Northern Periphery and Arctic Programme

Northern Cereals – New Markets for a Changing Environment

Þorvaldseyri – Local Sustainability

Results and system analysis

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Birgir Örn Smárason

Matis

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Author(s): Birgir Örn Smárason

With contributions from:

Ólafur Eggertsson, Þorvaldseyri

Northern Cereals Partners:

Matis – Icelandic Food and Biotech R&D

Agricultural University of Iceland

Norwegian Institute of Bioeconomy Research

Agronomy Institute, Orkney College UHI

Agricultural Centre, Faroe Islands

Forestry and Agrifoods Agency; Newfoundland and Labrador, Canada

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1. Introduction

In the original concept of this work on Life Cycle Assessment (LCA) was to identify the environmental impacts and energy use at the Icelandic cereal and dairy farm Þorvaldseyri. The results would be used to refine guidelines and demonstrate how environmental impacts and resources use can be minimized. The aim of this activity was to identify the main environmental impacts, energy and material use within the systems of milk and cereal production at the farm and compare the results to the same system with imported raw materials and identify potentials for improvements.

As has been described before, Þorvaldseyri can become a sustainability model for its utilization of products and co-products from the farm's milk, cereal and rapeseed production. It produces its own feed for livestock, electricity from the local river, heat from a local borehole, fuel for the machinery, fertilizer and food for the residence. It was therefore indicated as an interesting case for LCA, to demonstrate the benefits of local production and utilization.

As the project evolved and after discussions with both partners of the project and the farmer at Þorvaldseyri, it was decided to adjust the scope in the direction of more practicability. As useful and practical as a full scale LCA study can be, it is not necessarily the most practical in this instance. We wanted to make something really useful for both the project and the farmer and therefore adjusted the scope to introduce and show the local sustainability of Þorvaldseyri. The farm receives huge numbers of domestic travelers and foreign tourists every year where the residents at the farm showcase the influence of a recent eruption on the farm and its surroundings and how they have managed to create a sustainable small community.

The result was that an information sheet or infographic of the farm's activities was created which visualizes how the farm operates, maintains local sustainability with the aim of reducing environmental impacts and costs. The fundamental principles of LCA was still used to determine the release of GHG emissions (greenhouse gas emissions) from the farm and also to show the reduction in GHGs by operating at local level. Furthermore, this can be used to demonstrate and present local sustainability. Local Sustainability means that an area is designed, built and operates in a way that uses energy and natural resources efficiently and equitably, for both present and future generations of humans and other species. Making a community sustainable means integrating economic development, community development and environmental protection. This usually cannot be achieved without the direct involvement of local government, although they have done so in this instance. Building sustainable communities requires a proactive, localized and participatory approach that depends upon the role and capabilities of local government.

As stated in the project's description, warmer growing conditions, improved varieties and technologies, and concerns about sustainability are creating new opportunities in northern areas for greater cereal production. In few areas, it has already been possible to produce higher value cereals for milling and malting which has allowed SMEs to develop new "local" products to meet a growing demand from tourists and residents. The challenge faced is to help all partners benefit from these opportunities while taking into account the different levels of development of cereal cultivation across the partner regions. The project objectives are to increase cereal growing in the partner areas and to increase the growing of higher value cereals for local food and drink products. The main outputs from the project will be increased numbers of farmers growing cereals for feed, malting or milling and the production of higher value cereal products like seed, malt, food and beverages. These changes will increase employment, income and consumer choice in rural areas. The main beneficiaries will be growers and their local communities, SMEs and consumers. We therefore believe that this will contribute and strengthen the project's objectives.

2. Data and farm processes

2.1.Information presented

Since the objective emphasis of this work package has developed slightly, the previous description of the full scale LCA model is no longer applicable. All data gathered and presented in this chapter was retrieved from the farmer at Þorvaldseyri. Additional data such as on transportation was retrieved from the Ecoinvent 3 LCA database, developed by the ecoinvent Centre in Switzerland[1]. Data on electricity production and cost is from Icelandic national inventories and producers (Statistics Iceland, Landsvirkjun, national power company of Iceland, National Energy Authority). The data that appears on the information sheet will be presented here in a similar way. Cost calculations are shown in Euros and exchange rate taken from the Icelandic Central bank in May 2016.

Farm activities - Production

The various production on the farm makes it possible to create the circular environment that is called *local sustainability* in this instance. The processes use co- and by-products from each other and benefit from the local electricity generator and hot water.

Grass/Hay – 130 ha total, 70 ha processed and used as feed input for animals.

Cereal – 48 ha – 150 tons of barley – sold as final product and used for feed.

Rapeseed – 10 ha – 22 tons. Rapeseed meal is sold as a final product. Biofuel is produced for the machinery and by-products as feed input.

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[1] http://www.ecoinvent.org/

The main production at Þorvaldseyri is the dairy farm, producing around 330.000 liters of milk along with meat from sheep and cows, according to Ólafur Eggertsson, the farmer at Þorvaldseyri.

Feed

Feed comes from co- and by-products from farm crop operations as stated above. This ensures that 90% of feed need is fulfilled within the farm. The remaining 10% is dry-feed and additives. This saves the farm around 46.500 EUR/year[2] and 3120 kg of GHG[3] emissions per year[4].

Fertilizer

Fertilizer comes from animal manure and co- and by-products from farm crop operations. The usage is around 20 tons per ha/year and is 100% of need. This saves 88.000 EUR/year (based on the price of a popular fertilizer from Fóðurblandan[5] and numbers from Þorvaldseyri) and 554 kg GHG emissions/year of transporting fertilizer to Iceland (numbers generated from Ecoinvent using SimaPro 8 LCA software. Average transport distance of 3000 km using a generic transport ship).

Electricity generator

The farm operates a local electricity generator from a stream of river near the farm. The generator produces about 18 kWh of electricity and provides the farm with 50% of total electricity need, which is around 120.000 kW per year. This saves 5.600 EUR per year and around 528 kg GHG emissions per year considering the Icelandic energy production[6].

Biofuel

Biofuel is produced from pressed rapeseed. The production is not at maximum capacity at the moment so numbers are based on theoretical output accord to Ólafur Eggertsson. The production can be around 5 tons per year which is enough to fuel machinery for about 40% of the farm's operations. This saves 6.770 EUR per year – based on 5400 liters * 1.25 EUR/liter, and 14.040 kg GHG emissions per year – based on 5400 liters and 2.6[7] kg of CO_2 eq. emitted per liter burned.

Hot Water

A borehole on the farm's land provides 100% of need for house heating and hot water. This resource can also be used to dry cereal or corn.

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[2] Based on 90-100 tons of feed annually and 516 EUR/ per ton of feed
[3] Greenhouse gas emissions, presented in kg CO_2 equivalents/year
[4] Based on transporting 90 tons of feed for the average transport distance of 3000 km
[5] www.fodurblandan.is
[6] Umhverfisskýrsla Landsvirkjunar 2011
[7] Based on IPCC and EPA emission models

Household

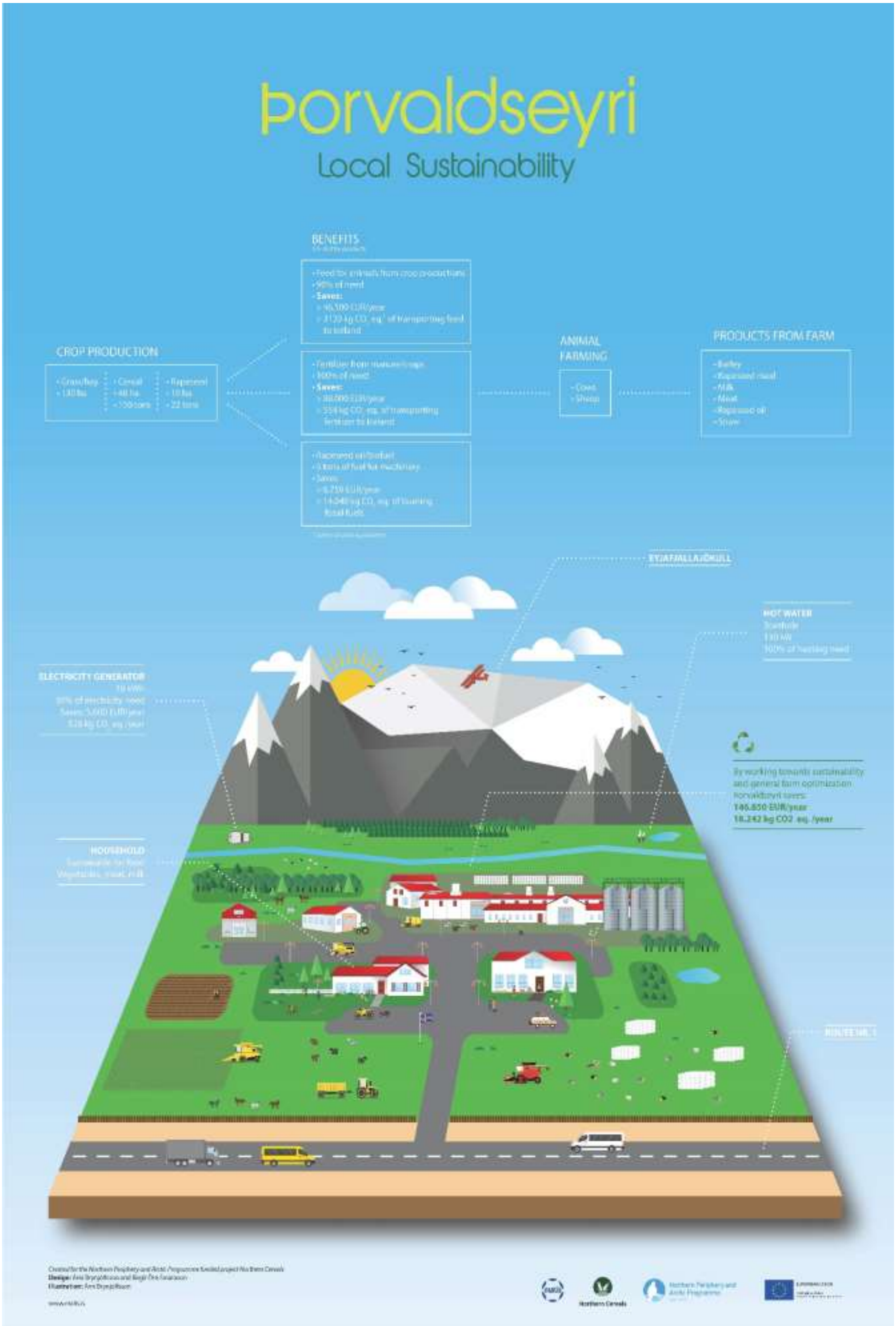
The household itself gets most of the food they need from the farm, along with heating, water and electricity. They produce vegetables in addition to getting meat and milk.

Products from farm

The farm produces and sells many different kind of products to customers. It is this production, namely the by- and co-products along with optimized processes and good utilization, that enables them to adhere to local sustainability. Their main output products are milk, meat, barley, rapeseed meal, rapeseed oil and straw. This is sold to bakeries, other farmers, breweries, milk end-producers and to the general public, to name a few.

3. Conclusions

As has been stated before, Þorvaldseyri can be referred to as a model farm for sustainability. The farm itself can in theory be 100% self-sufficient for energy, raw materials, feed, water and food, while still selling end products to support the farm financially. It has also been discussed that the Þorvaldseyri model can be used as a soft blueprint for other farms with similar conditions. The infographic attached in this document (also attached in a separate file for better quality) can provide an overview of possible improved processes and guidelines for farms planning to increase their overall sustainability. It would have been possible to do a much more detailed and complete LCA on the farm's operations, but the information presented on the infographic was carefully chosen to be as understandable as accessible for everyone to enjoy. The total calculated cost savings were 148.850 Euros per year and total calculated carbon dioxide equivalents savings were roughly 18.242 kg.


Þorvaldseyri
Local Sustainability
BENEFITS
CROP PRODUCTION
Saves:
Saves:
ANIMAL FARMING
- Cows
- Sheep
PRODUCTS FROM FARM
- Barley
- Milk
- Meat
- Straw
EYJAFJALLAJÖKULL
HOT WATER
ELECTRICITY GENERATOR
HOUSEHOLD
146.850 EUR/year
18.242 kg CO2 eq. /year