McDonald's Europe Flagship Farms

Lettuce – Primaflor Farm, Spain

Intensive produce farming can be undertaken in areas of low rainfall, making efficient use of water and plant protection products.

This case study shows how lettuce production in an area of low rainfall can be undertaken using water in an efficient and precise manner, combined with targeting application of fertilisers and plant protection products to improve effectiveness and protect the natural environment.

This case study highlights good practice in water use, agrochemical and fertiliser use and food safety.

The McDonald's Flagship Farms scheme has been developed in co-operation with the Food Animal Initiative to showcase good agricultural practices which are environmentally sound, economically valuable and ethically acceptable. A limited number of 'flagship' farms have been selected from within the McDonald's supply chain to represent progressive agricultural practice.

The following matrix has been developed by McDonald's to help assess sustainability within the agricultural supply chain. Farms selected demonstrate good practice in at least one of the matrix key areas, whilst also operating to generally high standards in all other areas.

Symbols EN EC ET are used to highlight good practice in environmental, economical and ethical issues.

McDonald's Good Practice Matrix

✓ Good practices demonstrated in this case study

Ethical (acceptable practices) ET

Human health & welfare ✓
i Employee health & welfare ✓
ii Food safety ✓

Animal health & welfare
i Nutrition
ii Medication & growth promoters
iii Genetic selection
iv Animal cloning
v Husbandry
vi Transport
vii Slaughter

Business ethics & supplier relationships

Rural landscape preservation

Environment (protecting the planet) EN

Climate change
i Greenhouse gas emissions
ii Energy efficiency & renewables

Natural resources – soil ✓
i Soil fertility & health ✓
ii Soil erosion, desertification & salinisation
iii Soil contamination

Natural resources – water ✓
i Water pollution
ii Water usage efficiency ✓

Natural resources – air
i Air emissions

Agrotechnology ✓
i Agrochemical usage ✓
ii Bioconcentration & persistent organic pollutants
iii Genetically modified organisms

Ecosystem protection ✓
i High conservation Value Land (HCVL)
ii Habitat & species preservation ✓

Waste
i Production waste
ii Hazardous waste
iii Waste to landfill

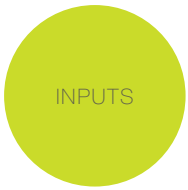
Economics (long-term economic viability) EC

Sufficient high quality production ✓
i Producer income security & access to market
ii Agricultural input costs ✓
iii Crop & livestock disease ✓

Community investment
i Local employment & sourcing
ii Support for community programmes

Executive summary

Key areas of good practice:



The farm uses fertigation (Fertigation is the application of fertilisers or other water soluble products through an irrigation system), which provides precise application and reduces the overall amount of chemicals applied compared to dry application.

Soil meters monitor moisture levels at 4 zones within soil structure, allowing for accurate assessment of irrigation undertaken and planned, verses actual crop requirements.

A weather station on the farm predicts likely rainfall events and calculates soil evaporation rates, ultimately helping improve irrigation/ water efficiency.

The weather station also predicts conditions which are likely to increase the risk of disease/pest incidence, so the use of plant protection products can be accurately targeted.

Biological repellents (garlic extract and neem oil) are used to control certain target pest species.

Pheromone and sticky traps capture pest species and if threshold levels are exceeded then the farm's technician can approve the use of specific plant protection products.

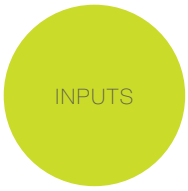
Sub-surface drip irrigation is used, which is an irrigation method which minimizes the use of water by allowing it to drip slowly to the root zone of plants. It is estimated to be 25% more efficient than other methods of irrigation.

A pressure compensated drip irrigation system is in use which, although more expensive than the conventional drippers, has far greater efficiency and accuracy.

All water sources have two microbial tests undertaken annually to ensure purity levels are met.

Additional areas of good practice:

The farm produces the lettuce under the requirements of the Global-Gap assurance scheme. This ensures that requirements such as food safety/quality, good environmental practices, record keeping and worker welfare are all independently audited and verified.



A programme of plant breeding in conjunction with seed suppliers sees over 300 different varieties planted every week during the growing season, with the objectives of improving pest/ disease resistance and growth in future generations.

Pest and disease strategies are planned out in conjunction with three specialist companies.

To date, around 500 native trees have been planted including Olive, Palm, Carob tree and Rosebay.

Summary of actions and benefits

	Action	Benefits		
		Environment EN	Economics EC	Ethics ET
Staff	1800 staff are employed per year			The company provides a reasonable basic wage with bonuses
Management	Global Gap approved	GlobalGAP covers environmental requirements within its standards that the farm has to meet		GlobalGAP standards are designed to control food quality, food safety and worker welfare.
Inputs	Fertigation system	The majority of nutrients are applied via the irrigation system which reduces losses and decreases the risk of pollution.	Nutrient application rates are matched precisely to plant requirements, leading to lower fertiliser costs.	
	Weather station	Helps with the planning of irrigation and plant protection products (PPP). Data on soil water evaporation rates and weather conditions likely to increase the risk of pest attack	Potentially reduces the crop requirement for irrigation and PPP, otherwise allows a targeted and more cost effective use of these inputs	
	Annual soil testing and nutrients plans	All planting areas are tested annually for nutrients which prevents over application	Targeted fertiliser applications plans are implemented which maximises yields whilst minimising nutrient losses	
	Specialist agronomist employed	Accurate and timely diagnosis of pests can reduce amounts of PPP required	The farm has a designated agronomist whom monitors the crop and plans PPP use	
	Soil moisture meters connected to computer software	Soil moisture levels can be more accurately maintained in the plants' root zone, limiting moisture loss through the soil	The water requirements of the plants are matched precisely by the irrigation system, maintaining production levels and limiting water losses/costs	
	The use of biological repellents	Reduces the requirement to use man made crop protection products		Reduces the requirement of PPP
	Pheromone and sticky traps	Allows monitoring of crop pest, ensuring agrochemicals is only applied when thresholds are exceeded	Targeted and necessary use of expensive crop health products	
Operations	Trial work via selective breeding of natural traits to develop new varieties	Breeding more pest/disease resistant varieties	Resistant varieties reduce the requirement of expensive crop health products	
	Working with plant protection product companies		Pest control strategies developed with PPP companies	

Summary of actions and benefits (continued)

	Action	Benefits		
		Environment EN	Economics EC	Ethics ET
Resources	Sub-surface, pressure compensated (PC) drip irrigation system	Reduces water consumption by reducing surface evaporation	Reduces water usage and costs and the PC system allows accurate placement of water	
	Microbial testing of water			All irrigation water is tested for purity
	Environmental Integration Plan	A regime of tree planting with natural species is being carried out		

Introduction

Lettuce (Lactuca sativa L.) is an annual plant species of Asteraceae (daisy family) and is native to the Mediterranean region. It has been cultivated for over 2000 years and is thought to have originated in Europe and Asia. The lettuce is a popular salad vegetable and today is grown on all continents throughout the world.

There are four commonly recognised groups of lettuce:

- The Butterhead, which forms loose heads and has a buttery texture.
- Crisphead, also called Iceberg, which forms tight, dense heads that resemble cabbage. They are generally the mildest flavoured of the lettuces, valued more for their crunchy texture.
- Looseleaf, which has tender, delicate, and mildly flavoured leaves. This group comprises oak leaf and lollo rosso.
- Romaine, also called Cos, grows in a long head of sturdy leaves with a firm rib down the center.

The annual European production of lettuce is estimated at around 2.4 million tonnes.

Primaflor was originally founded in the 1970s and originally produced flowers and vegetables. In the 1980s the business expanded and consolidated its interests, and the focus changed to producing leaf vegetables. The business is currently farming some 2,500 hectares of land in Almeria, Spain, growing around 55 different vegetable varieties. Iceberg lettuce comprises around 80-85% of the production, equating to around 50,000 tonnes of Iceberg (each head weighs around 500 grams) produced annually (in current terms, 10% of Spain's total production). In 2007 the business had sales of almost €100 million. There are 1,800 workers employed over the season, picking some 180 million pieces of lettuce. The summer growing area, which is located in farms near Sierra Nevada (Granada) at an altitude of 1,100 metres, provides ideal summer growing conditions and avoids the problem of hot summer temperatures which causes bolting and leaf damage. The volume of iceberg lettuce per week is 70% less compared with the winter season and only the Spanish market is supplied during this period.

The water/fertiliser solution applied through the irrigation system is one of the greater costs to the business, making up around 20% of the total production cost.

The farm "Fatima" has been selected by the company as their representative for the flagship farms project and covers an area of 212 hectares, with 135 hectares planted with Iceberg lettuce.

Staff

Over the course of a season the company employs 1,800 workers, with a large percentage of these coming from outside of the EU. The company organises all the paperwork and work permits that are necessary and books and pays for the flights for the workers. A good basic wage is paid to all the workers and a productivity bonus is available, with some staff able to earn an extra 30-40% on top of their basic wage.

The company is accredited under SA8000, which is an international standard for improving working conditions. Based on the principles of thirteen international human rights conventions, it is a tool to help apply these norms to practical work-life situations. Sufficiently specific to be used to audit companies and contractors alike in multiple industries and countries, SA8000 represents a major breakthrough: it was the first auditable social standard and creates a process that is truly independent (it is neither a government project, nor dominated by any single interest group).

The company also works closely with the local town, helping integrate the temporary workers with the local community by organising sporting events.

ET

The farm provides a fair basic wage with opportunities to earn bonuses.

Management

The farm is Global Gap approved. This means that an independent certifying organisation audits the farm to the requirements of the scheme, which is primarily designed to maintain consumer confidence in food quality and food safety. Other important goals of the scheme are to minimise any detrimental environmental impacts of farming operations, optimise the use of inputs and to ensure a responsible approach to worker health and safety.

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By complying with the GlobalGap standard the farm demonstrates its good practice in terms of food quality, safety and environmental practices.

Inputs

Fertigation

The farm uses a fertigation system, which is the application of soluble fertilisers through an irrigation system. This provides precise nutrient applications to the plant, and the system in use also controls the pH levels of the irrigation solution. The business has a defined plan for nutrient application which is implemented on the basis of planting dates, soil type and crop type. This method of scheduling reduces the effects on the plants of over- or under-fertilising and results in improved plant growth. Fertigation allows the plant to absorb up to 90% of the applied nutrients, whereas granular fertiliser applications typically result in absorption rates of 10-40%. Another drawback of granular fertiliser applications is that they rely on rain or topical applications of irrigation (which is wasteful due to high evaporation losses) to dissolve the fertiliser granules. With this precise application method and defined planning system, the overall amount of fertilisers applied is reduced verses granular applications.

As the fertigation system is targeted at the plants' root zone the risk of runoff or leaching is greatly reduced, which is also aided by the small amounts of fertiliser applied in each drip cycle.

"Of equal importance is a correct control of the pH. The pH control of the irrigation solution is an important part of the nutrient uptake of the plants. It has been clearly demonstrated that a pH around 6 optimises the application and absorption of fertilisers."

(Abstract from Innovaciones Techicas Agricolas website)

"In fertigation small doses of nitrogen frequently added prevents leaching. Fertigation is more advantageous in drip irrigation systems and better fertiliser distribution is achieved compared to furrow and surface irrigation. Drip irrigation also has higher water use efficiency and higher fertiliser use efficiency. Fertigation is also an efficient method for providing and supplying available forms of immobile elements such as P at a desirable level in the root zone. This is especially important during the very first stages where P is badly needed for developing a good root system.

1. *Since with fertigation, fertiliser application can be controlled better, over fertilisation and over irrigation at any growth period can be avoided. Thus, by synchronisation of water and nutrient supply with the crop demands, both water and fertiliser use efficiencies are improved and the adverse impact of over fertilisation on the environment is minimised. The nearer the time of fertiliser application to peak nutrient demand, the higher the utilisation efficiency of fertilisers.*

2. *Drip irrigation has proved to be the most efficient method of irrigation in terms of water saving and yield increase. Conventional fertilisation techniques are not suitable under drip irrigation farming system while the fertigation is considered the only appropriate techniques for fertiliser application. In fact, fertigation in many countries has gained momentum since adoption of drip irrigation systems. This is also of extreme important in countries where water resources quantitatively and qualitatively are limited.*

3. *By fertigation, one can avoid application of large amount of solid fertilisers by conventional methods thus avoiding salt damages of plant roots.*

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4. *By fertigation, one can minimise the losses by leaching and/or volatilisation because the nutrients are directly supplied into the root zone in small amount and frequently according to the needs of each growth period.*

5. *Compared to soil application, fertigation can save time, energy, labour and overall application cost.*

6. *Frequent application of small doses of fertilisers with fertigation keeps the amount of fertilisers in the soil at any time low enough to minimise losses by leaching and runoff during heavy rainfall or excessive irrigation. This regulates nutrient uptake, minimise losses and increase fertiliser use efficiency.*

7. *With surface irrigation, soil varies from saturation to wilting point between irrigation*.

8. *Benefits of fertigation include reduction in soil compaction and mechanical damages to the crops due to reduced use of tractors and other heavy machines in the fields.*

9. *Fertilisers can be applied to the soil when crops and soil conditions are inconvenient (wet soil surface, crops are growing, etc) for labour or equipment to enter the field to apply fertilisers by conventional methods.*

10. *By fertigation, immobile nutrients such as phosphorus and micronutrients will be supplied right into the root zone and the nutrients therefore are not widely mixed with the soil. Thus less soil volume is fertilised and less fixation, sorption or precipitation is taking place and fertiliser use efficiency is improved*."

(Abstract from: Prerequisites for Successful Fertigation by M. J. RUSAN (Jordan University of Science and Technology))

ET

EN

Use of fertigation ensures accurate and precise nutrient application, ensuring minimal waste and maximising plant growth.

Irrigation

Water is a precious resource in this growing region and also contributes around 20% to the cost of production. To ensure that irrigation is undertaken in the most efficient approach the farm has integral soil moisture meters within the growing crop to monitor soil moisture levels. These have sensors set at four zones within the soil structure at depths of 10, 20, 30 and 50cm. These monitor moisture levels every five minutes and the data is sent via Wi-Fi to a nearby computer system. The computer software charts the moisture levels and also records the amount of water applied via the irrigation system and gathers data from the weather station. All these figures are then assessed by the farms technician who can adjust irrigation amounts from the pre-determined target levels. Any rise in moisture levels recorded at the sensor placed at 50cm deep shows that the crop has been over irrigated and the technician will reduce the subsequent applications of water to address this. At 50cm the water has moved out of the plant's root zone and is therefore unavailable for its use.

EC

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Automatic water monitoring ensures the optimal irrigation. Unnecessary water use is avoided and plant growth maximised.

Weather station, irrigation & pest control

The on-farm weather station is a monitoring device that takes accurate, real-time weather measurements and transmits them to the farm's computer. It measures wind speed and direction, humidity, precipitation, temperature, barometric pressure, dew point and provides data to calculate soil evaporation rates, which is used within the irrigation models. The farm is also able to use disease/pest prediction models which can direct the use of plant protection products in a timely and cost-effective manner.

The weather station also predicts conditions which are likely to increase the risk of disease/pest incidence. With the use of pheromone and sticky traps to capture pest species, a targeted and accurate use of plant protection products can be applied. The other benefit of the pheromone and sticky traps is that if pest threshold levels are exceeded then the farm's technician can approve the use of specific plant protection products to deal with this in a timely manner before elevated levels are reached.

Benefits of using pheromone traps:

- Monitors relative levels of pest activity during the season.
- Allows for decisions to be made on the basis of reliable estimates of pest numbers.
- Traps are species-specific.
- Used to determine spray requirements.

Biological control of insect pests is the only major alternative to the use of pesticides in agriculture.

Biological repellents (garlic extract and neem oil) are used to control certain target pest species. Formulations made of Neem oil have a use as a bio-pesticide, as it repels a wide variety of pests including the mealy bug, beet armyworm, aphids, the cabbage worm, nematodes and the Japanese beetle (not all of these are pests to lettuce). Neem Oil is not known to be harmful to mammals and birds or to beneficial insects such as honeybees and ladybirds. Garlic extract has a reputation as both a prevention and cure and there seem to be few pest species immune to their characteristically strong smells. With the use of these two natural products the requirement for manmade chemicals can be reduced, minimising negative impact on the environment.

EC

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The use of ongoing weather monitoring helps predict weather events and disease incidence, enabling appropriate, low impact, preventative actions to be taken.

EN

Biological repellents and sticky traps, are used on the farm, avoiding the negative environmental impacts associated with manmade chemicals.

Operations

A programme of plant breeding in conjunction with seed suppliers sees over 300 different varieties planted every week during the growing season, with the objectives of improving pest/disease resistant and growth characteristics for future generations. Only 1% of the trialled varieties make it to commercial production, and it then takes a further three years until full-scale field production. It is hoped that these new varieties will reduce the requirements for plant protection products and fertilisers required to produce a marketable lettuce.

Pest and disease strategies are planned out in conjunction with three specialist companies. DuPont develops caterpillar control, Sygenta fungus control and Bayer botrytis control strategies. It is hoped that by working directly with these companies the farm can control these conditions in the most effective way.

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EC

The farm runs a plant breeding programme, to develop resistant plants with strong growth characteristics. This will decrease the need for intensive inputs in future species.

Resources

The farm's subsurface drip irrigation (SDI) uses a temporarily buried dripper line located at the plant roots. These are placed at 15cm intervals and have a flow rate of 0.6 litres/hour. These lines are typically removed and reinstalled up to four times before new dripper line is required, and at the end of its life it is recycled. This system has become popular for row crop irrigation, especially in areas where water supplies are limited as it is the most efficient irrigation system. This type of irrigation method minimizes losses by allowing water to drip slowly to the root zone of plants. It can be 25% more efficient than other methods of irrigation as it does not incur the losses through evaporation that topical applications of water are subject to.

The farm has gone one step further with the introduction of a pressure compensated drip irrigation system, which is more expensive to purchase than the convention drippers but provides a higher degree of accuracy over the conventional system.

The farm is supplied with water from two sources and microbial testing is undertaken to ensure purity levels are consistently met. The main water source comes from the Guadiana Menor which flows into the huge Negratin Lake, the third largest of its kind in Andalusia, with a capacity of 5567Hm3. A large underground pipeline conveys water from the Negratin Lake to two large reservoirs in the local area and this provides water for both regional agricultural production and domestic use.

To date, the company has planted around 500 native trees, including Olive, Palm, Carob tree and Rosebay. When the weather improves after winter more planting will be carried out across the rest of the farms.

"Non pressure compensated drippers and drip-lines, regardless of manufacturer will have a degree of output flow variation along a length of drippers. This is caused as the drippers' output flow is directly related to the water pressure acting on it. On any drip-line there will be pressure loss caused by friction in the pipe so as you move down the line each dripper has slightly lower pressure acting on it so the dripper at this point gives a slightly lower flow. The relationship between pressure and flow is called the exponent and is a factor that manufacturer's measure. Netafim have an exponent of 0.4 to 0.46 dependant on dripper type, thus meaning if the pressure is increased by 100% on the dripper the flow will be increased by 40-46%. Lower quality drippers may have an exponent as high as 0.7.

In practice on short row lengths the exponent can be overcome by good hydraulic design but on slopes greater than 1% or on longer row lengths (20m+) the exponent does have significant bearing and a well designed system can easily have 20-30% difference in dripper output between one end of a drip line and the other. This means either part of the crop is over irrigated by 20-30% or part is under irrigated by 20-30% and with a corresponding situation where fertilisers are under or over-fed through the drip-lines."

(Technical explanation of the benefits of the pressure compensated irrigation system by Julian Gruzelier from Eden Irrigation)

EN

The farm's efficient irrigation systems maximise water for the crops while minimising waste.

Appendix

"We are very proud for being invited to participate in the McDonald's flagship farm programme, because we think it is a result of hard work throughout the years in the areas of quality, food safety and environmental issues. For us, it represents a challenge to improve the confidence of the consumers, producing safe and quality products in a sustainable way:

- *Optimising water and fertiliser use, sub-surface drip irrigation, soil moisture probes, and advanced fertigation technology.*
- *Introduction of new varieties, resistant to pest and diseases, and adapted to our conditions to obtain the highest quality all year round.*
- *Implementation of pest and disease control strategies developed in collaboration with the main chemical companies, optimising the efficiency and minimising residues.*
- *Producing safe products, very rigorously controlled by our quality control department, through a huge quantity of micro and residues analysis.*
- *Introducing environment integration programs in order to minimise the impact of growing.*

We have achieved several different quality certifications, based on good agricultural practices, quality, food safety, environmental respect and ethical trading. The final customers of our products would possibly be unaware of the effort and practices made to obtain these certifications and by taking part in the Flagship Farm project we can show a wider audience what we have achieved."

Antonio Marhuenda, Production Director at Primaflor

"The amazing array of technology and good practices at play here show what is truly possible in the production of agricultural products. There are practices that have been put in place because they have an economic benefit, but what has also been considered is the beneficial impact that they have on the environment. Reducing the requirements of fertilisers, pesticides and water is one of the most important and pressing sustainability aspects of modern agriculture and Primaflor have taken up this challenge."

Karl Williams, Flagship Farms Programme Manager, FAI