



True Cost Assessment of Finca Irlanda in Chiapas, Mexico

September 2015



Customer Ulrich Walter GmbH

Title Evaluation of Finca Irlands's past and current state of soil fertility and economic and environmental impact assessment

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Date September 2015

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Economic and environmental impact assessment of the Finca Irlanda

Motivation and objective

According to latest FAO reports, on a worldwide average the area of arable land per capita shrank from 4307 m² per person in 1961 to 2137 m² in 2007. The reason is simple: due to non-sustainable farming practices such as over fertilization of mineral fertilizers and related soil erosion, annually about 12 Mio. Hectares of arable land are lost globally while the world population tripled in the last 100 years.

In times of shrinking natural resources worldwide such as soil or water, it is of strategic importance for the agricultural sector as well as the national economy in general, to closely monitor the development of fertile soils, accessible clean water, energy etc. and how agricultural practices influence these developments. Apart from the national or worldwide agricultural sector, it is of critical interest to each and every company, active in the food industry or agriculture in general to carefully observe and constantly optimize the use and management of those most essential resources, simply to maintain the agricultural business.

If and at which price agricultural goods will be available in the future is determined by the agricultural practices applied today.

To assess this issue, various impact or resource efficiency assessments have been carried out, but only recently, so-called full cost accounting models have been developed in order to evaluate and monetize external costs such as greenhouse gas emissions, water pollution, soil erosion as well as social and health aspects. Generally speaking, full cost accounting is about considering the environmental as well as socio economic impact of e.g. farming practices. These external costs aren't considered in today's cost calculations of products and productions systems, but nevertheless are real and will be more and more important in the future.

Due to the complexity of this subject, full cost accounting hasn't arrived yet in the companies' daily accounting work. Nevertheless, more and more entrepreneurs at farming or processing level ask for practical full cost accounting tools and approaches to be integrated in their strategies and daily decision making.

Ulrich Walter GmbH took the initiative to work on this issue on a real, company respectively supplier level – at Finca Irlanda. In this case related to the cultivation of biodynamic coffee in Chiapas, Mexico.

As full cost accounting is a „young science“, there is still many open questions regarding models, monetization factors, assessment boundaries to be applied etc. but the FAO recently published a first guidance document which has been used as a basis for this study.

The actual result of a full cost assessment is very much depending on the location and management specific conditions of a farm. This study is based on data provided by Finca Irlanda's management and from reports. In general, the more professional and holistic a farm is operated, the better the overall full cost accounting results are expected to be.

The United Nations respectively the FAO has worked for three years on the topic of full cost analysis utilizing extensive surveys, evaluations and stakeholder consultations and recently published a study on this research. The results and approach and recommended parameters of that FAO report were used as the basis for this full cost accounting assessment.

“The economic invisibility of natural capital inputs in the global economy is at the source of ecosystem collapse and prices’ volatility. Businesses and nations need to account for the true price of activities by appraising environmental and social externalities, risks and dependencies, incorporating it into decision-making and ultimately, mitigating impacts on natural resources and well-being.”

Nadia El- Hage Scialabba, Senior Natural Resources Officer FAO/UN

Scientific Approach

The main aim of this study is to show if biodynamic farms provide additional benefits and services for the environment and society beyond the mere production of healthy products.

The holistic and with it economic sustainability is heavily dependent on the local and product specific factors - ecological but also socio-economically. One of the core issues for the coffee farms is the build-up and maintenance of SOM through the usage of pruning material for composting, which secures soil fertility, a good water holding capacity and prevents erosion. Other full cost accounting parameters such as partnerships, research and energy use as well as employee loyalty and motivation were also identified as important aspects but at a secondary level.

The individual parameters were evaluated based on information provided by the Finca Irlanda management and using a plausibility check with standard modeling techniques. To determine soil carbon, organic matter and nutrient contents and dynamics as well as erosion, the appropriate models were used. The agricultural greenhouse gas emissions and CO₂ sequestration was calculated using the Cool Farm Tool, which is a widely used and recognized tool in the food and agricultural sector. The evaluation of the potential water pollution by nitrate leaching and other pollutants was carried out based on the guidelines of the Global Water Footprint Network.

There are different approaches from industry and research on the consequences of the environmental impacts of farming in monetary terms. In 2014 the Food and Agriculture Organization of the United Nations (FAO) published a report about full cost accounting summarizing the results of a three year multi stakeholder consultation process on this topic conducted by the FAO and other organizations such as FIBL and UNEP. This report presents a generic approach to the overall cost estimate at the farm level and presents further economic factors for greenhouse gas emissions, water use and pollution, soil erosion, fertilizer, land use, biodiversity, socio-economic aspects and individual health. As this report with its scientific approach and recommended parameters was generated by independent institutions, these parameters were used in this present study for Ulrich Walter GmbH respectively its supplier of biodynamic coffee, Finca Irlanda.

Ecological Aspects

The year 2015 has been declared by the United Nations as the international year of the soil. And for good reason. Worldwide, we destroy at an alarming rate our arable soils, the basis of our food and agriculture in general. Critics say over and over that organic farmers require more land due to the partial lower yields. Therefore, conventional farming systems would perform better regarding land use. In reality though and apart from the fact that our current world food problem depends only to a very small part on agricultural productivity, the loss of fertile soil through intensive, not appropriate agricultural practices is much greater than the need for more space through organic farming.

Low food prices put pressure on the farmers to intensify the agricultural practices causing soil overuse, depletion and erosion, which in the case of the climate and soils of the Finca Irlanda can lead to a loss of up to 50 tons of topsoil per hectare and year.

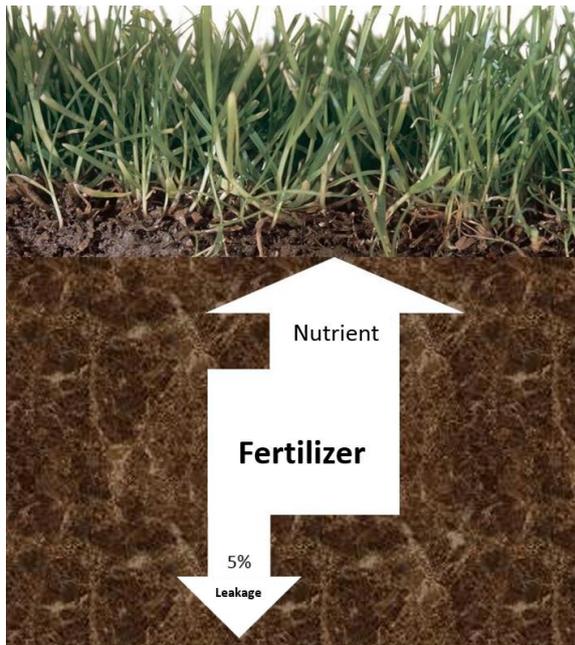
Apart from using compost instead of synthetic fertilizers, the options for sustainable soil management practices are limited in a crop like coffee. Finca Irlanda already uses some of the pruning material, leaf litter and cuttings as well as manure to produce compost to naturally fertilize and build-up the soils.

In the case of arable field crops such as potatoes, crop rotation, green manure as well as different tillage schemes would need to be considered but these activities aren't applicable for a permanent tree crop such as coffee. Still, leguminous cover crops could be used at least at planting stage of new coffee bushes to increase SOM, fix nitrogen and suppress the weeds.

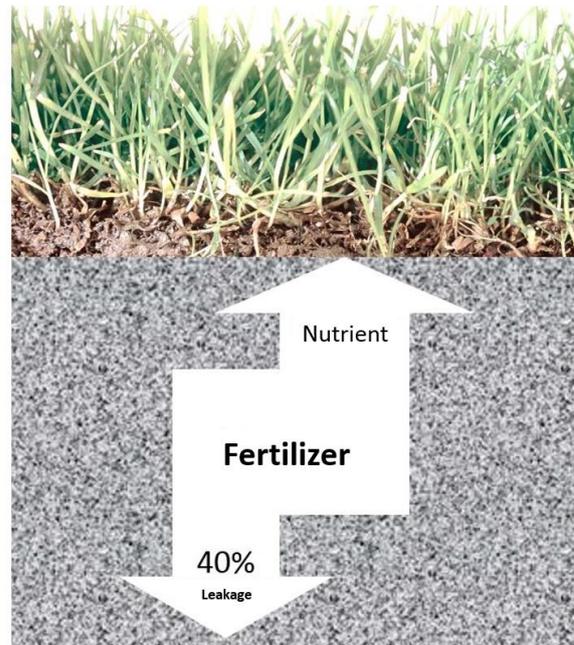
In this context and if the availability of water would allow it, the whole coffee farm could be covered with a not ranking, deep rooting leguminous crop, providing a good structure to the soil, potentially fixing nitrogen and preventing the topsoil from erosion.

What's actually happening in the soil

Soil structure: if you take a crumb of topsoil and look at it under a microscope, you can see a crystalline mineral structure, a so-called clay-mineral which is populated by millions of microorganisms. Closely nested millions of these so-called clay-humus-complexes form the whole of the humic topsoil. The tiny pores between the individual crystals can absorb many times its weight in water, which is why a good humus soil is known to have a better water holding capacity than comparably "poor" soils. This also counts for the nutrients. The clay-humus complexes form a coherent, stable soil structure, which allows only few losses e.g. through leaching. The application of synthetic fertilizers such as ammonia nitrate or urea which are mineral salts, interfere with or even destroy the microbial life causing a collapse of the soil structure. Depending on the type of soil, the loss of structure either leads to severe wind or water erosion or extreme compaction. In both cases, this means a deterioration of the water and nutrient management, as they increasingly run off. As a result of the ever-growing nutrient loss more fertilizer needs to be applied, which, considering the rising fertilizer prices means a significant cost increase - not to mention the impact on groundwater and the environment in general. The underlying idea of organic agriculture including compost application counteracts. Humus structure is built, leaching losses are minimized and nutrients are used more efficiently - in comparison, a plausible model.



Good soil structure means low leakage loss



Bad soil structure means high leakage loss

Compost applications, mulch and no tillage are not only good for soil fertility but also for climate protection. Our top soil is the world's largest carbon reservoir, more than the aboveground biomass and mineral deposits together. Through erosion or other soil degradation, this carbon is released as CO₂. Meaningful, organic farming preserves these carbons in the soil or even sequester additional CO₂. In the soils of Finca Irlanda up to 1.14 tons of CO₂ per hectare are sequestered per year in average. Intensive farm and soil management using mineral fertilizers results in increased degradation of humus and thus release of carbon in the form of CO₂ as well as other greenhouse gases. The FAO defined the costs or value of CO₂e emissions for the environment and society with US \$ 113 per ton CO₂e. Factoring in this amount into the cost/benefit calculation of conventional coffee farm, additional costs occur due to the release of CO₂ and these costs aren't accounted for currently. As mentioned above, Finca Irlanda in contrary not only avoid these costs but sequesters CO₂ which can be valued with the same factor, resulting in a generate benefit of up to € 115 per hectare and year.

CO₂ respectively carbon sequestration are together with the above-mentioned compost application and mulch important ingredients for the build-up of humus and topsoil. Humus thereby has ample positive effects. Firstly, humus is a supplier of top soil material. Secondly and above all humus is the "home" of millions of microorganisms, which ensure natural soil fertility and health. As a result of Finca Irlanda's sustainable agroforestry management, carbon is sequestered but if SOM and humus is actually built-up needs to be investigated. Applying the compost starter on the crop residues at the right time, potentially up to 1.25 tons humus rich topsoil or more could be built-up per hectare and year.

For comparison, the erosion models resulted in up to 50 tons of topsoil per hectare and year, which may occur due to intensive, not sustainable farming practices. The FAO assesses the environmental and societal damage caused by water erosion with US \$ 21.54 per ton of eroded topsoil.

Again, a damage to the environment and society equivalent to potentially hundreds of US\$'s per hectare and year is opposed to a potential benefit of potentially € 24 per hectare and year through biodynamic farming practices, whereby only the build-up of soil and not the avoided damage is taken into account. Other environmental issues that have been assessed using the parameters

recommended by FAO are water use and potential pollution through nitrate leaching resulting from compost application. In addition, the environmental effects of organic pest and disease control in terms of water pollution and biodiversity loss were evaluated as well.

As mentioned above, the guideline of the Global Water Footprint Network was used for the assessment of a potential water pollution. In particular the grey water footprint was evaluated. The grey water footprint is the amount of water needed to dilute an occurred pollution to a pollutant-specific water quality level. Especially with the usage of pest and disease control agents, the grey water footprint can be very high. As the grey water footprint calculation related to pesticide use requires various assumptions, only the grey water footprint related to the potential nitrate leaching has been taken into account in this study. Since Finca Irlanda only applies mature compost, the potential leaching of nitrate from the compost can be neglected.

Considering all these environmental parameter, Finca Irlanda's biodynamic coffee generates an environmental benefit of up to € 139 per hectare and year. This is to be understood as the net benefit, meaning both the benefits as well as some environmental costs are considered. Compared to intense, not sustainable farms the difference can be more than 1,000 € per hectare and year.

Socio-Economic Aspects

In addition to environmental impacts, the FAO has evaluated as well the social and health impact of unsustainable farming and its related costs. As mentioned above, full cost accounting is still a young science, and in particular the definition of the cost related to health damages due to e.g. pesticide-contaminated foods is still very vague. Yet this context and these costs are very real and understandable for many people. The loss of habitat due to erosion, the loss of soil fertility or soil and water pollution can be very real and cause real costs. Another often ignored but now probably most relevant and real factor are social conflicts. Unsustainable short-term, one-sided profit driven farming systems cause a fight over fertile soil, clean water, raw materials which can lead to local and partly regional unrest, or at least forcing people to leave their homes.

To include these real, well understandable but difficult to quantify parameters, the FAO carried out comprehensive surveys to define the costs associated with the loss of livelihoods due to soil erosion, individual health damage through e.g. pest and disease control and social conflicts.

In the regional socio-economic context of the Finca Irlanda, the potential individual health damage caused through the application of pest and disease control measures was evaluated whereas the risk of conflict due to resource scarcity was decided to be neglected.

Overall, the FAO estimates the social costs to be 33 €ents per hectare and year if applicable, whereby almost 90% of these costs may be attributed to the health costs through the use of pest and disease control.

Overall Results

Today's pricing for coffee does not include the environmental and social costs occurring through unsustainable agriculture practices nor the benefits and additional services provided through meaningful and appropriate agricultural practices. Both should be considered in the future for the evaluation of foods.

The following table shows the results for the assessed biodynamic coffee farm, Finca Irlanda in Chiapas, Mexico:

Full Cost Accounting Parameter	Cost/Benefit per hectare			
"external cost"	("-" means benefit)			
	Biodynamic	Conventional	Difference	
Greenhouse gas emissions	- 115,02 €	59,97 €	174,99 €	the negative value means CO2 sequestered
Water quality	- €	109,58 €	109,58 €	
Water use	- €	- €	- €	
Soil erosion (water)	- 24,04 €	961,61 €	985,65 €	the negative value means build-up top soil
Loss of biodiversity	- €	12,88 €	12,88 €	
Loss of livelihood	- €	0,003 €	0,00 €	
Individual health damage	- €	0,30 €	0,30 €	
External cost/benefit per kg dry coffee (€)	- 0,23 €	0,96 €	1,19 €	
External cost/benefit per hectare (€)	- 139 €	1.144 €	1.283 €	
External cost/benefit per 270 ha farm (€)	- 37.546 €	308.976 €	346.521 €	
kg soil build-up/erosion	Biodynamic	Conventional	Difference	
per kg dry coffee and year	2,09	83,62	85,71	
per hectare and year	1.250	50.000	51.250	
per 270 ha and year	337.500	10.000.000	10.337.500	
kg CO2 sequest./emission	Biodynamic	Conventional	Difference	
per kg dry coffee and year	1,91	0,91	2,82	
per hectare and year	1.140	547	1.687	
per 270 ha and year	307.800	109.400	417.200	

Extrapolated to the total area of Finca Irlanda which is planted with coffee of about 270 hectares about 307 tons of CO₂ are sequestered and potentially 337 tons of topsoil are build-up. Taking into account all investigated parameters mentioned above and the corresponding factors of the FAO, Finca Irlanda's biodynamic coffee fields generate a social and environmental value or benefit of about € 37,000 per year. A comparable conventional farm at the same size would cause a social and environmental damage of € 308,000 per year.

Biodynamic agriculture therefore is not a "nice to have" but an economic and environmental necessity.

Conclusion of environmental and economic impact assessment

The theme of the full cost accounting must find its way more and more into our everyday life and business. Ultimately, it is about responsibility - for the sake of the environment and society and thus in our own interest. It is not difficult to understand that each, at least most, of our actions and decisions make a difference. Sometimes more, sometimes less. The approach of the total cost analysis is to take nothing other than these considerations. It is only important that we do so consciously. Through a conscious purchase decision, we can make a positive difference for the sustainable development of agriculture, in our own interest. The aim of this study is to show that aspects such as soil fertility and erosion, water pollution or protection, diversity, or biodiversity loss are not only intellectual luxury topics, but are an economic reality for each of us.

It is very likely that the world population will continue to grow, the planet Earth and the natural resources won't. A gentler, less bad treatment of our natural resources is not enough there. We need to build our resources such as soil, water, biodiversity. We cannot afford to waste these goods. As explained above, Finca Irlanda shows various options and solutions sustainable agriculture may offer. Locally adapted, balanced crop rotations were applicable, mixed farms to ensure a closed nutrient and carbon cycle, enlivening of the soil for the development and maintenance of soil fertility through composting and conservation tillage. All these are essential ingredients to a holistic, sustainable development of agriculture. However, much remains to be developed but initial solutions are there.

References/Sources:

[FAO Full Cost Accounting Report](#)

(www.fao.org/3/a-i3991e.pdf)

[FAO Foodwaste Report](#)

([http://www.fao.org/fileadmin/user_upload/sustainability/pdf/Global Food Losses and Food Waste.pdf](http://www.fao.org/fileadmin/user_upload/sustainability/pdf/Global_Food_Losses_and_Food_Waste.pdf))

[Cool Farm Tool](#)

(<http://www.coolfarmtool.org/>)

[Waterfootprint Network](#)

(<http://www.waterfootprint.org/?page=files/home>)