, supplying Icelanders with most

of the food they need, especially with regards to meat and dairy products. The main crops have been hay, potatoes and other root vegetables with other crops such as barley and oats on a rise in the last 10 years and only a very small amount of suitable land being cultivated (Ministry for the Environment of Iceland and Natural Resources, 2018). Vegetables and flowers are mainly cultivated in greenhouses dependent on geothermal water and electricity. New technology for high-tech indoor agriculture with vertical farming and LED lighting are on a rise, promoting a variety of sustainable and environmental-friendly crops (Vaxa, 2021). In 2017, 118 thousand square meters of land was used for vegetable production in greenhouses (Orkustofnun, 2017). In the year 2020 alone an addition of over 10.000 square meter production capacity for tomatoes, cucumbers and lettuce shows ambition amongst Icelandic farmers. According to the chairman of the Farmers Association (Gunnar Þorgeirsson, 2020) there are great potentials in vegetable farming in Iceland. Apart from the rise in vegetable production in greenhouses there are great opportunities in outdoor vegetable cultivation with a variety of species being able to grow in Iceland, mentioning for example onions and radishes which are imported in large amounts. A recent report (Erla Sturludóttir et al., 2021) shows that resources, such as land for cultivation, knowledge and equipment are the main limiting factors with regards to food security. Domestic food supply is also very dependent on imports of fuel and fertilizer. Nevertheless, there are great opportunities in increasing the share of horticulture, through a better utilization of resources, knowledge building, land management and governmental support.

Community farming

The natural environment provides basic needs such as clean air, water and heat. Ecosystem services are the benefits that the ecosystems in our environment generate for our society. In an urban environment, these services are generally under high pressure caused by the dense population and the decline of biodiversity. The result has been a great demand placed on the ecosystem services of the areas surrounding the city and ever-increasing dilemmas regarding disposal of waste and pollution. One of the main goals of any new development must be to decrease or eliminate negative impacts on the local and surrounding ecosystems. Small-scale farming supports biodiversity and can come in exchange for common grass areas in urban environments.

Urban farming has been practiced in Reykjavík for a long time. In the early days of urbanization in Reykjavík, citizens were eager to rent a growing spot in the outskirts of the city with a focus on growing potatoes, swedes and cabbage. By the mid 20th century citizens of Reykjavík grew a fourth share of all potatoes grown in Iceland and despite large growing areas, demand exceeded availability (Eggert Þór Bernharðsson, 2014). As the city expanded, it came at a cost for these large growing areas. Nevertheless,

it remained popular throughout the 20th century to rent a spot for growing potatoes, so called potato-gardens (*kartöflugarðar*). School-gardens (*skólagarðar*) were popular throughout the last century, aiming not only to teach children about growing methods, but also to keep them connected to the farmland in times of urbanization (Eggert Þór Bernharðsson, 2014). Today some people still rent a spot from the city to grow their own vegetables. These gardens have made a return in the city center, but at a smaller scale, referred to as either school-gardens or family-gardens (*fjölskyldugarðar*). A typical garden consists of two small growing beds, one with potatoes and one with a variety of other vegetables and herbs.

In addition, people grow spices, herbs and vegetables in backdoor gardens and greenhouses and keep shrubs for berries. Some garden owners also have the space and opportunity to keep chickens for eggs and bees for honey (Dagný Land Design, 2018). Producing your own food is an encouragement to spend more time in activity outside and promotes awareness about food and consumption.

Food crops such as vegetables or edible plants can be grown; outdoors, indoors or in greenhouses; in different settings such as in roof gardens, terraces, private backdoor gardens and in public spaces. Plants can grow underground, on the ground, on vertical or horizontal structures.

Organic waste and compost is part of the circularity of farming. Most organic material from the household or garden can be composted and used in soil improvement. Management of water and nutrient systems is an important factor in evolved farming methods.

Community farming is a practice where the inhabitants share responsibility for the management and upkeep of the communal garden. As an arena for learning about gardening for both young and old through the exchange of knowledge and experience, community farming can improve communication and encourage social inclusion within the neighborhood. Schools and kindergartens can benefit from using gardens for teaching and practical learning.

There have been some small-scale community garden projects in Iceland for example Seljagarðar (https://seljagardur.is/), Sólgarðar (https://www.facebook.com/solgardarborgarbuskapurreykjavik/) and Gróandi in Ísafjörður (https://m.facebook.com/groandi/). Reykjavík City has published a brochure "Borgarbúskapur. Forsendur, fyrirkomulag og útfærslur" with conditions, arrangement and implementation for urban farming in Iceland (Dagny Land Design, 2018).

Community supported agriculture is also a collaboration where the responsibility for the crops is shared, but the members do not necessarily take an active part in the work. The consumers pay an advance for a share in the production and thereby the cooperatives can strengthen the production and the quality of the harvest as well as ensure a more sustainable and organic agriculture according to consumer wishes (Aronsen and Devik, 2021).

Local production and distribution

Vegetables grown, both outdoors and in greenhouses, account for about 5% of the total food supply of daily calories consumed in Iceland of which about 40% are grown in Iceland (Þórhildur Ósk Halldórsdóttir and Nicholas, 2016). Industrial importance of gardening in Iceland is considered profitable in terms of economic and environmental impacts in the Icelandic context (Vífill Karlsson, 2019). The total share of gardening in agricultural practices (including aquaculture) was around 8% in 2017, with a total income ranging from 4,2 billion ISK in 2008 to 6,1 billion ISK in 2017. Among the most common domestically grown food products in Iceland are tomatoes, cucumbers, lettuce, peppers and strawberries (in greenhouses) and potatoes, swedes, carrots, cauliflower, cabbage, Chinese cabbage and broccoli (outdoors). In addition, many common herbs are grown both indoors and outdoors. As shown in figure 1, vegetables and mushrooms account for 74% market share of domestically grown products, other crops such as herbs, fruits, grain and industrial crops account for 6% with the rest being propagation (5%) and flower production (15%) (Vífill Karlsson, 2019).

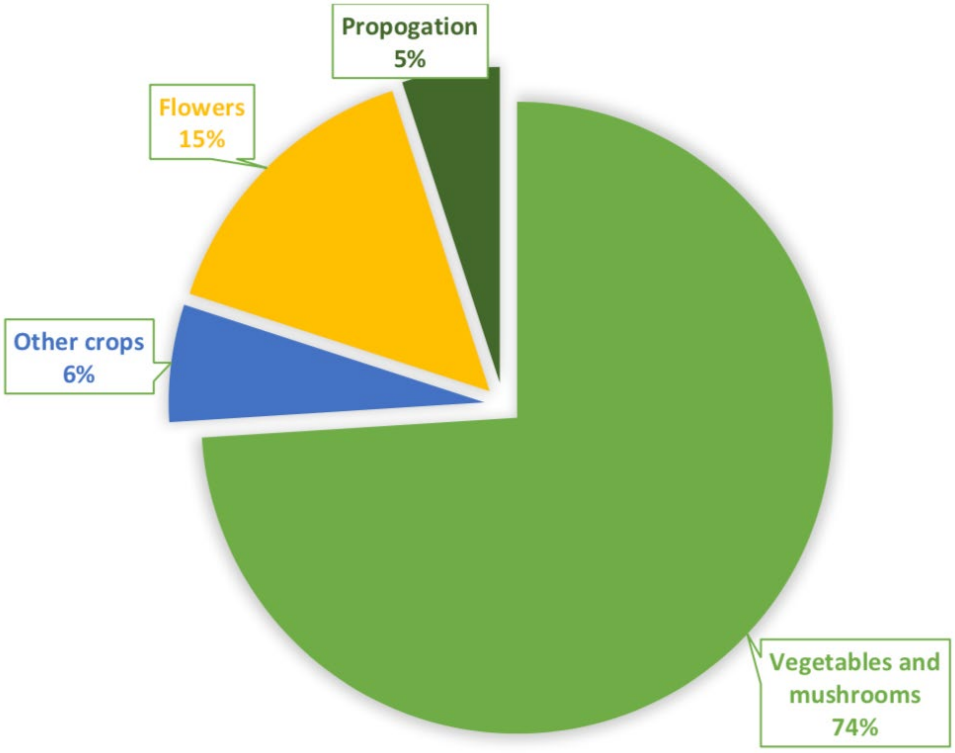

Figure 1: Market share of different gardening activites in 2017. Based on picture from Vífill Karlsson (2019).

Production in greenhouses has doubled since the year 2000 with tomatoes and cumbers accounting for the majority, production of carrots and swedes has grown in the last 20 years but potato production has remained the same for the last decades and the share of cabbage and cauliflower decreasing considerably for the last 10 years, with broccoli as an exception (Erla Sturludóttir et al., 2021). The reason is linked to increased competition with imported vegetables offering lower prices and a greater variety, along with some unfavourable years with regards to weather conditions in Iceland.

Even though domestic cultivation is environmentally and economically advantageous compared to imported vegetables, imports of vegetables in Iceland have exceeded six thousand tons for many years. Data supports the general presumption and political issue that these numbers could be lowered by growing more food in Iceland (Arnór Snæbjörnsson et al., 2010), (Þórhildur Ósk Halldórsdóttir and Nicholas, 2016). The carbon footprint for local Icelandic production is significantly lower than for imported vegetables (Eymundur Sigurðsson, 2015). However, given the limited range of crop cultivation this would come at a cost on current diversity of fruits and vegetables (Þórhildur Ósk Halldórsdóttir and Nicholas, 2016).

Geothermal water is essential for local food production and local food security in Iceland. It has been utilized for horticultural practices for centuries to prolong growing seasons for outdoor crop as well as growing vegetables and nurturing tree saplings under controlled conditions in greenhouses. Because of Iceland's harsh growing conditions, it is difficult to rely on production growth for outdoor crops in the same way as we have been seeing for cucumbers and tomatoes, which account for majority of greenhouse yields with a constant growth in production (Butrico and Kaplan, 2018). Modern greenhouse technology makes it possible to grow almost everything in Iceland from lettuce and peppers to bananas, melon and grapevines, though some plants require more intense care or costly treatment and harvesting. The idea of a sustainable, authentic food experience, eating bananas grown in Iceland or enjoying a cup of Icelandic coffee directly from the tree in a greenhouse-café is sure to be competitive amongst a growing number of tourist and people willing to pay for the quality and the consciousness of where the food comes from (Guðríður Helgadóttir, 2017).

Plants

Various Icelandic vegetables are well established on the market today. The Icelandic Veggie Calendar (figure 2) gives an excellent overview of grown Icelandic vegetables on the market (The Horticulturists' Sales Company). In addition, other well-known edible plants are grown and/or grow wild in Iceland. Grain is widely grown outdoors and continuous research aims to find hardy cultivars of different cereals for Icelandic conditions (see also korn.is) (Hrannar Smári Hilmarsson et al., 2019).

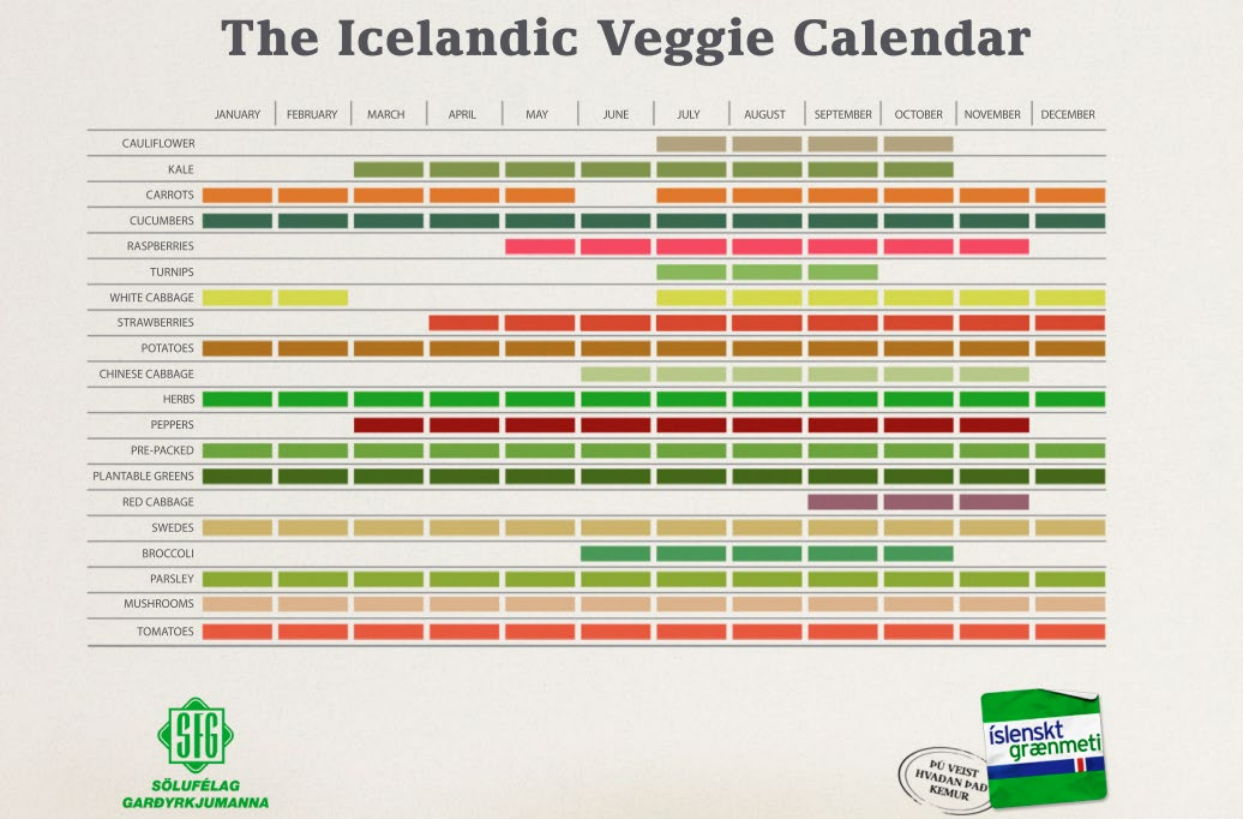

Figure 2: Overview of Icelandic production from the Horticulturists' Sales Company website (www.islenskt.is)

Various fruits (such as apple, pear, cherries and plums) have gained more attention amongst garden owners and some growers along with speculations of better tolerance due to global warming – although much more probation is needed before we can rely on such fruit crops in the Icelandic climate. Amongst passionate horticulturalists, farmers, institutions, gardeners, and other enthusiasts, many edible and usable plants such as vegetables, berries, fruits, cereals, and perennials have been tried out for cultivation. Newly successful examples include melons grown in greenhouses at the Agricultural

University (Magnús Hlynur Hreiðarsson, 2019) and garlic on a big scale at a farm in South Iceland (Sigurður Már Harðarson, 2020).

Making use of some edible garden- and landscape plants along with wild-growing berries and herbs grown in private gardens is a longstanding tradition in Iceland to add diversity to the diet as well as for medicinal purposes. The most commonly used garden plants are red and black currant and rhubarb. Various other garden- and landscape plants with potential edible values thrive well in Iceland, as well as decorative plants in the urban context. Berry production is limited to strawberries and raspberries (in greenhouses), but honeyberries have great potential for outdoor production in Iceland.

Foraging and use of wild growing plants have long been part of the Icelandic culture. The use of crowberries, bilberries and Iceland moss is still the most popular. In fact, foraging (most commonly berries) is part of Icelandic culture and upbringing (*að fara í berjamó*). Use of sea-weed, dulse and coastal plants was widespread before, often being a vital source of vitamin C in times of self-sufficiency. Today more attention is given to these practices due to the sustainability goals and increased awareness of environmental and health issues. Examples can be found in the book *ætigarðurinn* (Edible garden) (Hildur Hákonardóttir, 2006) and the innovation project Arfistinn (wordplay meaning someone enthusiastic for weeds; a weeder) (Ásta Þórisdóttir, 2019).

The plant list provided (appendix I) holds information for some commonly used edible plants, all suitable for Icelandic conditions as well as some examples of promising newcomers. As mentioned, imagination is the main limiting factor for what you can grow with modern technology, so the list is far from being a complete list. There are countless other edible plants and possibilities in Iceland. Nevertheless, it provides a good overview showing conditions, known values, uses and examples of well-adapted cultivars for a variety of different edible plants (vegetables, cereals, fruits, berries, trees, shrubs, perennials, annuals and wild flora).

Geothermal energy

Iceland offers a wide variety of sustainable energy sources, among them geothermal energy, which has a long and vital history for local food production and local food security in Iceland. Warm water has been used through centuries for bathing, washing and sustainable heating and electricity. The natural washing springs in Laugardalur played an important role in the urbanisation process of Reykjavík City (Reykjavík City Museum); heavy loads of clothes were washed and sterilized, people and animals bathed, children learned to swim and vegetables were grown in a small heated house. In Laugardalur

and elsewhere the warm water was used in food production, for cooking, mostly fish and potatoes, baking bread and producing a type of whey-cheese.

In greenhouses, it is common to use inert growing media like volcanic scoria and rhyolite on concrete floors with individual plant watering. Geothermal steam is commonly used to boil and disinfect the soil. Outdoor growing at several locations has been enhanced by soil heating that enables growers to thaw the soil so vegetables can be brought to market during early spring. Soil heating is not a growing application, partly because similar results are commonly obtained at a lower cost by covering the plants with plastic sheets. However, it is estimated that about 120,000 m^2 of fields are heated this way. One of Iceland's oldest and most important usages of geothermal energy is for heating greenhouses. The total geothermal energy used in Iceland's greenhouse sector is estimated to be 740 TJ per year (Árni Ragnarsson, 2003).

Hydroponic systems to manage water and soil

Many greenhouses in Iceland are hydroponic. Vegetables grown in such systems require less water than open field counterparts. This is because water is used more efficiently in hydroponic systems, reducing loss from evaporation and the recycling of water not used by the plants. The renewable and plentiful nature of Iceland’s water supply contributes to the self-sufficiency and environmentally friendly nature of the horticulture industry (Barbosa et al., 2015).

Furthermore, advances in greenhouse technology such as automatic watering systems and precise temperature control allow for a greater variety and quantity of crops than could ever be achieved outdoors in Iceland’s climate. Automatic watering technology is regulated by a computerized system. Factors controlled include soil saturation and watering times, automatically pumping water to plants when needed through a tubing network.

Due to persistent erosion, topsoil can be a scarce resource in Iceland. The switch to hydroponic technology substantially decreases the need for soil. Hydroponic plants grow in an inert medium, such as clay, gravel, and mineral wool, while minerals and fertilizers are supplied with the water. Stone wool is a man-made mineral fibre that is used by many hydroponics farmers because it is inexpensive and reusable. However, many farmers use or supplement stone wool with locally sourced pumice, which is available in abundance for the industry to source domestically and sustainably.

Electricity

Greenhouses require electricity to operate, and electricity demands include ventilation, watering, backup heating, and computer processing. During the winter months, artificial lights are used around 17 hours a day, while in summer months, thanks to natural sunlight, the lights will be off. The electricity consumption in agriculture accounted for only one percent of all electricity consumed in Iceland.

Due to the increased use of electric lighting, the use of geothermal energy has decreased as the lights also give heat. Such increasing of artificial lights in recent years has extended the growing season and improved greenhouse utilization. This development has been encouraged through governmental subsidies spent on electricity for lighting.

Light pollution

In Northern countries, the negative consequences of light pollution are mainly recognised as not being able to see the stars and northern lights. However, light pollution can have serious consequences for human health, flora, and fauna. Among some of its negative effects we could mention:

Disorienting migratory birds.
Altering some nocturnal animals' life that may use the darkness to hunt.
Throwing off human circadian rhythm (24-hour clock sleep/wake cycle), causing obesity, diabetes, and heart disease.

Furthermore, nocturnal light from greenhouses can interfere with nearby airport operations, and negatively impact light-sensitive crops in adjacent greenhouse facilities. The only practical way to prevent reflected supplemental light from greenhouses is to physically block it, and that is by using horizontal, retractable curtains installed at gutter height (or otherwise above the light fixtures). It should also be utilized along the greenhouse sidewalls to block light from all directions. These can be expensive to install but are typically much less expensive when designed into a new structure rather than added to an existing one. Therefore, if it is included in the design process, a retrofit will be easier and less costly. Furthermore, the blackout curtain can substantially reduce heat loss at night during the winter (Runkle, 2019).

The blackout curtains are typically single-layer screens with reflective upper and lower sides. The upper side of the screen helps reflect sunlight, preventing heat build-up if the screen needs to be used during daylight hours. The screen's lower side is always white, to reflect the light from the lamps back towards

the crop, increasing the light intensity within the greenhouse. This three-to-five-percent increase in light can positively impact crop growth and yield. The closed structure of the screen provides greenhouse energy savings by retaining the heated air beneath it. The screen's humidity transport properties are also essential, a knitted structure, can allow humidity to pass through. To avoid the fire hazards, it is important to ensure that the screen is installed far enough from the lights.

Concluding remarks

Despite being a volcanically active island on northern latitudes, in the middle of the Atlantic Ocean, posed with challenges such as unpredictable and harsh weather conditions, restricted growing seasons and reliance on external supplies for agriculture; Iceland has comparative advantages and potential regarding food production.

There is an abundance of water and available land for cultivation; the main limiting factors for food production worldwide. Considerable advantages for horticulture such as few insect pests, long hours of daylight for parts of the year and plenty of hydropower and thermal heat are also present. Being a highly-educated country (World population review, 2021), there is potential for tapping into existing knowledge, innovation and experimentation. Iceland´s history of self-reliance has taught inhabitants to make use of existing resources so that modern technology paired with knowledge could provide countless opportunities in gardening practices and food production. Urban farming is receiving increased awareness worldwide in combination with environmental and communal issues. The issues that have been addressed in this report show that there is no reason not to follow these trends in Iceland.

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Appendix I:
Plant list for edible plants

Steinunn Garðarsdóttir

The plant list provides an overview of plants grown in Iceland with edible values, showing growing conditions, known values and potentials. The list contains information for some commonly used edible plants, all suitable for Icelandic conditions as well as some examples of promising newcomers. In fact, imagination is the main limiting factor for what you can grow with modern technology thus we are not providing a complete list and there are many other edible plants and possibilities in Iceland.

Vegetables and herbs

Vegetables are grown both outdoors and indoors. Limiting factor for outdoor yields are environmental conditions but geothermal water has made up for some of them. Modern greenhouse technology makes it possible to grow so to say everything in Iceland and various Icelandic vegetables are well established on the market with others being grown and well known or experimented with by horticulturalists, passionate farmers or institutions and other growers and enthusiasts. Sowing phase often takes place in greenhouses.

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G = good
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				Growing conditions in Iceland					Known values in Iceland				
Common name	Latin name	Icelandic name	Some known or recommended cultivars for Icelandic conditions	outdoor	greenhouses	vertical farming/gardening	rooftop / container farming	for landscaping	edible value	common knowledge on values	well known on the market	commercial potential	Comments and other uses
Potatoes	*Solanum tuberosum*	Kartöflur	'Annabelle', 'Belana', 'Gullauga', 'Helga', 'Premiere', 'Rauðar íslenskar'	VG					VG	VG	VG	VG	
Swedes	*Brassica napus*	Gulrófa	Maríubakkarófa (Kálfafellsrófa), Sandvíkurrófa, 'Vige', 'Vigod'	VG					VG	VG	VG	G	
Rhubarb	*Rheum rhabarbarum*	Rabbabari		VG				M	G	VG	L	L	
Carrots	*Daucus carota*	Gulrætur	'Napoli', 'Namdal', 'Romance'	G			G		VG	VG	VG	VG	Stems and leaves also edible
Tomatoes	*Solanum lycopersicum*	Tómatar	Different culitvars and varieties		VG				VG	VG	VG	VG	
Peppers	*Capsicum annuum*	Paprika og eldpipar			VG				VG	VG	VG	VG	
Cucumbers	*Cucurbitaceae*	Gúrkur	'Ventura', 'Rapides', 'Cumuli'		VG				VG	VG	VG	VG	
Lettuce	*Lactuca sativa*	Salat	Various	G	VG	VG	G		VG	VG	VG	VG	
Herbs	*Herba*	Kryddjurtir	Various specices	G	VG	G	G	M	VG	VG	VG	VG	
Beet	*Beta vulgaris*	Rauðrófa	'Zeppo'	VG			G		G	G	M	G	Leafs also edible
Chard	*Beta vulgaris var. cicla*	Beðja		VG			G	M	G	M	N	L	
White cabbage	*Brassica oleracea var. alba*	Hvítkál	'Parel', 'Castello'	G					VG	VG	VG	G	
Brussels sprout	*Brassica oleracea var. gemmifera*	Rósakál		G		G			G	G	L	L	
Kohlrabi	*Brassica oleracea var. gongylodes*	Hnúðkál	'Kolibri' (red), 'Konmar' (white)	VG			G		VG	G	G	G	
Broccoli	*Brassica oleracea var. italica*	Spegilkál / brokkolí	'Aquiles', 'Ironman', 'Marathon'	VG			G		VG	G	VG	G	The cultivar "Romanesco' is known as Romanesco broccoli with a shape resembling barnacle
Red cabbage	*Brassica oleracea var. rubra*	Rauðkál		G					VG	VG	G	G	
Savoj cabbage	*Brassica oleracea var. sabauda*	Blöðrukál		G					G	M	L	L	
Kale	*Brassica oleracea var. sabellica*	Grænkál	'Reflex', 'Oldenbor', 'Red bor' (red leafs)	VG		G	VG	M	VG	VG	G	M	Red leaf cultivar great for ornamental values
Turnips	*Brassica rapa*	Næpur		VG			G		G	G	G	M	
Chinese Cabbage	*Brassica rapa var. pekinensis*	Kínakál	'Manoko', 'Bilko'	M					VG	VG	VG	G	
Cauliflower	*Brassico oleracea var. botrytis*	Blómkál	'Arizona', 'Freedom', 'Momentum', 'Fargo'	G			G		VG	VG	VG	VG	
Cerly stalk	*Apium graveolens*	Stilkselleri	'Tall Utah'	G			G		G	VG	VG	G	
Radish	*Raphanus sativus*	Hreðka / radísa		VG					G	M	L	L	
Pea	*Pisum sativum*	Ertur		G			G	M	VG	L	L	L	
Broad bean	*Vicia faba*	Bóndabaunir		G			G	M	VG	M	L	L	
Asparagus	*Aspargus*	Spergill		G					G	G	L	L	
Muskmelon	*Cucumis melo*	Melónur			G				VG	VG	N	T	Trials by the AUI at Reykir
Alliums													
Garlic	*Allium sativum*	Hvítlaukur		G			G		VG	VG	T	VG	Trials by Hörður Bender at Efri Úlfsstaðir in Landeyjar
Chives	*Allium schoenoprasum*	Graslaukur		VG			G	G	G	G	L	L	
Onion	*Allium cepa*	Matlaukur	Early-sprouted varieties of yellow and red onion	G			VG		VG	VG	L	L	Needs a warm, sheltered spot. Leaves also delicious.
Wild leek	*Allium ampeloprasum var. porrum*	Blaðlaukur / púrra	'Autmumn Mammoth' (snowstar), 'Musselburg'	G			G		VG	VG	L	M	

Grain / cereal crop

Grain is widely grown outdoors and continuous researches aims to find hardy cultivars of different grain products for Icelandic conditions. Needs space and harvesting equipment. However, can have an educational role and possibly suitable as a roof top framing crop and sutable as cover crop.
Many ongoing trials by the AUI and various farmers (e.g. Sandhóll, Þorvaldseyri and Vallanes).

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Common name	Latin name	Icelandic name	Some known or recommended cultivars for Icelandic conditions	Growing conditions in Iceland: outdoor	greenhouses	vertical farming/gardening	rooftop / container farming	for landscaping	Known values in Iceland: edible value	common knowledge on values	well known on the market	commercial potential	Comments and other uses
Barley	*Hordeum vulgare L.*	Bygg	'Kría', 'Smyrill', 'Brage', 'Aukusti', 'Kannas' and others	G			G	G	G	M	M	G	Brewery, cover crop, substrate for growing mushrooms (straw), fodder production
Oats	*Avena sativa L.*	Hafrar	'Cilla', 'Perttu'	G			G	G	G	G	M	G	Cover crop, fodder production
Winter Wheat	*Triticum aestivum L.*	Vetrarhveiti	'Magnifik'	T			G	G	G	?	L	L	Cover crop, fodder production
Rye	*Secale cereale L.*	Vetrarrúgur	'Reetta'	T				G	G	L	L	M	Brewery, cover crop, fodder production
Quinoa	*Chenopodium quinoa*	Inkakorn		T					G	L	N	N	

Oil and energy crop

Rapeseed	*Brassica napus L. var. olifeira*	Repja	'Galileo'	M				M	M	M	M	G	Oil and bioenergy, fodder production
Turnip rape seed	*Brassica rapa L. var. olifeira DC*	Nepja	'Cordelia'	M				M	M	M	M	G	Oil and bioenergy, fodder production
Hemp	*Cannabis sativa*	Hampur	'Finola'	M					M	M	M	L	Seeds for health oil and stems as fibers for various uses
Sunflower	*Helianthus*	Sólblóm		M			G	G	M	M	M	L	Various uses

Mushrooms

Low tech mushroom farming is great for reliable local production. They can be grown indoors in sustainable substrate such as barley straw and coffeground and are not dependent on light. Until recently there was no tradition of foraging of wild mushrooms in Iceland. Potentials are great, the species abundance is still rather low and the poisonous ones are well documented.

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Cultivated mushrooms	*Boletus cultis*	Ræktaðir sveppir				VG			VG	VG	VG	VG	Not dependent on light
Wild growing mushrooms	*Boletus*	Villtir sveppir		VG					G	M	L	M	Beneficial to plants

Fruit trees

Fruit production is not suitable for Icelandic weather conditions while there have been some experiments and few blooming fruit trees ripening fruits in sheltered gardens. Domestically grown fruits in greenhouses (such as bananas) are not able to compete on the market. Experiments, with some rate of success are made by privat growers and the horticultural society of Iceland along with the AUI. Trials by Jón Guðmundsson at Miðvogur nursery with some good results.

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Bananas	*Musa*	Bananar			T				VG	VG	N	L	Trials by the AUI at Reykir
Fig	*Ficus carica*	Fíkjur			T				VG	VG	N	L	Trials by the AUI at Reykir
Apples	*Malus*	Epli		T		M		G	VG	VG	N	N	Flowers can tolerate light frost. Attract bees
Sweet and sour cherry	*Prunus avium and prunus cerasus*	Sætkirsi og súrkirsi		T	T			G	G	G	N	L	
Pears	*Pyrus*	Perur		T		M		G	VG	VG	N	N	
Plums	*Prunus subg.*	Plómur	'Herman', 'Edda'	T		M		G	G	G	N	N	Flowers do not tolerate frost
Grapes	*Vitis vinifera*	Vínber			T	G	L		VG	VG	N	L	

Trees, shrubs and berries

Shrubs with edible berries have long been utilized in Iceland though mostly limited to currants and gooseberries. There are various other garden- and landscape plants with potential edible values that thrive well in Iceland, while at the same time being great for landscaping. Berry production is limited to strawberries and raspberries (in greenhouses) but honeyberries have great potentials for outdoor production in Iceland.
Trials are undertaken by the AUI and the project Yndisgróður, garden- and landscape plants for Icelandic conditions.

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Common name	Latin name	Icelandic name	Some known or recommended cultivars for Icelandic conditions	Growing conditions in Iceland: Outdoor	Greenhouses	Vertical farming/gardening	Rooftop / container farming	For landscaping	Known values in Iceland: Edible value	Common knowledge on values	Well known on the market	Commercial potential	Comments and other uses
Strawberries	*Fragaria x ananassa*	Jaðarber	'Glima', 'Jonsok', 'Zephyr', 'Korona', 'Bounty'	M	VG	G	G	L	VG	VG	VG	VG	
Raspberries	*Rubus idaeus*	Hindber	'Balder', 'Borgund'	G	VG			L	VG	VG	M	G	
Honeyberries	*Lonicera Caerulea*	Hunangsberjatoppu		T				G	VG	L	T	VG	Trials by the AUI
Juneberries	*Amelanchier*	Hlíðaramall		G				G	G	L	L	M	
Silverberry	*Elaeagnus commutata*	Silfurblað		G				VG	L	N	N	N	Companion plant, nitrogen fixer, soap
Mountain currant	*Ribes alpinum*	Fjallarifs	'Dima', 'Skessa' and others	VG				VG	L	L	N	N	
White-Flowerd Currant, Trailing black currant	*Ribes laxiflorum*	Hélurifs	'Rökkva', 'Pón', 'Lukka'	VG		M		VG	G	L	N	N	
Blackcurrant	*Ribes nigrum*	Sólber	'Jänkisjärvi', 'Melalahti', 'Nikkala XI', 'Polar', 'Storklas', 'Sunderbyn II' 'Öjebyn', 'Kristinn'	VG				G	VG	VG	M	L	
Redcurrant	*Ribes rubrum*	Rifsber	Rauð hollensk, Hvít hollensk, 'Jonkheer van Tets'	VG				G	VG	VG	M	L	
Gooseberry	*Ribes uva-crispa*	Stikilsber	'Hinnomäki', 'Hinomaen', 'K.F.Packalen', 'Pellervo', 'Lepaan Punainen', 'Black velvet'	VG				G	G	VG	M	L	
Stink currant	*Ribes bracteosum*	Blárifs	'Perla'	G				VG	M	L	N	N	
Squashberry	*Viburnum edule*	Bersarunni		VG				VG	G	L	N	N	
Sea-buckthorn	*Hippophae rhamnoides*	Hafþyrnir	'Hallargarður', 'Tytti', 'Terhi', 'Tarmo'	VG				VG	G	L	M	L	Well adapted to the sea side
Balck chokeberry	*Aronia*	Logalauf	'Telemark', 'Nero', 'Aron', 'Viking'	M				VG	G	L	N	N	Great autumn colors
Kolomikta	*Actinidia*	Kattaflétta	'Anna'	M		G		VG	G	N	N	N	Climber
Roses	*Rosa*	Rósir	Meyjarrósir *R. Moyesii* , igulrósir *R. Rugosa,* hjónarósir *R. Sweginzowii* and other species and cultivars	VG	VG			VG	G	L	N	N	Hips and other parts of the plant are edible, many roses are well adapted to the sea side
Rowan	*Sorbus*	Reyniviður	Mountain-ash (Úlfareynir) *S. Hostii* and other different species and cultivars	VG				VG	M	L	N	N	Berries great for decoration
Coffea	*Coffea arabica*	Kaffi			T				VG	VG	N	L	Trials by the AUI at Reykir, has been sold in small portions

Perennials and annuals

Many perennials and annuals are edible and/or make a great companion with other plants. They are great for beatification and may be beneficial to environmental factors such as soil, pest repelent and pollination.

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Perennials				VG		VG	VG	VG	M	L	N	L	Great for beautification, landscaping and biodiversity. Trials by AUI/Yndisgróður
Plantain lilies	*Hosta*	Brúskur		VG		VG	M	VG	G	L	N	N	
Leopard plants	*Ligularia*	Skildir / skjaldmeyjarblóm		VG			M	VG	M	L	N	N	
Bigroot Geranium	*Geranium macorrhizum*	Ilmgresi		VG				VG	M	N	N	N	
and many others													
Annuals				VG			VG	VG	M	L	N	N	Great for beautification, companion plants and biodiversity
Pot marigold	*Calendula officinalis*	Morgunfrú		VG			VG	VG	G	M	N	M	Beneficial companion plant, used for cosmetics and medicine
Borage, starflower	*Borago officinalis*	Hjólkróna		VG			VG	VG	G	L	N	N	Beneficial companion plant, vegatable use, seed for health oil
Garden nasturtium	*Tropaeolum majus*	Skjaldflétta		VG		M	VG	VG	G	L	N	N	
Violet	*Viola*	Fjóla		VG			VG	VG	G	L	N	N	
and many others													

Wild flora

Foraging is part of Icelandic culture and the use of plants in the days of self sufficiency was commen as well as use of plants for medicinal pruposes. These practices seem to be gaining more attention due to increased conciousness on environmental and health issues.

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Crowberries	*Empetrum nigrum*	Krækiber		VG				L	G	VG	L	L	Prefer infertile soil
Bilberries / european blueberries	*Vaccinium myrtillus*	Aðalbláber		VG				L	VG	VG	L	M	
Bog bilberries / blueberries	*Vaccinium uliginosum*	Bláber		VG				L	VG	VG	L	M	
Stone bramble	*Rubus saxatilis*	Hrútaber		VG					M	M	N	N	
Wild tyme	*Thymus praecox*	Blóðberg		VG				M	G	G	L	M	Prefer infertile soil
Garden angelica	*Angelica archangelia*	Hvönn		M				L	M	M	N	M	
Dooryard dock	*Rumex longifolius*	Njóli		M					M	L	N	N	Seen as unwanted weed nowadays
Sweet cicely	*Myrrhis odorata*	Spánarkerfill		VG					M	L	N	?	May be invasive
Caraway	*Carum carvi*	Kúmen		G			?	L	VG	G	N	L	
Iceland moss	*Cetraria ialandica*	Fjallagrös		VG					G	G	M	VG	
Scurvy-grass	*Cochlearia officinalis*	Skarfakál		VG					VG	M	N	?	Coastal plant, main/important surce of vitamine C in times of self sufficency
Dulse	*Palmaria palmata*	Söl		VG					VG	G	M	G	
Seaweed	*Alga*	Þang	around 30 species	VG					G	L	L	VG	Fodder, fertilzer, cosmetics, bioplastic and other potentials. Trials by Iceland Ocean Cluster and others

Sources for the plant list: Agricultural University of Iceland, 2021a; 2021b; Arnór Snæbjörnsson et al., 2010; Ásta Þórisdóttir, 2019; Eydís Mary Jónsdóttir, 2011; Hildur Hákonardóttir, 2006; The Horticulturists' Sales Company; Hrannar Smári Hilmarsson et al., 2019; Hraundís Guðmundsdóttir, 2013; Jóhanna Þ. Guðmundsdóttir, 2010; Guðríður Helgadóttir, 2020; 2017; 2016; Jón Guðmundsson, 2014; Lilja Karlsdóttir, 1990; Matarauður Íslands, 2021; Ræktunarstöð Reykjavíkur; Sjávarklasinn, 2010; Svanhvít Lilja Ingólfsdóttir, 2007; Vífill Karlsson, 2019; Vilmundur Hansen, 2017; 2012; Þórhildur Ósk Halldórsdóttir and Nicholas, K. A., 2016 and Þóroddur Sveinsson, 2020.