The role of nut crops in achieving long term food security in Ireland

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The Sustainability Institute

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The Sustainability Institute
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Introduction - the looming food crisis

Ireland imports in excess of 50 percent of the food that its population eats, and a significant proportion of all animal feed. In addition, almost all food eaten is produced and processed using intensive, fossil fuel-based methods. This will all soon change. In the post fossil fuel era, Ireland will be obliged to produce the greater part of its domestic food needs, and will have to do so without the convenience of heavy fossil fuel inputs at all stages of production.

The transition to low-energy input, organic systems of agriculture can be expected to take anything up to 12 years to complete. In Cuba during the Special Period, when the population faced famine, it still took about eight years to reconfigure agriculture and ramp up food production to a level capable of meeting the dietary requirements of the whole population. During this period, the population suffered serious deprivations, including widespread malnutrition and related illnesses.

Cuba had little or no warning that crude oil, machinery and food supplies from the Soviet Union were about to end, so preparations were minimal. However, one mitigating factor was Cuba's tropical climate, which enabled multiple crops to be grown in the same calender year.

To date, discussions on future food security in Ireland have tended to focus primarily on grain production. This is not surprising give the historical role of grain in feeding the population of North West Europe prior to the arrival of the potato from South America in the 1600s. The subsequent success of the potato owed much to its ability to perform well on poor land, and its lower vulnerability to the wet cool summers that historically had often led to the failure of the grain crop.

The supremacy of the potato ended in the mid 1840s, when potato blight decimated crops, leading to widespread famine in Ireland and elsewhere. Since then, potato blight has demonstrated great ability to evolve in tandem with the development of more disease resistant varieties, and presents an undeterminable, though probably moderately high risk to future crops. This risk notwithstanding, the potato still provides opportunities to grow large quantities of food on a relatively small area. It should be noted that grain crops are also vulnerable to diseases, and that the incidence of these diseases is currently on the increase.

In addition to grain and potatoes, a number of other tillage crops may also make a significant contribution to national food requirements. These crops include turnips, swedes, carrots, parsnips, peas, beans, onions and squashes. A wide diversity of tillage crops will ensure greater security of food supply.

Of possibly lesser significance but still strategically important are soft fruits, notably blueberries and the various members of the ribes and rubus families (gooseberries, currants, raspberries and blackberries, and hybrids) and tree fruit such as apples, plums, cherries and pears. All these fruit crops have the advantage of not requiring tillage grade land, and are not dependent on any form of mechanisation.

Nuts may also have a role to play in food security. This will be examined in more detail later.

The contribution of livestock or animal products towards meeting national food requirements is likely to fall far below current levels, as contemporary method of livestock farming are extremely dependent on high energy inputs in the form of imported oil, animal feeds, fertilizers and other agro-chemicals. Also, when compared to tillage crops, raising livestock on good land is an extremely inefficient way of converting land into food, as only a small proportion (typically 2-5 percent) of the animal food intake is converted into an utilisable food product. The remainder goes into building non-edible tissue, maintaining essential biological processes, reproduction, or is unutilised.

From a food security perspective, the principal role of animal husbandry will be to provide food outputs on land unsuitable for tillage. This will include low density deployment in woodlands or the seasonal grazing of orchards, as well as low density deployment in upland areas. A further role will be to periodically graze tillage land, thereby recycling nutrients made accessible by fodder crops, and adding diversity to crop rotations.

The difficulty of achieving long term food security in Ireland should not be underestimated. Inadequate preparations will result in widespread food scarcity, comparable or possibly worse than occurred in Cuba during the Special Period. Maintaining high soil fertility levels will present a serious challenge, and will require systematic recycling of nutrients - something not easily achieved in the short to medium term. The cool damp climate in Ireland - with its attendant higher demand for both heating and food, is likely to compound problems of energy and food scarcity.

The role of nuts in achieving food security

From the documentation and archaeological evidence available, it appears nuts have not featured significantly in food security in Ireland during the last millennium. While there is ample evidence that the people of medieval or earlier times ate the common hazelnut (*Corylus avellana*), there appears to be little or no tradition in Ireland of planting nut bearing trees for food purposes. However, from around the time of Cromwell, both the Anglo-Irish ascendancy and various religious orders planted Spanish chestnut (*Castanea sativa*) and walnut (*Juglans regia*) on their landed estates, both for ornamental and timber-producing purposes. In time some of these trees produced viable nuts, albeit not on a regular basis.

Recent anecdotal evidence gathered by the Sustainability Institute suggests there are few if any counties in the island of Ireland not capable of producing both walnuts and chestnuts for food purposes on favourable sites. It is believed that many areas south of a line from Belfast to Sligo and east of a line between Ballina and Skibbereen are capable of producing regular crops of both types of nut, once the appropriate cultivars of the respective trees are established and reach nut bearing age.

One feature of all the older nut trees is that they would have been grown from seed: typically chance selections acquired from Spanish or French sources. Also, historically speaking walnut and chestnut trees were generally planted for their fine timber, not for their nuts. Any nuts that occurred were considered a bonus.

The science of nut growing has moved on considerably in the last one to two hundred years and has followed in the footsteps of earlier developments with fruit trees. It is now common practise to propagate nut trees using techniques such as grafting and layering. This guarantees that new trees will have the characteristics of the parent wood. Desirable characteristics include precociousness (the ability to begin fruiting at an early age), disease resistance, and of course cropping ability.

Across Europe, many distinct cultivars of chestnut and walnut are recognised. Some are widely grown while others may be specific to a single valley. The total number of different chestnut and walnut cultivars grown in Europe is not known but is believed to be between 250 and 500. In France alone there are at least 60 distinct cultivars of chestnut and a further 40 cultivars of walnut. A number of the French cultivars have the potential to produce good crops in Ireland. The likely yields are hard to estimate, but results from trials carried out by the Agroforestry Research Trust in Devon, England give some indication of what to expect.[1]

Cultivars of the common hazelnut, known as cobnuts or filberts, are already known to do well in many parts of Ireland. However, there is no evidence of nuts having ever been grown on a commercial scale anywhere in Ireland and most planting to date has probably been carried out by people unfamiliar with best practices for optimising nut yields. Consequently, estimates of potential future yields are based on yields elsewhere, with allowances made for the different climate and circumstances in Ireland.

In order to more accurately assess the contribution of nut crops (cobnuts, Spanish chestnuts and walnuts) towards future food security in Ireland, a number of different questions must be answered:

Do nut trees compete with other crops for the same ground, and if so how do yields compare?

How many nut trees are needed in order to make a significant contribution to food security?

How long will it take to produce this number of trees from the nut stock available?

How many years from planting does it take for nut trees reach significant levels of nut production?

[1] *Agroforestry Research Trust www.agroforestry.co.uk*

Chestnut, walnut and cobnut yields

Chestnuts

Yield: 10-50kg/tree =10 kg-50kg/100 m²
Yield/ha 1.0-5.0 tonnes
Shelled weight is approx 70 percent of unshelled weight
Calories per kg: ≈1900
Calories per ha @ 2 tonnes (unshelled) yield: ≈ 2.6 million
Equivalent human calorific provision per annum per ha: 2.8 persons @ 2500 calories per day
Other yields: Sheep/hens/pigs/fuel
Energy inputs: 5-8 percent of crop energy value in human labour
Comments: Crop yields in Ireland not confirmed
Problems: Wet windy weather at flowering time (early summer) could lead to very poor crops

Walnuts

Yield:10-75 kg/tree = 10kg-50kg/100 m²
Yield/ha 1.0-5.0 tonnes
Shelled weight is approx 45 percent of unshelled weight
Calories per kg: ≈6200
Calories per ha @ 1.5 tonnes (unshelled): ≈ 4.2 million
Equivalent human calorific provision per annum per ha: 4.6 persons @ 2500 calories per day
Other yields: Sheep/hens/pigs/fuel
Energy inputs: 5-8 percent of crop energy value in human labour
Comments: Crop yields in Ireland not confirmed
Problems: Wet windy weather at flowering time (mid spring) could lead to very poor crops. Trees possibly susceptible to fungal infections

Cobnuts

Yield: 2-5 kg/tree = 2-5 kg/20 m²
Yield/ha 1.0-2.5 tonnes
Shelled weight is approx 45 percent of unshelled weight
Calories per kg: ≈6300
Calories per ha @ 2 tonnes (unshelled): ≈ 5.7 million
Equivalent human calorific provision per annum per ha: 6.2 persons @ 2500 calories per day
Other yields: Sheep/hens/pigs/fuel
Energy inputs: 6-10 percent of crop energy value in human labour
Comments: Crop yields in Ireland not confirmed, but highly likely
Problems: High winds during female flowering (late winter) may result in flower damage, leading to poor crops

Further thoughts on nut yields

The main risks to each of the nuts occur at different times of the year. It is very unlikely all three would have poor crops in the same year. Of the three, cobnuts are the most reliable crop, and will tend to produce a higher food output per given area. However, chestnuts and walnuts will add both variety and greater versatility. Chestnuts and walnuts, being larger trees, may offer more scope for integrating livestock such as pigs, sheep or cows.

The lack of knowledge in relation to specific cultivars of walnut and chestnut in Ireland make them a relatively high risk enterprise. It is vital therefore, that nut tree trials are undertaken at locations throughout Ireland as soon as possible. Modern cultivars begin cropping at five to eight years old, and even earlier in some cases.

The impact of global warming

Global warming brings great uncertainty to future food supplies. There is a high probability that many major global food producing areas will become deficient in water, leading to widespread crop failures. Even in Ireland, there is some evidence that warmer temperatures may lead to reduced summer rainfall in eastern and south eastern counties.

The bigger problem in Ireland however, is more likely to be excessive rain, and the attendant problems of waterlogged ground, inaccessibility and flooding. This is likely to impact significantly on both tillage and livestock farming. In particular, it is highly probable that grazing densities will have to be drastically reduced. Equally, the repeated failure of crops in areas adversely affected by rising precipitation may lead to these areas being abandoned for tillage.

For nut crops, the consequences of global warming induced climate change are less clear. Cobnuts are tolerant of a wide range of climates, and harvesting is not especially dependent on good weather. However, in particularly wet years ripening will be significantly delayed, possibly leading to lower yields.

In the case of both chestnuts and walnuts, increasing precipitation is likely to cause a higher incidence of fungal problems. Areas already marginal for walnut or chestnut production may eventually become unviable. However, it should be noted that the relationship between rainfall and fungal infections in walnuts and chestnuts is not a straightforward linear one and other factors such as soil type, evapo-transpiration potential, and orchard management also play a major role in tree health. In many cases, soil drainage and levels of humidity within the nut orchard may turn out to be more significant than total annual precipitation. The establishment of carefully monitored trial projects would do much to increase understanding of the effect of micro climates on both nut production and tree health.

Calorific yield comparisons with other crops

1/ Wheat and oats on 3 year rotation (organic/sustainable methods of production)

Wheat yield: 2.5-5 tonnes/ha

Calories per kg: 3300

Calories per ha @ 3.25 tonnes ≈ 10.5 million (year one of rotation)

Year 2 of rotation: winter green manure followed by spring oats?

Yield: 2-4 tonnes/ha

Calories per kg: 3800

Calories per ha @ 2.5 tonnes: ≈ 9.5 million

Year 3 of rotation: green manures in combination with livestock grazing

Total plant yield over three years: ≈ 20 million calories.

Average per year: ≈ 6.5 million calories

Equivalent human calorific provision per annum per ha: 7.1 persons @ 2500 calories per day

Other yields: Other yields: Sheep/hens/pigs/cattle

Energy inputs: 10-15 percent of crop energy value if based on manual work and animals.

Comments: Yields presumed to be low compared to those currently achieved with artificial fertilisers

Problems: High risk of heavy crop losses from heavy rainfall events during late summer; difficulty with harvesting and ripening grain during wet weather conditions at harvest time.

2/ Potatoes and vegetables on 4 year rotation (sustainable methods of production)

Potato yield: 15-25 Tonnes/ha

Calories per kg: 770

Calories per ha @ 17.5 tonnes ≈ 13.5 million

Year 2 of rotation: Brassicas

Yield: 5-10 tonnes/ha

Calories per kg: 250

Calories per ha @ 8 tonnes/ha: 2 million

Year 3 of rotation: Mixed vegetables

Yield: 4-10 tonnes

Calories per kg (onions): 300

Calories per ha @ 6 tonnes: 1.8 million

Year 4 of rotation: Red clover

Total plant yield over four years: 17.3 million calories

Average per year: 4.3 million calories

Equivalent human calorific provision per annum per ha: 4.7 persons @ 2500 calories per day

Other yields: Other yields: Sheep/hens/pigs/cattle

Energy inputs: 12-18 percent of crop energy value if based on manual work and animals.

Comments: Yields presumed to be low compared to those achieved with artificial fertilisers.

Problems: High risk of potato blight causing partial or total crop failure in bad years. Wet ground conditions in autumn may lead to difficulties with the harvest. Spacious storage facilities essential.

3/ Apples

Yield: 15-30 tonnes/ha

Calories per kg: 450

Calories per ha @ 18 tonnes/ha: 8.1 million

Equivalent human calorific provision per annum per ha: 8.9 persons @ 2500 calories per day

Other yields: Sheep/hens/pigs

Energy inputs: 8-12 percent of crop energy value in human labour

Comments: Crop yields very variable

Problems: Wet windy weather at flowering time (mid spring) could result in flower damage and poor pollination, leading to poor crops. Extreme weather events may cause the crop to fall prematurely

Further thoughts on crop comparisons

The yield from apples, although impressive, has to be seen in context, namely that a person cannot live on apples alone. The calorific yield per hectare from wheat and oats appears significantly superior to any of the nut crops, even when the fallow year is factored in. From a per-hectare perspective, potatoes and vegetables look to give better calorific yields than chestnuts but possibly worse yields than cobnuts, with walnuts somewhere in between. Potatoes may do well on wetter land unsuitable for Spanish chestnuts or walnuts. On the other hand, nuts can be grown on rocky ground where any form of tillage would be extremely difficult. It can be concluded that nuts and grains or potatoes could occupy different niches within the agriculture sector.

Another consideration is the energy required to grow a given crop. Generally speaking, tillage crops require significantly higher energy inputs than nut crops. The main energy inputs associated with nut crops relate to the actual establishment of the nut trees, on-going tree maintenance, and the harvesting of the crop. Almost all of this work is of a manual nature, with the harvest requiring the lion's share of the annual labour input. Reliance on technology is extremely minimal.

The need to harvest entire fields of grain over very short periods, in order to harvest at the optimum time in terms of weather, grain moisture content and other factors, makes hand harvesting techniques potentially much higher risk. Teams of horses can harvest grain far more quickly than agricultural workers using scythes or sickles. while a tractor can harvest in a few hours the same area that a team of horses would do in a week. A long drawn out harvest increases the risk of adverse weather ruining part of the crop. On the other hand, horses have to be fed, and tractors fuelled and maintained, and add further complexity into the food production chain.

By contrast, nut harvests can be spread over a prolonged period, and may be carried out during short breaks in otherwise poor weather. As is the case wth grain, there are issues with storage, especially if the quantities are large. Most chestnuts have a comparively short storage life, while some cobnuts will store a year or more. Walnuts require a warm but well ventilated covered area in order to ripen properly.

One notable disadvantage shared by all nuts is the absense of a nut growing or nut using culture in contemporary Ireland. Consequently the potential of nuts as a food crop may be seriously underestimated by a society more familiar with grain, potatoes or animal products as staple foods.

Fuel coppicing and hedges

One of the useful by products of nut trees is fuel wood. Annual pruning and maintenance on established nut orchards can be expected to produce in the region of one tonne of fuel grade timber per hectare. This figure includes all branches of greater than 2cm in diameter. Smaller material could be composted and returned to the land. In energy terms the fuel wood yield per hectare would be around 3000 kWh per annum - sufficient to heat a small building.

Although coppicing is often practiced on both hazel and Spanish chestnut, such practices will tend to significantly reduce nut production. Coppicing produces multitudes of long poles useful for building purposes or firewood, but the congested nature of the coppiced tree is not condusive to nut production. In the case of cobnuts, nut yields per coppiced tree may be as little as one tenth that of a well trained tree in an orchard situation.

Cobnuts may also be grown in hedges, although here the nut yields will also be very low compared to trees grown in open situations. One exception might be on very exposed sites, where the hedge-grown trees may have the advantage.

Animal grazing

Low density livestock regimes are entirely appropriate for nut orchards, providing care is taken that the animals do not damage the trees. Livestock options include pigs, hens, sheep or small breeds of cow. Management plans will vary according to the type of livestock. Pigs for example may be best grazed for periods of short duration immediately following the nut harvest. In the case of chestnuts or walnuts they can be used to clean up harvest debris. Sheep and cows could be grazed intermittantly between the end of the harvest period and the start of the new growing season, with care being taken to avoid overgrazing. The sustainable level of grazing in nut orchards will vary widely but in all cases is likely to considerably exceed the sustainable grazing density in an equivalent area of mountain or bog (usually given as 0.5-1.5 sheep/0.08-0.25 cows per ha).

Critical paths to developing significant levels of nut production

Quantities

Desirable national yield: 10 percent of national diet would be a good target ≈ 400 billion calories
(annual national consumption = 4.4 million people x 2500 calories per day x 365 ≈ 4 trillion calories

Assuming the nut output in calorific terms breaks down as 60 percent cobnuts, 25 percent chestnuts and 10 percent walnuts, the respective output from each crop and the numbers of trees required can be summarised as follows:

240 billion calories from cobnuts	= 42000 ha	= 21 million trees
100 billion calories from chestnuts	= 38500 ha	= 3.85 million trees
40 billion calories from walnuts	= 9500 ha	= 0.95 million trees

Walnuts although having potentially higher calorific yield per hectare, are regarded as higher risk than chestnuts. This uncertainty is reflected in the smaller area allocated.

Time taken to build up stock

Cobnuts

Stock can be ramped up by approximately a factor of 5 every two years by stooling. From a starting point of 60 trees, it would take 16-20 years to reach 20 million trees. If the starting point is 1500 trees, 4 years are saved.

Chestnuts

Stock can be ramped up by approximately a factor of 5 every two years by stooling and grafting. From a starting point of 60 trees, it would take 14-16 years to reach 4 million trees. If the starting point is 1500 trees, 4 years are saved.

Walnuts

Walnut cultivars are grafted onto rootstock grown from seed. Providing a reliable source of nuts (*Juglans regia*) for growing rootstocks can be found, and proper grafting conditions established, quantities can be bulked up relatively quickly in the early years. Although Irish provenance of nuts for seed-stock is desirable, sufficient quantities of nuts may be very hard to source. While nuts of British, French or Dutch provenance may also be considered, trees raised from nuts grown in drier continental climates may perform poorly in Ireland's cool maritime conditions. Assuming the rootstock and graftwood is available, up to 5,000 trees could be grown to planting-out size within 4-5 years. However, increasing numbers much beyond this will require considerably more effort. Alternative methods of rootstock propagation (hardwood cuttings for example) may be considered, but the success rate is likely to be low compared to seed-grown rootstock.

Nut propagation

Given the very long lead times in ramping up stock, the importance of establishing nut nurseries throughout Ireland within the next 1-2 years cannot be overstated. Countrywide, many hundreds of small nurseries will be needed. Such nurseries could be run as small independent businesses, or as cooperatives or semi-voluntary community projects. For the first 4-6 years of operation, any financial return on producing nut trees for commercial purposes will be extremely low. This mitigates more towards community projects, or possibly towards cooperative structures that have other options for generating income.

Time taken for trees to produce significant yields

After planting, 10-15 years should be allowed for the trees to begin producing yields similar to those quoted above.

Conclusions - the contribution of nut crops to food security

While nut crops certainly have potential to contribute to national food security, they are a long term project. The long lead time in building up stock, and the subsequent time needed for trees to reach the level of maturity needed for heavy crops, means that nut trees will mainly benefit future generations, not this one. Any national nut planting programme must be seen in this context. In 25 to 30 years time, nuts could become a significant component of the Irish diet.

At a local level, nut production may become significant within about 12 years, with the first small crops occurring after only two or three years at locations where trees are currently being established.

Historically, it was common practise for human society to engage in activities that would benefit future generations. The planting of orchards and deciduous woodland from the time of the civilisations of Rome, Greece and Asia Minor bear testimony to this. However, it is also important to acknowledge that these civilisations eventually exceeded the limits of their resource base, lost their food producing capability through bad agricultural practices, and generally ignored the many warning signs, leading to the inevitable collapse.

It appears that modern industrial/technological civilisation has learned almost nothing from the mistakes of the past. Indeed, during the last 100 years or so the practice of sacrificing the future to pay for the present has become the default *modus operandi* of humanity. This practice has tended to become ever more extreme during the latter stages of the fossil fuel era, leading to environmental degradation and finite resource depletion on a scale that now threatens the very survival of future generations.

The planting of nut trees is an act intended to give something of long term value to those who come after us. It represents a clear departure from the short termist policies that have plundered the earth in recent times and provides an opportunity to demonstrate a rediscovered consideration for both the biosphere and future generations. Even in the very lean times that will be experienced by humanity in the next few decades (as a consequence of declining energy availability), it is crucial that the nut planting project is begun and then continued. It symbolises our hopes and good intentions for the future, while simultaneously making a gesture at reparations for the immense damage caused by irresponsible use of finite resources.

Further information and feedback

This document should be treated as a work in progress and will be updated on a regular basis. Some revisions have already been made from the first draft. In particular, the estimate of walnut trees planted in the first five years has been significantly scaled down.

It is intended that this document will eventually form part of a much broader treatise on food security. This larger project is now well underway. Articles wll be posted on my own personal website: www.andywilson.ie

Additional information on nut-related research in Ireland and elsewhere can be found at the Sustainability Institute horticulture website: www.fruitandnut.ie

Comments and contributions are especially welcome. Of particular interest is further information relating to grain and livestock yields in low-input agricultural systems, and to livestock yields in orchard or woodland situations.

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