Future Expansion of the Dairy Industry in Cork: Economic Benefits and Infrastructural Requirements

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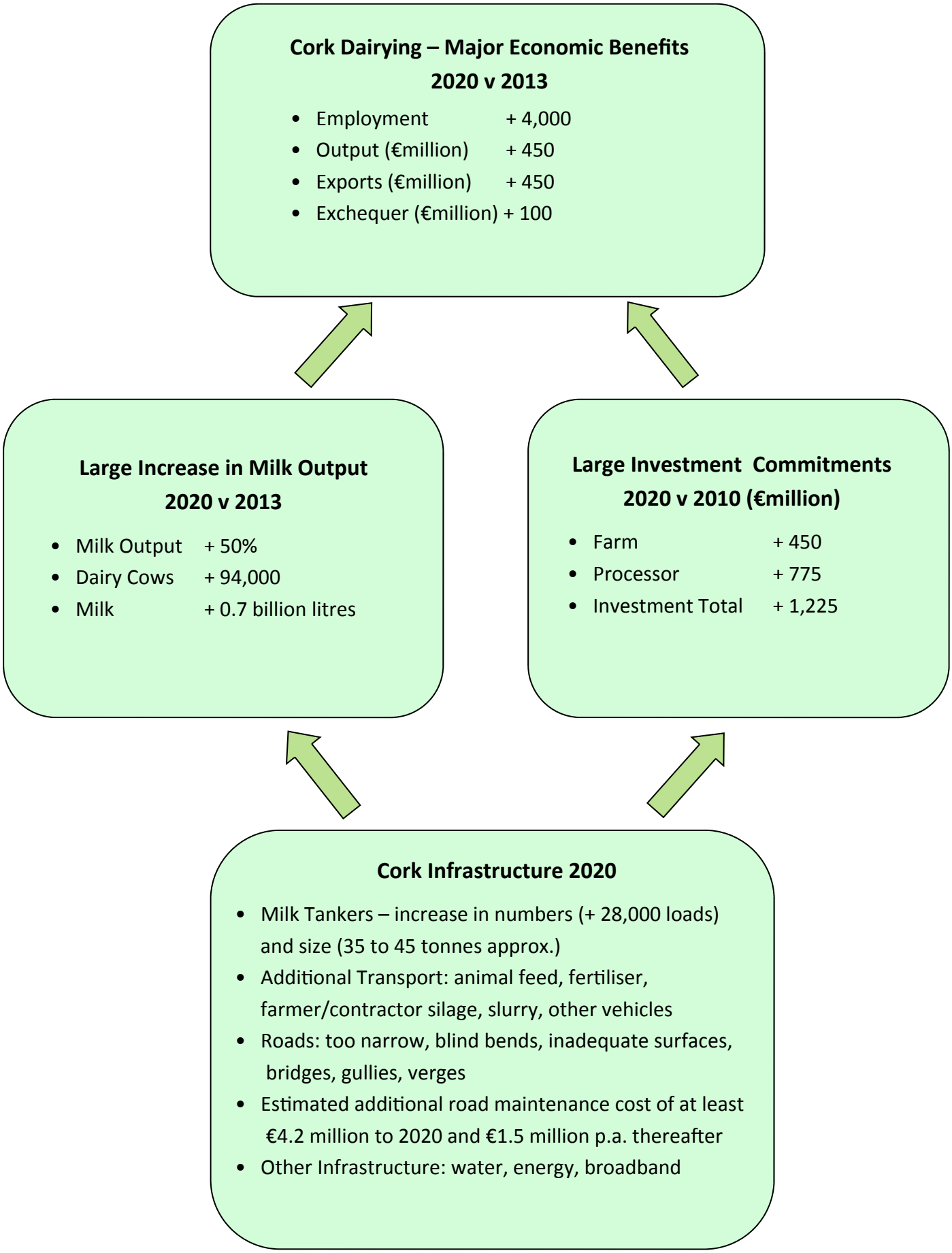


Executive Summary

Background to Study

- April 2015 heralds a new era in both Irish and EU dairying as it marks the expiration of milk quotas. From this date farmers will be able to expand production without the need to purchase milk quota rights for the first time since the introduction of milk quotas in 1984. This major policy shift will provide opportunities as well as challenges for the Irish dairy industry.
- Blessed with the natural advantages of a mild year round climate associated with the Gulf Stream, favourable soil, and rainfall, Ireland in general and Cork in particular, are uniquely placed to benefit from the opportunities now presented in dairying. Various studies of the competitiveness of Irish dairy farming all show that Ireland is one of the most highly competitive milk producers among all the major suppliers to the world market.
- The approach taken for this study involved a comprehensive literature review, distribution of questionnaires to milk processors and the agribusiness sector in Cork, and personal interviews with a very wide range of those involved with the dairy sector. Excellent cooperation was received from all and this provided the basis for a detailed assessment of the economic impact of dairy expansion to 2020 and a review of infrastructure requirements in the County to facilitate dairy expansion.

Expansion Estimates

- Cork is Ireland's leading dairy county with an output of over 1.4 billion litres of milk in 2013 which is in excess of 25% of the total Irish output. This milk output in Cork is provided by 4,500 dairy farmers with an average herd size of 70 dairy cows in 2013, which is significantly higher than the national average.
- The Food Harvest 2020 report (published in 2010) proposed a national target of a 50% increase in milk output by 2020 from a 2007-2009 base. As about a 10% increase from this base was achieved by 2013, this leaves a remaining target of a 40% increase by 2020. The survey of dairies in Cork resulted in a larger estimated expansion for the county from 2013 to 2020 of almost exactly 50%. This was generally consistent with opinions of interviewees from the wider industry, although there was regional variation in expected expansion within the county.
- Consultations with interviewees suggest that an increase in milk yield of 15% is achievable by 2020. With regard to dairy cow numbers, an increase in milk output in Cork of 50% from 2013 to 2020 combined with an increase in milk yield of 15% implies an increase in dairy cow numbers of about 30%. This represents an increase from 306,000 dairy cows in Cork in 2013 to approximately 400,000 in 2020.
- While survey results and personal interviews provided varying opinions, there was a general expectation that Cork dairy farmer numbers would change little by 2020 from 4,500 as in 2013. Based on this, the average herd size may increase in the county from 70 to approximately 90 cows by 2020.

- Precise estimation of the employment benefits of dairy expansion in Cork by 2020 is difficult and any estimate is inevitably subject to a margin of error. However, based on the valuable research literature available, a total increase in jobs of 4,000 in the county is estimated by 2020 associated with a 50% increase in milk output in Cork. This includes direct employment increases in dairy farming, milk processing and transport as well as indirect and induced employment in the wider economy in Cork. These would be long-term sustainable jobs with the prospect of further steady growth in the decade beyond 2020.
- In economic terms a net increase in output at farm level in Cork as a result of dairy expansion of about €225 million p.a. by 2020 is estimated. This may result in an output increase in the overall economy of close to €450 million p.a. by 2020. Account is taken of both the increase in output of milk and the decline in other enterprises that may be replaced by dairying. As virtually all of the increased output will be exported, this also represents increased exports from Cork of about €450 million on an annual basis by 2020. The tax inflow to the Irish exchequer by 2020 as a result of dairy expansion in Cork is likely to be about €100 million per annum.

Constraints and Risk Factors

- A number of constraints were considered, including land, labour and capital. With regard to land, farm expansion through land purchase is extremely difficult due to the exceptionally low level of land sales that occur each year, hence expansion will mainly occur through renting and leasing. Land scarcity for expansion is seen as a particularly acute problem in West Cork. Farm partnerships and contract arrangements such as heifer rearing may play an increasingly important role over time.
- It is estimated that there will be a demand for an extra 1,150 personnel at farm level in Cork to milk and manage the forecasted herd expansion by 2020. Given the demands of modern dairy farming, the skillsets required in terms of both technical and business skills will be high. The long working day as well as the physically demanding and complex nature of the work will also make recruitment a challenge and many interviewees stressed that expansion will require careful planning at farm level. More positively there has been very healthy growth over recent years in the numbers of young entrants to courses in dairying. The emphasis on supporting younger farmers in the recently agreed CAP reform to 2020 is also welcome.
- While some current dairy farmers engaged in modest expansion will be able to do so at limited cost, most expanding dairy farmers will incur significant additional capital costs. The additional costs are dependent on herd growth and the proportion of milk output growth accounted for by increased milk yields. Based on various studies at national level it is estimated that additional investment of about €450 million at dairy farm level in Cork over the decade to 2020 is required. The survey of dairies indicated investment of €775 million in milk processing in Cork from 2010 to 2020, giving a total investment in Cork dairying in excess of €1.2 billion. This illustrates the very large levels of capital required.
- Although EU policy constraints on milk output through the quota regime are being abandoned in 2015, there are important EU environmental constraints such as the nitrates directive and the obligation on European Union members to achieve the overall goals of the EU 20-20 by 2020 initiative which aims to reduce greenhouse gas

(GHG) emissions, increase the share of renewables in energy use and improve energy efficiency. Important studies on the implications of these environmental constraints for planned milk output increases by Teagasc and others indicate that, while environmental constraints may potentially impact on individual farmers, good farm practice supported by adequate advisory input can achieve both the environmental requirements and the output objectives of Food Harvest 2020.

- Since the major changes in EU dairy policy under the Luxembourg Agreement of 2003, volatility in price (milk and farm inputs) and income has become a major risk factor for dairy farmers when considering expansion. The successful management of price and income volatility will be most important if dairying is to fully capitalise on the opportunities available from expansion. There are an increasing number of options available, such as forward contracting and use of futures markets, and it is likely that these methods of managing price risk will be increasingly used in the future.
- There are a wide range of bovine diseases that can affect dairy herds and inhibit dairy expansion. These can have very serious consequences for individual herd owners and could be of even greater consequence as herds become larger and more intensive. Continuing research and veterinary advice will be required to achieve a healthy dairy herd as expansion occurs.
- While the climate in Cork in general is very favourable for growing grass, which is the cheapest source of fodder, there are times when weather conditions are far from optimal or desirable. The length and timing of the grazing season can vary dramatically as witnessed in the first half of 2013. While this can be viewed as atypical it should be noted that less extreme conditions, usually associated with prolonged or heavy rainfall or less occasionally prolonged dry conditions, are a feature of dairying in the county. Such events require supplemental feeding with expensive concentrates which adversely and significantly affect profitability.
- Overall, while there are a series of significant constraints and risk factors, Cork is particularly well positioned to achieve 2020 targets in dairying, At worst, these factors would only slightly delay the achievement of the targets.

Infrastructure Requirements

- In a recent report by Cork Chamber ***"Cork's Agri-Food and Drinks Opportunities"***, it was stated that "*Cork, with its long and rich heritage, abundant natural resources, intellectual capital and technical capabilities, has a major competitive advantage and distinctive opportunity to position itself as an agri-food region of leading capability in the global market. However and critically, in order to fully exploit and capitalise on these opportunities, it is critical that the optimal infra-structure, services, resources, supports and capabilities are in situ so that Cork's competitive advantage is harnessed and the now existing very rich and unique opportunities are not missed"*. In this report, infrastructure requirements were classified under the headings, roads: water, environmental, planning and other.

- Cork County Council is responsible for more than 12,400 km of roads, placing approximately 12.5% of the nation's roads under its remit. The challenge of developing and maintaining such a large and varied road network has been amplified in recent years given that the budget allocation has halved from a 2008 peak of circa €82 million to a current figure of circa €45 million. This reduced funding and the forecasted future requirements of the network was expressed as a primary source of concern amongst all of those interviewed for this study and was identified as a major barrier to attaining the growth forecast for the dairy sector mentioned in the previous page.
- Cork dairying is serviced by a very large fleet of milk tankers, animal feed and fertiliser trucks, farmer owned and contractors' silage, slurry and related equipment and product distribution both to and from Cork and other ports as well as to domestic wholesalers and retailers. All vehicles are steadily becoming larger and heavier and will increase substantially in numbers and travel longer distances in many cases in line with dairy expansion. The rural roads network in Cork, which is already very difficult to maintain with current budgets, will be placed under much greater stress with dairy expansion. Unless adequately addressed, the full realisation of the economic benefits of dairy expansion in Cork, which can have an important impact on growth in the national economy, will be seriously jeopardised.
- Based on the result of the interim study, on a very limited sample, it is estimated that Cork County Council will require an additional transportation infrastructure maintenance budget provision by 2020 of approximately €1.5 million per year (2014 costs), for pavement rehabilitation alone, to cater for the additional traffic loadings generated by the expansion of the dairy industry. In the interim period to 2020 an additional budget of at least €4.2 million will be required for pavement rehabilitation.
- Based on the rule of thumb that six litres of water are required on a dairy farm for each litre of milk produced, dairy farms in Cork producing 1.41 billion litres of milk in 2013 required about 8.5 billion litres of water. The projected milk output increase of 50% on Cork dairy farms from 2013 to 2020 represents an increase of slightly over 0.7 billion litres of milk which will require the usage of a further 4.2 billion litres of water on dairy farms, bringing the total usage on dairy farms in Cork by 2020 to 12.7 billion litres. Not alone is a high quality of water required on dairy farms, it must also come from a consistent and reliable source with adequate water pressure. Dairy farmers on group schemes and public supply have often felt that the inconsistent nature of these supplies meant that they themselves have had to invest in water provision on the farm. As a result, many dairy farmers have invested in private wells rather than rely solely on public or group water schemes for both consistency of pressure and cost reasons. However, to ensure security of supply and provide backup if required, many dairy farmers continue to avail of dual sources of water supply and it is important that all sources of supply meet the farmers' water needs.
- 2,285 agricultural holdings in Cork use a daily average in excess of normal domestic consumption (600 litres/ day). The distribution of these is mainly concentrated in the north of the county, and in areas west and south of Kinsale.
- Several schemes in the county are currently close to capacity or are unable to supply current peak demand. These include a number of schemes where there is significant water usage by dairy farmers. It is known that

some of these schemes require significant maintenance and capital investment including increases in storage capacity and/or leakage detection/repair.

- While some farm building work has been completed in advance, there is a sense that this is not nearly adequate to meet future projections. Interviewees highlighted the possibility of a likely surge in planning applications, particularly in 2016. Interviewees also highlighted that a short time window for some expansion activities at farm level exists, namely from November to January. This requires that all planning, banking, engineering, building and grant approval have to dovetail on a very tight timeline and it is important that all parties involved are fully coordinated to avoid extended postponement.
- The provision of state-of-the art energy and communications networks are increasingly important if modern dairy farming and processing are to be internationally competitive. With regard to energy, interviewees stated that both two and three phase networks were inconsistent leading to costly equipment damage on farms. It was stated that the greater adoption of technology at farm level has resulted in a greater use of electronic components which are very susceptible to interrupted power supply. As natural gas is the cheapest form of energy it was also strongly expressed by dairy processors and associated industries that a supply of natural gas should be available throughout the county. Given that a growing proportion of farm business is now conducted online, farming apps have become an increasingly important tool on many farms with most reliant on mobile networks. Hence, a fast and reliable broadband service was also considered a necessity for the farming community.

Cork – An International Dairy Hub

- With its rich dairy heritage going back to the leading international role of the Cork butter market in past centuries and its current strengths, Cork can properly be regarded as a significant international dairy hub. At farm level it is generally recognised that many of Ireland's leading commercial dairy farmers are based in Cork. Cork farmers were also the originators of the rapidly growing and highly successful farmhouse cheese sector and continue to be leaders in this industry. The farmhouse and small scale dairy products sector in Cork has also become highly diversified with equal market success and employment in an impressive range of dairy products. At processing level Cork is a base for international leaders such as Dairygold, Carbery and Kerry PLC. Macroom was chosen as a major European production site by Danone/Nutricia, a global leader in infant formula where its new state-of-the art production plant currently produces about 80% of the base powder for Europe with 22 different formulas. The Irish Dairy Board has recently announced that it has chosen Mitchelstown as its new national centre of excellence for butter packing and exporting, thus reinventing Cork's leading role of past centuries. With regard to support services for dairying, Teagasc Moorepark is recognised as a global leader in dairy research, while in dairy education and research UCC and CIT are also seen as international leaders. The Irish Cattle Breeding Federation (ICBF) based in Bandon operates the national cattle breeding database where the genetic evaluations and research performed in close association with Teagasc are used by dairy farmers throughout the country to make Cork and Ireland a global leader in science based dairy herd improvement. SWS

Business Services also headquartered in Bandon provides a wide variety of services for the Irish dairy sector including the national calf registration programme and has rapidly expanded to be a significant participant in international outsourcing services. Cork is also the location for a range of engineering and related services for the national and international dairy industry, with Charleville for example seen as a significant engineering hub. These and other services based in the county make Cork a leader in service provision for the national and international dairy industry.

Overall, it is clear that Cork is a significant hub for the Irish and international dairy industry with leadership in both products and services for the domestic and international dairy sector. However to maintain its position it is important that the planned expansion to 2020 is not constrained by infrastructural weaknesses within the county.

Future Expansion of the Dairy Industry in Cork: Economic Benefits and Infrastructural Requirements

Introduction

April 2015 heralds a new era in both Irish and EU dairying as it marks the expiration of milk quotas. From this date farmers will be able to expand production without the need to purchase milk quota rights for the first time since the introduction of milk quotas in 1984. This major policy shift will provide opportunities, as well as challenges, for the Irish dairy industry. These opportunities are perhaps best encapsulated in the Food Harvest 2020 (FH2020) strategy published in July 2010, Department of Agriculture, Fisheries and Marine (DAFM) 2010. Food Harvest 2020 provides an ambitious goal of increasing the value of primary agricultural output by 33% by 2020, relative to the average position in the 2007–2009 period. This sector level goal is supported by a number of detailed targets for key agricultural sub-sectors, the most ambitious of which is for the Irish dairy sector with a target to increase the volume of milk production by 50% by 2020. As a result of the desire by the EU Commission to ensure a soft landing by allowing five annual 1% increases in national milk quotas, Ireland is already part of the way to achieving its FH 2020 target. However, much of the target will have to be met in the relatively short period following April 2015. If the 50% goal is to be met then significant planning and investment will be required throughout the dairy supply chain. Giving the not insignificant lead time required to increase production at farm and processing levels, a certain amount of investment has already occurred or is committed. However, the ability and desire to fund any further investment will depend on the success and return from current expansion plans. In order to increase the probability of success it is vital that all infrastructural requirements are outlined and any bottlenecks or problems addressed. The purpose of this report is to outline the potential benefits for Cork and the wider economy of dairy expansion in Cork and to identify the current and potential infrastructure requirements along with possible choke points.

Method and Report Outline

The approach taken involved a comprehensive literature review, distribution of questionnaires to milk processors, milk transporters, and animal feed manufacturers in Cork, and personal interview with a very wide range of those involved with the dairy sector, such as the farm organisations, DAFM, Teagasc, and personnel from the extensive range of services that engage with the dairy supply chain. This provided the basis for a detailed assessment of the economic impact of dairy expansion to 2020 and a review of infrastructure requirements to facilitate dairy expansion.

In the next section, a brief background to the EU milk quota policy is provided together with a few significant developments in Irish dairying during the 30 years of milk quotas 1984-2014. Next a brief review of Ireland's dairy

competitiveness is provided which forms the basis for the expected large increase in milk output by 2020. Then the issue of the availability of markets is discussed through a summary of expected demand and supply over the next decade in global dairy markets. This is followed by a discussion of the role of dairying in Cork, together with the potential for expansion in the county post April 2015. Then the prospects in Cork for additional employment, economic output and exports arising from dairy expansion are considered. This is followed by consideration of some of the constraints and risk factors which could potentially jeopardise the potential expansion. Next the infrastructure requirements to meet this expansion are outlined, together with key infrastructural issues and constraints. Finally, a summary section where conclusions are drawn is presented.

The EU Milk Quota Policy and Irish Dairying

When Ireland joined the EU in 1973 Irish milk production more or less doubled in a decade reflecting the very favourable market conditions and Ireland's unique attributes for milk production within Europe. However, the much higher guaranteed product prices under the EU dairy policy regime stimulated ever expanding milk production throughout the EU which, when combined with static internal dairy products consumption, led to a rapidly growing imbalance between EU milk production and internal consumption. The growing surplus had either to be sold at very high public subsidy on low priced world markets at that time or stored in increasing volumes in public (intervention) storage. This led to a fundamental policy decision in 1984 to impose milk quotas on each country, dairy and milk supplier with a prohibitive fine (the superlevy) if quotas were exceeded. In the recently ended 2013/2014 quota year for example, Irish milk supplies were 0.65% over quota and a superlevy bill in excess of €10 million arises. Dairy farmers who were over their quota and who supplied over quota dairies will have to pay this fine set at 28.7 cent per litre on all over quota milk on their farms. This milk quota policy completely halted the rapid Irish dairy expansion of the 1970's and early 1980's, with the quota system only now being abandoned in April 2015.

Regarding the market crisis that led to the introduction of milk quotas, fortunately both the world and Irish dairy markets have been completely transformed from the 1980's era. Growing world demand for dairy products led by world population growth, steadily increasing incomes, especially in China and other Asian countries, the westernisation of diets and the development of attractive innovative products on the supply side has meant that world dairy market prices have risen very substantially and in recent years are very similar to internal EU market prices. With about 85% of Irish products being exported, dairy product export returns in 2013 were €3 billion approx. Bord Bia (2014). As the targeted 50% expansion in milk output would be almost entirely for export, the scale of the returns in terms of export earnings and the benefit to the Irish economy is clear.

As a consequence of the EU milk quota policy, Irish milk output has remained largely static for the last 30 years at between 5.0 and 5.5 million tonnes, with small variation from year to year due to minor

policy changes, weather conditions or economic factors. While milk supply has remained largely static the number and herd size of suppliers has changed dramatically, with milk supplier numbers falling from 97,000 in 1973, the year of EU membership, to 68,000 in 1983, the commencement of quotas introduction to about 18,000 currently. Average herd size has increased from 14 and 22 in 1973 and 1983 respectively to approximately 65 dairy cows in 2013, Table 1.

Table 1 Changes in Dairy Herds and Cow Numbers, 1973 - 2013

	Dairy Herds '000	Dairy Cows '000	Average Herd Size, Dairy Cows
1973	97	1362	14
1983	68	1509	22
1993	43	1269	29
2003	27	1156	43
2013	18	1163	65

Source: CSO

A summary of recent Irish dairy statistics shows that average annual milk sales per producer has been steadily rising and has now reached approximately 300,000 litres, Table 2.

Table 2 Selected Irish Dairy Statistics

	2010	**2011**	**2012**	**2013**
Total Number of Producers	18,294	18,263	18,138	17,958
Milk Sold off Farms Mill. Litres	5,137	5,327	5,233	5,421
Total Dairy Cow Numbers '000 June	1,071	1,117	1,141	1,163
Milk Sales per Producer (Litres)	282,770	291,683	288,510	301,418
Yield per Cow (excl. on-farm)	4,830	4,769	4,586	4,661
Average Cows per Producer	58.5	61.2	62.9	64.7

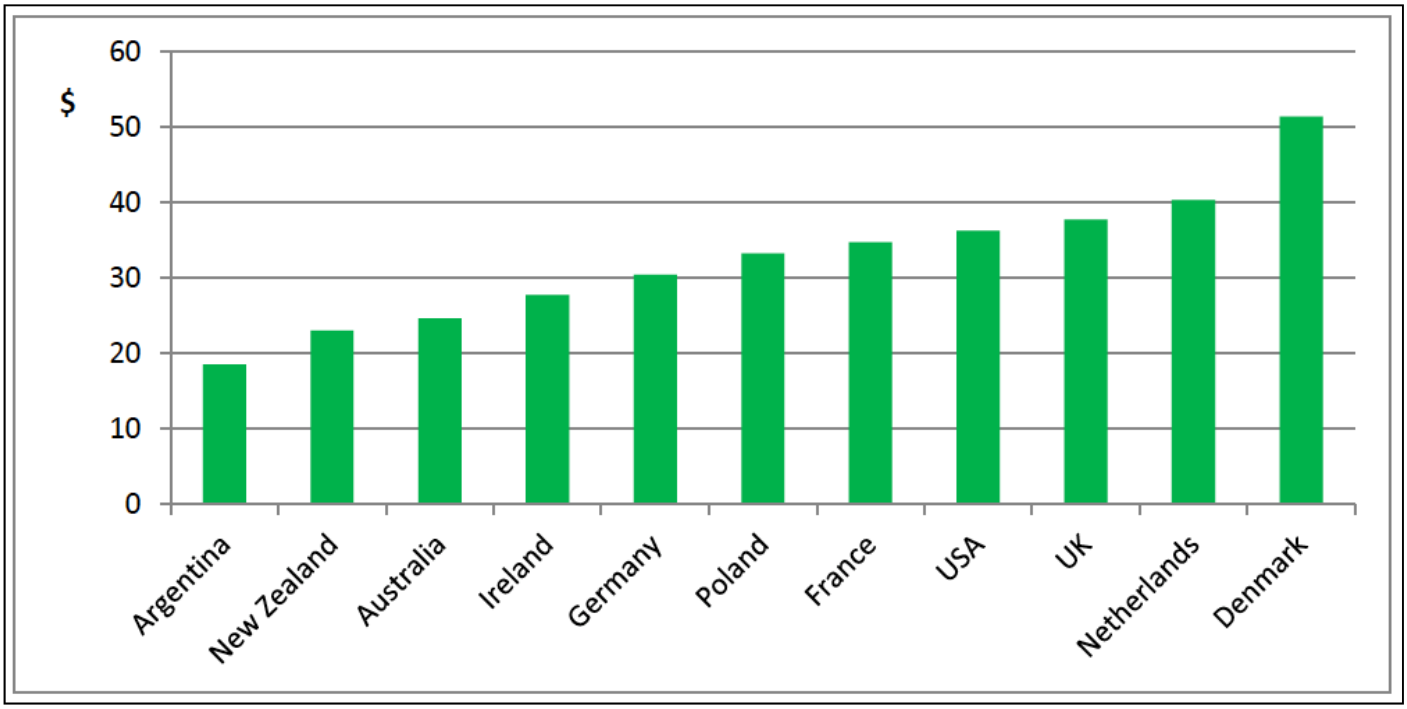
Source: DAFM, CSO

Ireland's Competitive Advantage in Dairying

Blessed with the natural advantages of the mild year round climate associated with the Gulf Stream, favourable soils and rainfall, Ireland is uniquely placed to benefit from the opportunities now presented in dairying. Various studies of the competitiveness of Irish dairy farming all show that Ireland is one of the most highly competitive milk producers among all the major suppliers to the world market, Rabobank (2014), IFCN (2012), Donnellan (2011).

International Farm Comparison Network (IFCN) data show that, for average sized dairy farms for 2011, Argentina, New Zealand, and Australia had the lowest estimated costs, however Ireland came next and then a range of European countries with USA similar to a middle ranking European country, Figure 1.

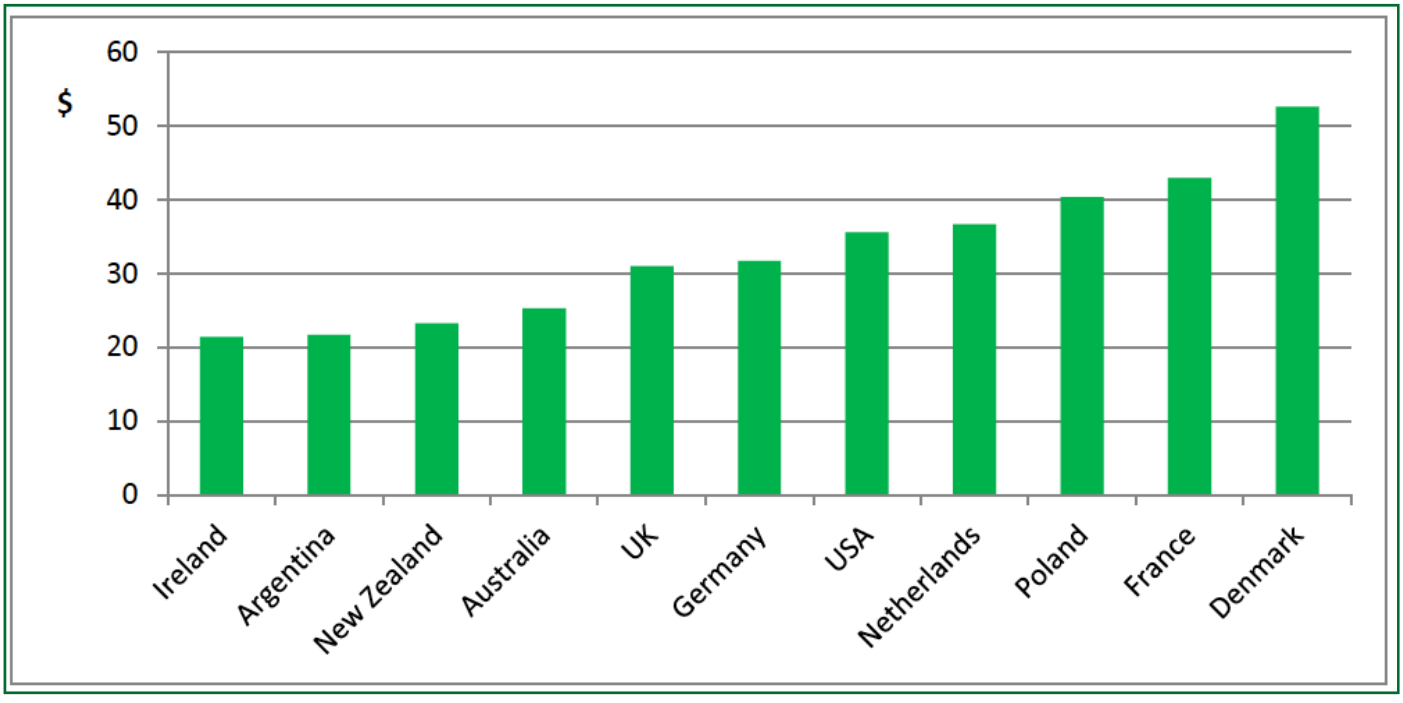
Figure 1 Cost Comparison: "Average" sized dairy farms ($/100KG Milk)



Source: IFCN (2012)

There was a very interesting change in the rankings for 2011 if larger dairy farms are considered, Fig 2. In this case larger farms in Ireland (110 cows) had the lowest cost of all those compared, reflecting perhaps the very favourable dairy situation in Ireland in 2011. Ireland was then followed by the three southern hemisphere countries as expected, and then the other European countries with USA in the middle, Figure 2.

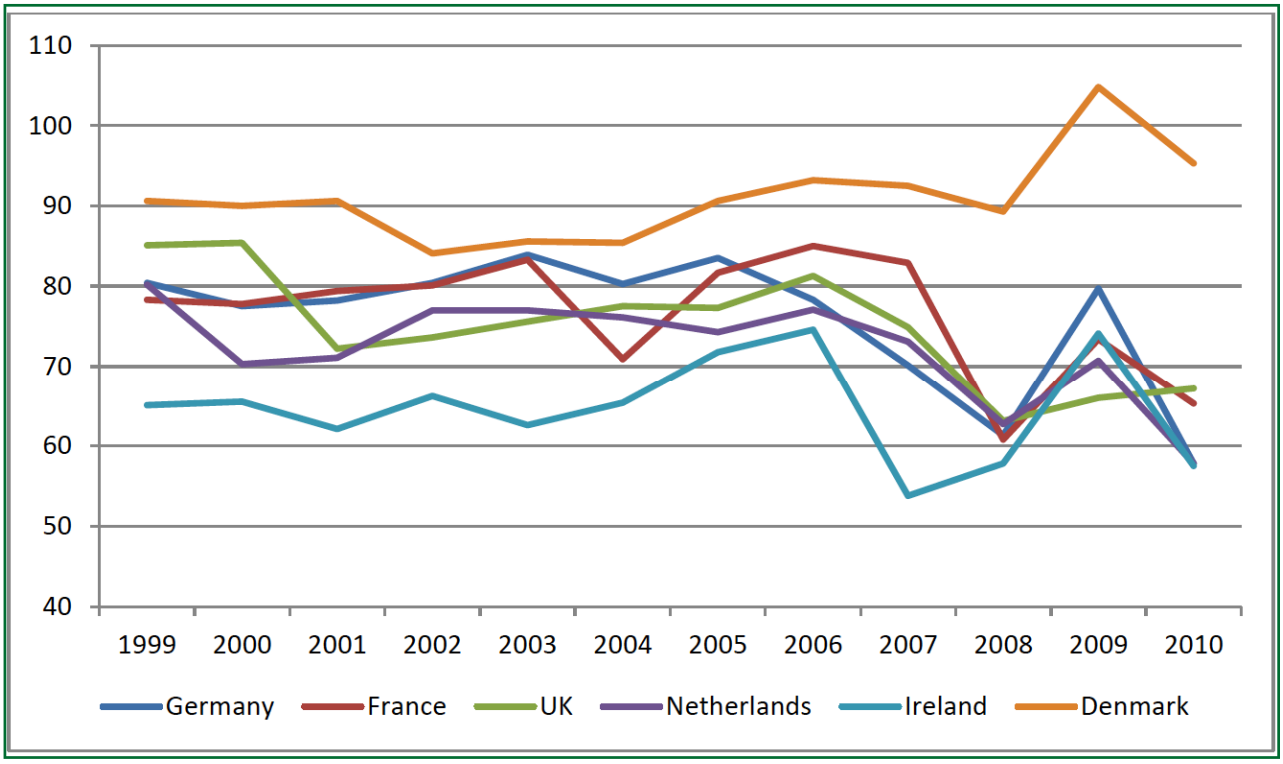
Figure 2 Cost Comparison: "Large" sized dairy farms ($/100KG Milk)



Source: IFCN (2012)

A comprehensive dairy competitiveness study by Teagasc also showed that Ireland was one of the world's most competitive dairying countries over the 15 year period 1996-2010, Teagasc (2011). Based on cash costs as % output as a good indicator of dairy farm competitiveness, Ireland was consistently the most competitive among the major EU dairy countries, Figure 3. Of non-EU countries it was found in this study that, for the main competitor countries, Argentinian herds had the lowest cost on average in the period 2008-2010, then the Irish 110 cow and New Zealand and Australian large cow herds. These lower cost herds were then followed by the typical US herds in Wisconsin, California and Texas. The highest cost herds were the typical farms in Idaho and the North East of USA and the small Polish farm, Teagasc (2011).

Figure 3 Cash Costs as % of Output



Source: Donnellan (2011)

A recent report by Rabobank also showed that, for six major exporting regions including Ireland, New Zealand and Australia, Ireland was consistently among the lowest cost milk producer over the period 2006-2012, Rabobank (2014).

It is clear from these various studies that Ireland is a highly competitive dairying country internationally and is well placed to engage in major expansion when milk quotas are removed if economic conditions are favourable and necessary supports and infrastructure are in place.

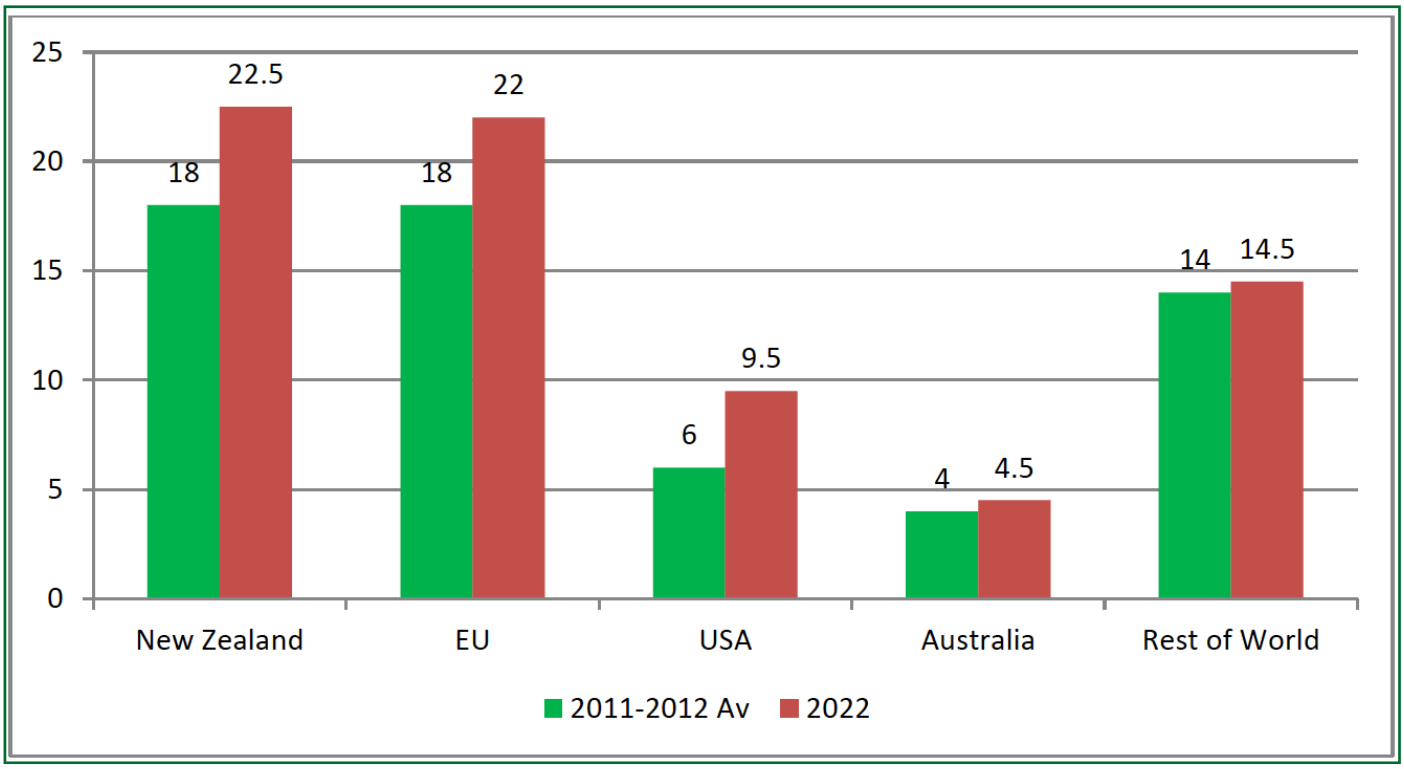
International Market Opportunities

World milk production and consumption at about 740 million tonnes pa in 2013 have been expanding by about 15mt or over 2% pa over the last decade and are expected to continue expanding at close to that rate over the decade ahead, OECD-FAO (2013). Given that a targeted 50% expansion in milk output in Ireland by 2020 involves about 2.5 billion tonnes of additional milk, this can be put in the context of about a 150 billion tonnes expected

increase in milk products consumption and production globally. World milk products trade, currently at about 60 mt. pa (excluding intra-EU trade), is only about 8% of world milk production and is projected to expand by about 13mt (+20%) to about 73mt by 2022, OECD-FAO (2013). Ireland is a significant participant in world trade and the targeted expansion of 2.5 billion tonnes milk by 2020 would all be for export. Globally New Zealand and EU, each at about 30% of world exports, dominate world trade followed by USA (10%), Australia (7%) and Argentina (3%). The EU is estimated to increase production by about 5% (+8mt) by 2022, with the increase fairly evenly divided in consumption terms between domestic consumption and exports (+4mt each), European Commission (2013). New Zealand is also projected to increase exports by 4.5mt and USA by 3mt, leaving both EU and New Zealand still dominating exports at close to 30% each by 2022, Figure 4. The worlds' leading importers are far more diverse, led by North Africa (10%), Russia (8%), China (7%) and Mexico (5%). China (+65%) is projected to expand imports by the highest level to 2022, with North Africa also very prominent (+42%) along with a very diverse range of growing world importers (+61%), Figure 5. Much of the growth in demand is likely to come from Asian countries which are rapidly growing in population and income and have increasingly western food preferences, and also from middle-eastern and African countries.

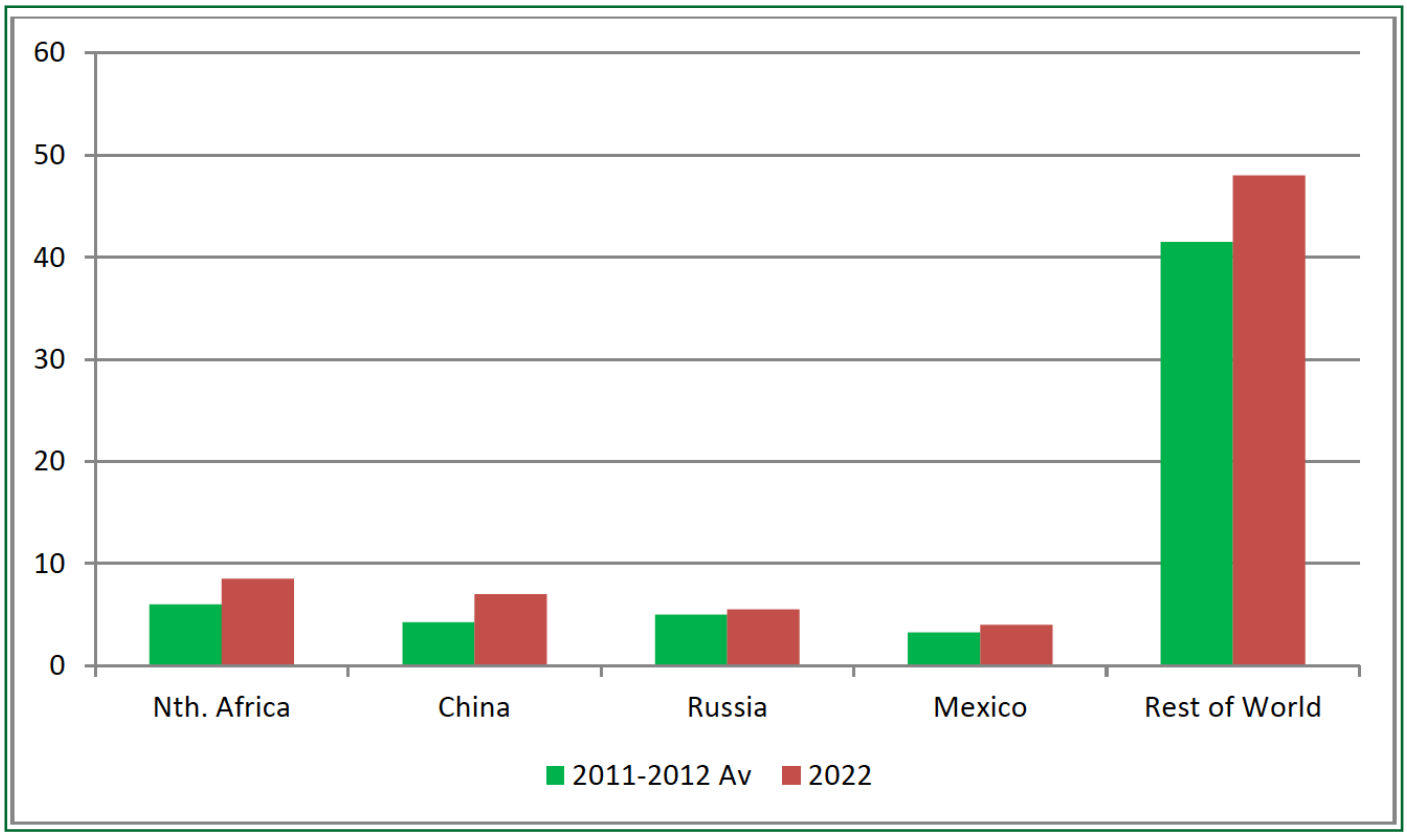
A recent Dairy Outlook report from the highly respected Rabobank "*sees a future for dairy characterised by solid market growth—to some extent the envy of the food world. That growth will be dominated in particular by developing markets, many of which will require outside assistance to supply enough product to meet rising appetites for dairy. This will sustain an era of trade growth and provide a substantial opportunity for many farmers, traders and processors in export regions*", Rabobank (2014)

Figure 4 World Dairy Exports, ml. Tonnes, Milk Equivalent



Source: OECD-FAO 2013

Figure 5 World Dairy Imports, ml. Tonnes, Milk Equiva-



Source: OECD-FAO 2013

The Role of Dairying in County Cork

Table 3 Summary Agriculture Data for Ireland and County Cork

	County Cork	Ireland	County Cork as % of Ireland
Number of farms	14,222	139,860	10.2
Average size of farm	38.1ha	32.7ha	116.5
Agricultural area used (Including commonage)	561,807ha	4,991,353ha	11.3
Total grassland	493,120ha	3,777,734ha	13.1
Dairy farms	4,521	18,456	24.5
Specialist dairy farms	4,037	15,654	25.8
Operating milk quota (billion litres)	1.41	5.61	25.1
AWU*	18,780	168,388	11.2

Source: CSO Census of Agriculture 2010 and DAFM, various publications.

***Annual Work Unit (AWU):** The labour input of each person who worked on the farm was measured in terms of AWUs with one AWU being defined as 1,800 hours or more of labour per person per annum.

With an area of 750,000 hectares Cork is the largest county in Ireland accounting for 8.88% of the national area (CSO). Just over 10.2% of Ireland's almost 140,000 farmers are based in the county, Table 3. Average farms in Cork are more than 16% larger than the national average. While Cork accounts for 11.3% of agricultural area used (including commonage) its proportion of national grassland is even higher at 13.1%, Table 3. This may be explained by the fact that Cork is endowed with all of the natural advantages for producing grass such as good soil, a favourable mild climate under the influence of the Gulf Stream and moisture bearing south westerly winds.

These favourable conditions have resulted in Cork being the dominant dairy county in Ireland with about a quarter of dairy farms and an even higher proportion of specialist dairy farms located within the county, Table 3. With more than 306,000 dairy cows in 2013 (or 26.3% of the national dairy herd) the significance of dairying in Cork and its contribution nationally, is undeniable, Table 4.

Table 4 Dairy Cow Numbers Cork and Ireland ('000 Head)

	Cork	Ireland	Cork as % of Ireland
2010	284.1	1,070.8	26.5
2011	295.3	1,116.9	26.4
2012	295.5	1,140.0	26.2
2013	306.4	1,163.0	26.3

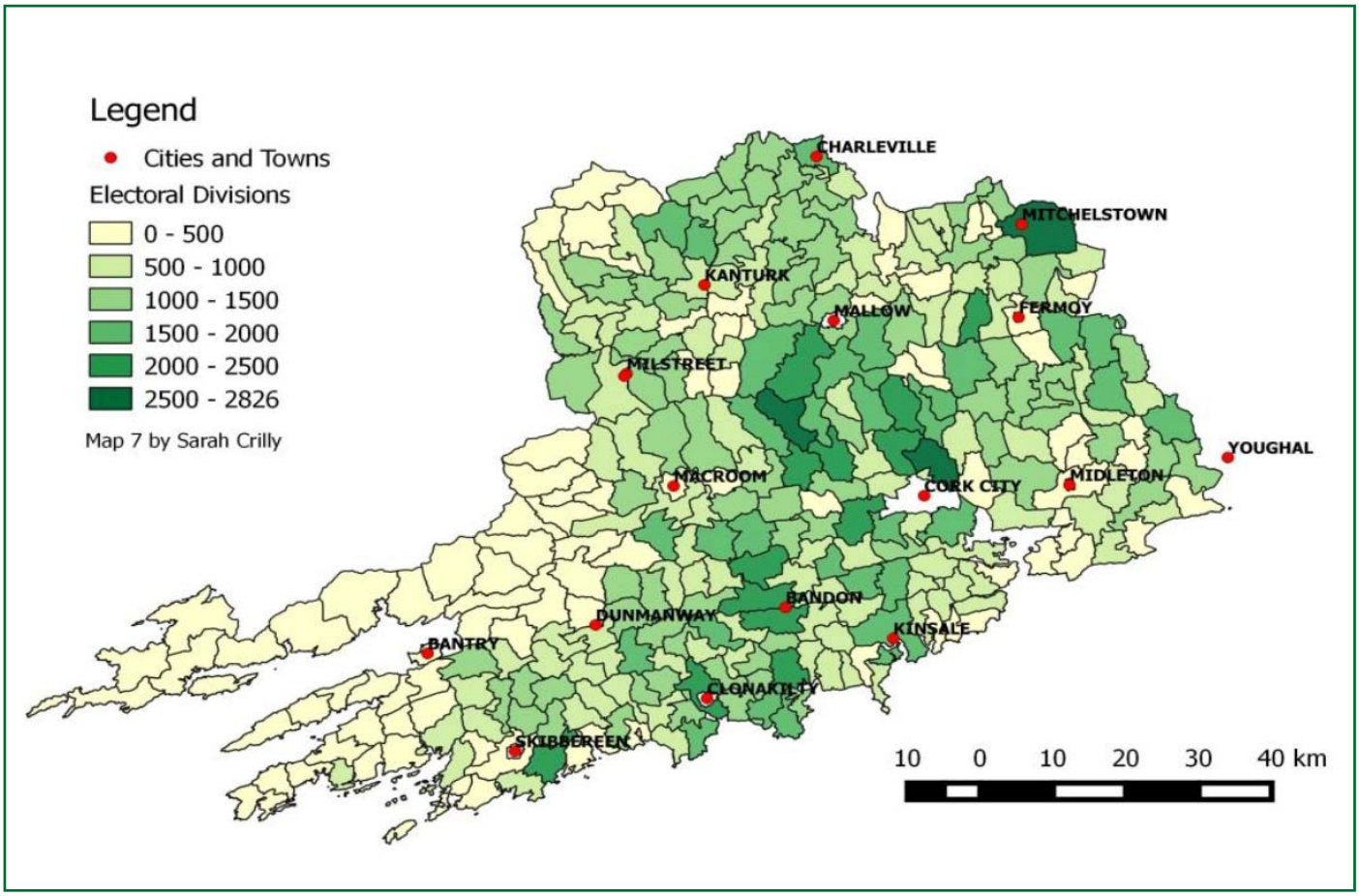
Source: June livestock survey, CSO

As can be seen in Figure 6 dairy cows, and hence farms, are located throughout the county's 309 ED's (electoral districts) with the exception of three[1]. However it is clear that dairy cows are more concentrated in certain locations within the county. Intensive dairying is a particular feature especially across the whole middle region of the county stretching from the whole south west (Skibbereen, Clonakilty, Dunmanway, Bandon districts) through mid and north Cork (Macroom, Kanturk, Newmarket, and Charleville districts) to East Cork (Fermoy, Mitchelstown districts). The only regions where dairying is less intensive relative to other farm enterprises are in the extreme western peninsulas e.g. Beara, Figure 6, and to some degree the south east of the county where intensive tillage crops feature strongly (Appendix 2).

However, as Figure 7 shows the distribution of dairy cows changes over time and, while the DED's (district electoral divisions) in the Beara peninsula and the most southern parts of the county have low dairy cow numbers, many have seen an increase in more recent times.

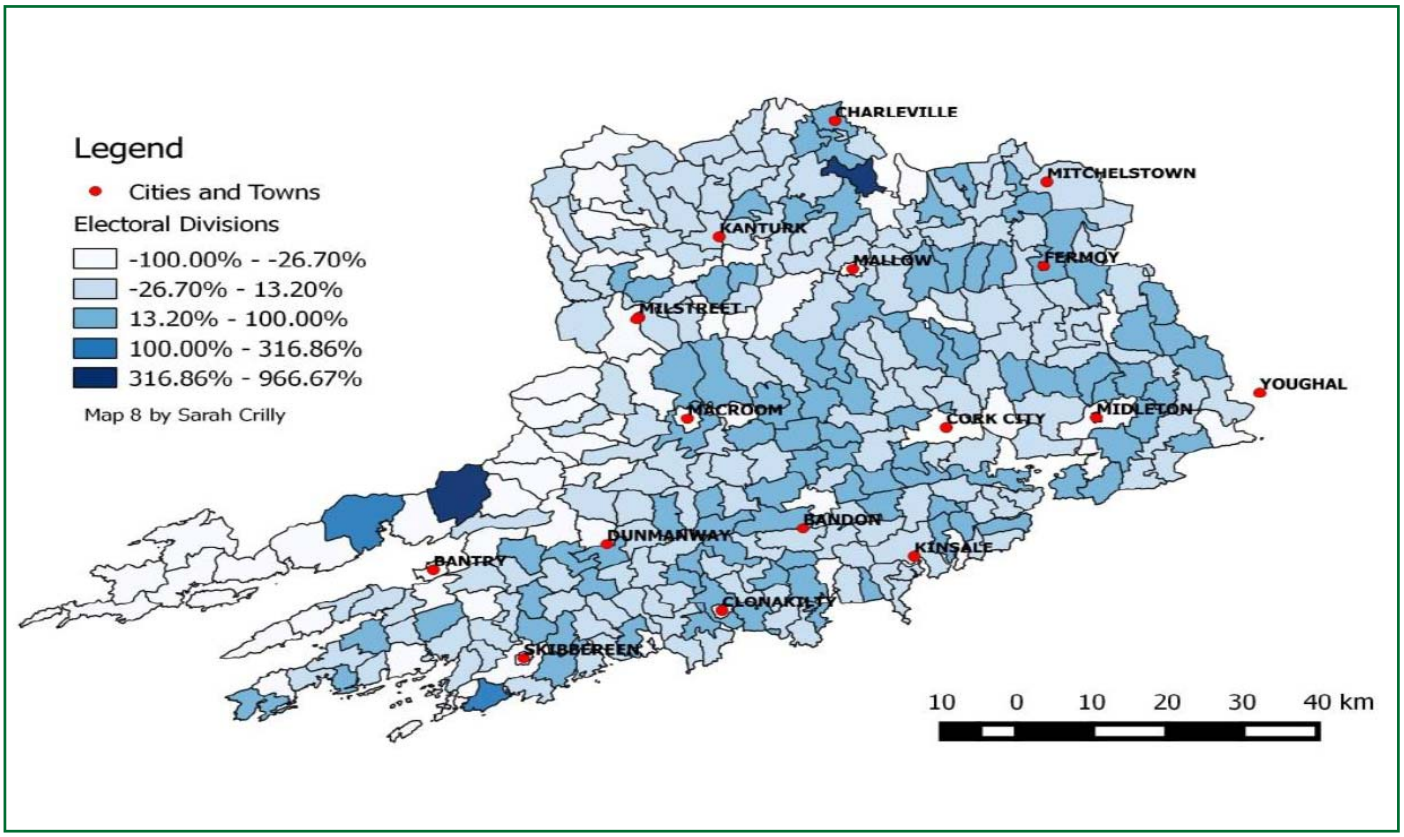
[1]There are a further 7 DEDs with less than 50 dairy cows

Figure 6 Distribution of Dairy Cows in County Cork based on 2010 Agricultural Census



Source: CSO Census of Agriculture 2010

Figure 7 Percentage Change in Dairy Cow Numbers, 2000 to 2010



Source: CSO Census of Agriculture 2010

Calf records for 2013 show that Cork, with close to 300,000 dairy calves, accounted for 26.5% of all dairy calves in the country, Table 5. About 80% of all calves born in Cork were dairy calves and Cork had the highest ratio of dairy to total calves of any county in Ireland. This emphasises the unique specialist position of Cork in Irish dairying.

Table 5 Calf Records 2013

	Dairy Calves '000	**Total Calves '000**	**% Dairy**
Cork	292.6	368.3	79.5
Ireland	1,104.1	2,094.9	52.7
Cork as % of Ireland	26.5	17.6	

Source: DAFM Bovine Statistics, 2013

Potential for Expansion

In terms of quantifying the farm level potential for expansion and the location of this expansion in Cork two studies in particular should be noted. Loughrey *et al.,* (2012) provided spatial analysis regarding the economic impact upon West Cork of dairy expansion under the FH2020 programme. While the study is primarily concerned with the findings for the West Cork area, projections at the county and national level are also provided. In general the projections indicate that Cork will benefit substantially post quota with an aggregate increase of 12.5% in forecast annual family farm income. However, the report indicates large variability in projected farm income and the percentage change in projected farm income following the quota reform. Indeed many farms in the county are forecast to exceed 20% in income increases and compare very favourably with the most positive national results. Overall the study predicts milk output in the county may expand by approximately 480 million litres with most parts of the county forecast to experience an increase in volume in excess of 30%. Applying a projected milk price of 33.78 cent per litre Loughrey *et al.,* (2012) estimated that there would be an increase in total projected output of €131.4 million for the West Cork region. On a pro rata basis this would equate to an increase in output of €312.2 million at county level. Finally household income in the entire country was estimated to increase by about €60 million as a result of dairy expansion, with most of this likely to remain within County Cork given the location of milk plants in the county, Loughrey *et al.,* (2012).

Läpple and Hennessy (2012) simulated the expansion capacity of Irish dairy farms and investigated the likelihood of reaching the FH2020 dairy target. Using a combination of assumptions a number of expansion scenarios were investigated. In the most optimistic price scenario, they conclude that, even with substantial productivity gains and a substantial number of new entrants, the milk volume target could not be reached without some expansion of the existing dairy farm land base. They also found that future potential milk output depends largely on the rate of structural change and productivity growth as well as on real milk prices. Their regional analysis reveals that, relative to other regions, the south (Cork and Waterford) has the greatest expansion capacity. These results suggest that quota removal could cause significant regional restructuring of milk production within the country and will most likely present challenges to the dairy processing sector.

Economic Benefits of Expansion for Cork County

A survey of dairies in Cork was undertaken to elicit information about the current dairy situation and expectations to 2020. A questionnaire was distributed to dairies representing virtually all milk intake in Cork and a wide range of issues were considered, including numbers of milk suppliers, expected milk volume increases, expected employment changes, investment in milk processing and exports. In addition, opinion was obtained on infra-structure requirements to facilitate dairy expansion, including the road network, water supplies and waste management. The response to the survey was excellent with respondents representing about 95% of all milk intake in the county. In addition to the survey of dairies, a very wide range of opinion was sought from other industries and organisations associated with the dairy sector, including farm organisations, animal feed suppliers, fertiliser suppliers, transport, dairy engineering, veterinary, banking, farm accounting, other farm services, DAFM, Teagasc, Irish Dairy Board, ICOS, Cork County Council Mayor, Councillors and relevant staff. A full listing of consultees is provided in Appendix 1.

With regard to milk supply increases in the county, the survey of dairies indicated a stronger increase in milk output in Cork by 2020 compared with the FH2020 national target. The FH2020 national target referred to a 50% increase in output by 2020 compared with a base of 2007-2009 annual average. As close to 10% of this target has already been achieved by 2013, this results in about a 40% targeted further expansion by 2020. The survey of dairies in Cork resulted in an estimated expansion from 2013 to 2020 of almost exactly 50%, Table 6.

Table 6 Survey of Cork Dairies, Milk Intake

Year	Million Litres	2013 = 100
2010	1,389	97
2013	1,426	100
2016	1,691	119
2020	2,136	150

Note: The survey involved dairies with milk intake of about 95% of all the milk in Co. Cork

If it assumed that Cork has also had an expansion of around 10% by 2013 relative to the 2007-2009 annual average base, similar to the national increase, then this represents about a 60% increase in milk output in Cork by 2020 relative to 2007-2009 annual average. This conclusion of a higher growth rate in Cork compared with the national average is consistent with conclusions on regional differences in milk output growth completed by Teagasc which involved an expectation of greater expansion in Cork and the South and South-West of the country as already discussed, Lapple and Hennessy (2012).

Table 7 Estimated Domestic Milk Intake by Dairies

	Cork		Ireland	
	Litres, billion	2007 - 2009 Index Average = 100	Litres, billion	2007 - 2009 Index Average = 100
2007 - 2009 Average	1,270	100	5,074	100
2013	1,410	110	5,600	110
2020	2,115	166	7,600	150

Source: CSO, Authors' estimates

Opinions of interviewees from the wider industry and relevant organisations on milk output increases to 2020 were varied, with some suggesting a possible increase in milk output in Cork of up to 60% from 2013 to 2020, however others were more conservative. Overall, growth of 50% from 2013 to 2020 in Cork, as concluded from the survey of dairies, was in broad agreement with the wider group. When this increase is applied to the "official" DAFM estimate of milk output for Cork in 2013 of 1.41 million litres, the result for Cork in 2020 is approximately 2.1 million litres, Table 7.

With regard to the years up to 2020 it was generally felt that, given favourable conditions, in particular weather conditions and milk plus farm input prices, this expansion could see a likely initial surge of more than 20% in Cork in the period immediately following the abolition of milk quotas (2015 and 2016). Should these conditions prevail then additional expansion will be at a more modest rate thereafter leading to a 50% increase overall for 2013-2020. An initial surge in milk output following the abandonment of quotas is currently indicated by increased dairy heifer numbers on farms. Significant short term milk yield increases can also be expected. Under the milk quota regime milk yields have been artificially suppressed through early drying off of cows in the autumn/winter, once-a-day milking, feeding milk to calves etc. Secondly, productivity per cow is steadily increasing, led by Teagasc Moorepark located in the county where dairy farming researchers are at the cutting edge of research internationally and enhanced communications with dairy farmers through for example dairy discussion groups. The latter activity was considerably boosted by the 2009-2013 Knowledge Exchange (Dairy Discussion Group Scheme (DEP/DPD) where circa 7,000 milk producers attended facilitator-led discussion groups and completed relevant tasks, with the programme incentivised by DAFM. Furthermore, many of the leading commercial dairy farmers in the country are in Cork and are showing the way forward for all dairy farmers, as for example, the hugely attended open days in Teagasc, Moorepark and also on the Browne dairy farm in Killeagh where current milking involves 820 dairy cows (IFJ, July 2014).

With regard to regional variation within Cork, there is an acknowledgement that expansion will not be evenly distributed, with a number of interviewees believing that the limited milking platform on the home farm, in particular in West Cork, will lead to somewhat lower overall growth in this region.

This expansion in dairying in Cork will be driven by two factors, increasing cow numbers and increasing milk yield per cow. Consultations with interviewees and in particular with Teagasc, Moorepark personnel suggest that an increase in milk yield of 15% is achievable by 2020. With regard to dairy cow numbers, some interviewees have suggested that an increase of about 350,000 dairy cows nationally by 2020, or 30% from the current base of 1.16 million cows, is achievable. However a national increase of 40% in milk output from 2013 to 2020, as is consistent with FH2020 as discussed above, combined with a yield increase of 15%, implies an increase in cow numbers by 2020 of 22% (1.15 multiplied by 1.22 =1.40). With regard to Cork, an increase in milk output in Cork of 50% from 2013 to 2020 combined with an increase in milk yield of 15% implies an increase in dairy cow numbers of about 30% (1.15 multiplied by 1.3 =1.495). This represents an increase from 306,000 dairy cows in Cork in 2013 to 400,000 approx. in 2020, Table 8. All other economic and related estimates discussed later are based on the 2020 milk yield, cow numbers, and milk output estimates in Table 7 and Table 8.

Table 8 Estimated Milk Yield and Cow Numbers

	Cork		**Ireland**	
Milk Intake Increase 2013 - 2020, %	50		40	
Milk Yield Increase 2013 - 2020, %	15		15	
Dairy Cow Numbers Increase 2013 - 2020, %	30		22	
Dairy Cows	Nos	%	Nos	%
2013	306	26.5	1,163	100
2020	398	28.0	1,419	100
Increase in Dairy Cow Numbers	92	35.9	256	100

Milk Suppliers

Information from DAFM indicated that there were 4,500 milk suppliers in Cork in 2013 and the survey of dairies resulted in an estimate which was quite consistent with the DAFM data, Table 7. With regard to future numbers of milk suppliers, the survey of dairies suggested a modest increase of 3.5% by 2020, Table 9. Consultations with personnel from the wider dairy supply chain provided varied opinion on future supplier numbers, with some suggesting an increase to 2020 while others thought there would be a modest but gradual decline.

Table 9 Milk Supplier Numbers Cork, Survey Results

Year	**Milk Supplier Nos.**	**2013 = 100**
2013	4,272	100
2016	4,348	101.8
2020	4,500	105.3

Note: The survey involved dairies with milk intake of about 95% of all milk in Co. Cork

Dairy farming will inevitably involve changing personnel, with some farmers retiring and being replaced with new entrants. Successful schemes to encourage new entrants have been developed by DAFM in recent years and information received from DAFM indicates that there have been 90 new entrants to dairying in Cork since 2010. With the abandonment of milk quotas in 2015, entry to dairying will now be possible without the cost of quota purchase which, combined with the training programmes in place, should further assist entry in the years ahead.

Investment

The investment required at farm level for this expansion is very considerable. Nationally a 50% expansion in milk output by 2020 has been estimated to involve €1.5 billion investment at dairy farm level as discussed in more detail later. On a pro rata basis this would involve investment of about €450 million on dairy farms in Co. Cork between 2010 and 2020. This will greatly enhance many local businesses and communities in the county, from building and construction to equipment suppliers and the great variety of services required by modern dairy farms.

The results from the survey of dairies in Cork indicates that the level of investment in dairy processing is higher than previous estimates for the country in total, such as Irish Farmers Journal (2014), Boyle (2012), Keane (2010). With regard to milk processing it has recently been estimated that planned or recent investment in Irish milk processing sites in the State stands at €623 million, with Cork alone accounting for €305 million of this sum or close to half of the total, Irish Farmer Journal,(2014). This reflects the particular focus on dairy expansion in the County in the years ahead. Based on the survey of Cork dairies in this study, processing investment in Cork alone is estimated to be about €775 million between 2010 and 2020 for those dairies that completed the survey, Table 10.

Table 10 Investment in Cork Processing, 2010 - 2020, € million

2010 - 2014	2015 - 2020	Total 2010 - 2020
270	505	775

Source: Survey of dairies. Note: Not all Cork dairies included

There will also be a major investment in milk tankers in Cork by 2020. Currently Cork dairying is serviced by about 140 milk tankers (including spares). The average size of tanker is expected to increase by 2020, with a sizeable shift to larger 45 tonne (fully laden weight) from 35 tonne approx., which is more typical at present. Thus the total investment in new milk tankers in Cork by 2020 may come to about €25 million.

Combining future investment in dairy farms, milk processing, and transport, it can be estimated that direct investment in dairying in Cork between 2010 and 2020 is likely to be in excess of €1.2 billion.

Consequences for Employment

While only limited information is available on non-farming employment related to dairying in Cork or indeed in Ireland, there is a body of research on employment in total agri-food. O'Connell (2012) completed a comprehensive analysis of the importance of agriculture and the food industry in the Irish economy. With regard to employment he concluded that specific Irish food related employment accounted for 287,000 to 308,000 jobs or 14-15% of total Irish employment. The estimate was based on a broad definition of agriculture and the food industry. Fitzgerald (2010), using a narrower definition estimated that there were 230,000 jobs in the agri-food sector, comprising 120,000 in farming, 45,000 in food processing, 60,000 in distribution and wholesaling and 30,000 in supply and services. An annual estimate of employment in the agri-food sector is also provided by DAFM, showing 167,000 jobs in the most recent report, DAFM (2014). However, agri-food is very narrowly defined in arriving at this estimate. O'Connell (2012) has outlined in detail the different areas in which farm output creates further employment. This includes food processing, farm inputs manufacture and supply, food and food raw material wholesaling, as well as a wide range of associated input sectors, such as energy, transport, storage, packaging, additives, insurance, banking, advisory/support, education/research and regulation. Miller et al. (2013) outlined in detail the employment effects outside farming that arise in association with changes in farm output. *"As well as the direct employment that would be created from an increase in activity in the agriculture sector, there would be a knock on benefit for the rest of the economy arising out of the linkages between agriculture and other economic sectors and the spending of those employed in the agri-food sector on goods and services produced in the economy. Commonly this is described as the multiplier impact. According to multiplier theory, spending by the agriculture and food processing sectors generates further economic activity in other sectors of the economy through knock-on or multiplier impacts".* Miller stated that these effects are of two kinds.

***Indirect Multiplier Effects*.** The agri-food sector makes purchases from other sectors of the economy in order to produce its output. This stimulates activity in a diverse range of sectors, including animal feed, fertiliser, fuel, building and construction, professional services etc. In turn, all of those industries must themselves make purchases from sectors they are linked to the wider economy in order to provide the products and services required by the agri-food sector.

***Induced Multiplier Effects*.** Households derive income in the form of wages, salaries and self-employment income. They then spend much of this income on goods and services (food, clothing, transport, leisure activities etc.). The purchase of these goods and services creates wages and salaries for people working in a range of sectors right across the economy. Hence, an increase in household income due to an increase in one economic activity will also lead to an increase in consumption of locally produced goods and services.

Total Effect. The direct, indirect and induced effects can be added together to give the total effect of a sector.

Miller *et al.,* (2013) estimated the national job creation potential of FH2020 of each of the four main sectoral targets with the linkages between the various sectors of the economy as described above included using a social accounting matrix (SAM). The four main sector specific targets in FH 2020 were as follows: (i) 50% increase in the volume of milk production; (ii) 20% increase in cattle output value; (iii) 20% increase in sheep/lamb output value; and (iv) 50% increase in pig output value. Of these targets the 50% volume increase in milk output is the dominant target in overall economic terms. Three alternative scenarios were analysed, S1 involved FH2020 creating high additional employment in farming, S2 involved FH2020 creating zero increase in farming employment with S3 being intermediate between the two. Of the three scenarios, the authors indicate that the employment potential estimated in S3, the intermediate scenario, should be seen as the one which is closest to the likely actual outcome that could arise if FH2020 was achieved. The total employment change for each respective scenario gives the national employment figures possible due to the achievement of each of the four main FH2020 targets. The results based on Scenario 3 show an increase in employment of 14,457 across all sectors in the economy by 2020 arising from a 50% increase in milk output. The corresponding estimates for the other sectors were 23,052 for S1 and 9,927 for S2. For S3 the estimated increase in employment in dairy farming was 4,192. Combining the four main sectoral targets it was estimated that a minimum of 18,989 jobs, a maximum of 38,430 jobs and an intermediate number of 24,719 jobs could be created in the economy as a result of achieving the four targets by FH2020.

While Miller *et al.,* (2013) produced estimates at national level, Carey and O'Donoghue (2013) provided regional estimates based on similar methodology using the NUTS 3 regional classification. For the South-West (Cork-Kerry) region it was estimated that the employment increases for the three scenarios if the four main sectoral targets in FH2020 were achieved were: S1: 6,521 additional jobs, S2: 3,222 extra jobs and S3: 4,195 added jobs. It may be noted that, based on the June 2013 livestock enumeration, Cork accounts for 78% of the dairy cows in the South-West.

With regard to direct employment in dairy farming as a result of dairy expansion in Cork, it has been previously estimated that dairy cow numbers in Cork may increase by about 30% from 306,000 in 2013 to around 400,000 in 2020, Table 8. Based on discussion with interviewees and with Teagasc, it is estimated that one additional job in dairy farming may arise for each additional 80 cows. Thus the increase in direct employment in dairy farming by 2020 in Cork is estimated at 1,150 new jobs. While this is an estimate of the gross increase in farm employment, it does not take account of the loss in farm employment in other farm enterprises which may be replaced by dairy farming. While it is difficult to estimate the net gain in employment, the loss of employment in other farm enterprises is likely to be modest. This is consistent with the comparative labour input in dairying compared with cattle and tillage output as estimated in the Teagasc NFS in which labour input is estimated in terms of labour units. Taking full time farming in the NFS for 2012 for example, labour units per hectare for dairying were 20-40% higher than for cattle or tillage, Teagasc (2013). Thus expansion of dairy farming at the expense of other farm enterprises both within existing dairy farms and in farms not devoted to dairying will involve increased labour in farming.

As there will also be steady increases in labour productivity in dairy farming it can be assumed that the 15% increase in yield per cow assumed earlier may involve no change in farm labour as such. Overall it is estimated that a net increase in employment of 1,150 is achievable at farm level arising from a 50% increase in milk output in Cork from 2013 to 2020. This estimate is consistent with that of Miller et al (2013) in the "most realistic" S3 scenario, given Cork's share of national milk output and assumed growth rate to 2020.

In relation to additional employment through increased farm inputs, dairying as a farm enterprise is far more input and services intensive than the other major land using enterprises. Based on the Teagasc National Farm Survey (NFS) 2012, a good representative year with neither exceptional weather or product prices, it is clear that dairying far outweighs the other major enterprises, drystock, and tillage, in terms of input costs per hectare. Taking full-time farming in the NFS 2012 survey, dairying involves more than double the input costs per hectare of drystock and is over 60% higher per hectare than tillage, Table 11.

Table 11 Farm Results by System of Farming Full-Time Farms

	Total Area Farmed, Hectares	**Total Input Costs, €'000**	**Total Input Costs/Hectare €'000**
Dairying	60	124	2.07
Cattle Rearing	63.8	57	0.89
Cattle, other	81.5	79	1.03
Sheep	71.2	53	0.73
Tillage	102.4	123	1.20
Mixed Livestock	68.3	75	1.10

Source: National Farm Survey Teagasc 2012

Table 12 Direct and Overhead Costs for Average Dairy Farm (Full-time) €, 2012

DIRECT COSTS	
Purchased concentrates	29,338
Purchased bulky feed	2,675
Fertiliser	12,402
Crop Protection	640
Purchased Seed	624
Hire of Machinery	7,720
Transport	340
Livestock (A.I., Vet, etc.)	9,904
Casual Labour	805
Other	8,561
Sub total	73,010
Fodder crop adjustment	547
TOTAL DIRECT COSTS	**73,551**

OVERHEAD COSTS	
Rent of conacre	4,483
Car, electricity, phone	4,982
Current hired labour	4,519
Interest charges	3,144
Machinery depreciation	7,424
Machinery operating	10,847
of which fuel and lub	4,893
Buildings depreciation	5,940
Buildings maintenance	1,933
Land improvement depreciation	655
Land improvement maintenance	1,692
Other	4,983
TOTAL OVERHEAD COSTS	**50,645**
TOTAL NET EXPENSES	**124,203**

Source: Teagasc National Farm Survey 2012

Full time farm data are chosen as the average dairy herd size in that classification in NFS 2012 of 70 dairy cows is virtually identical with the current herd average for Co. Cork. A more detailed breakdown of the various input costs involved is shown in Table 12.

As well as farm inputs, major increases in milk output will involve major expansion in milk processing, as already discussed in investment terms for Cork in particular, in milk transport (farm to factory) and in product storage and distribution. Milk processing is now highly automated in the manufacture of bulk products, and while major expansion involves substantial shorter-term employment in building and construction, plant installation and services, the longer term additional jobs for bulk products manufacture will be more modest. However the product portfolio is continually developing and becoming more refined, with exports in recent years moving away from basic dairy commodities towards more technologically advanced and consumer ready products. This is evident in Cork, for example, with Danone in Macroom being a leading infant formula manufacturer in world terms and the very sophisticated products now being manufactured by the other major manufacturers in Cork. A particular example involves the very valuable products now being manufactured from whey proteins by Cork dairy product manufacturers in particular, a raw material which was once regarded as little more than a waste product. Thus additional jobs can be expected on an ongoing basis in milk processing, including product research and development.

In the survey of dairies a question was asked regarding the likely changes in employment in milk processing by 2020. The results show that, for the dairies that completed the survey, an increase of 515 in employment is estimated for the decade 2010 to 2020, Table 13.

Table 13 Employment in Milk Processing in Cork, 2010 - 2020

	2010	2014	2020	Increase, 2020 vs 2010
Numbers	925	1,155	1,440	515
Index: 2010 = 100	100	125	156	

Source: Survey of dairies Note: Not all Cork dairies included

If milk output expands by a further 50 % in Co Cork from 2013 to 2020, this will involve an almost pro-rata increase in milk transport tankers and employment, although an increase in average tanker sizes and usage is planned by 2020. Likewise increased product distribution, which in this case will be mostly for export, will involve increases in storage, transport, and port activity, all of which will involve additional jobs.

All of the above involve direct activities and employment associated with increased milk output. At farm level, building and construction, which is particularly labour intensive, will receive a major boost in rural areas as well as major equipment installation and servicing. Both Miller et al (2013) and O'Connell (2012) also highlight induced economic activity when the income arising in both direct and indirect production is spent on a range of goods and services. Following a consultation exercise O'Connell (2012) noted that *"the vast bulk of input purchases by farmers were made locally i.e. within a 35 kilometre radius of the farm. This behaviour has a relatively huge impact on local economies throughout the country".* The additional household expenditure of farm families and of all the associated sectors mentioned above will involve a major and much needed boost for the local towns and villages in rural areas and will result in the retention of many jobs that would otherwise disappear, and also an expansion in job numbers.

Hence it is difficult to provide an estimate of the overall non-farming jobs that may arise if milk output increases by 50% in Co Cork by 2020, and any estimate is inevitably subject to a margin of error. However, by taking the ratio of farm: non-farm jobs associated with a 50% increase in milk output at national level in Miller (2012) for the most realistic Scenario 3 in that study, a total increase in jobs associated with a 50% increase in milk output in Cork of about 4,000 is estimated, Table 14. While a proportion of these new jobs will arise outside of Cork as a result of increased milk output in Cork, it can be anticipated that these jobs will be counteracted by increased jobs in Cork as a result of expansion of the wider dairy industry. Cork in many respects acts as a hub for the wider dairy industry, as exemplified by the recent statement from the Irish Dairy Board (IDB) that they will be building a state-of-the-art Kerrygold butter packing plant in Mitchelstown, with the €30 million investment bringing 50 new

long-term jobs and 200 in construction, IDB (2014). The IDB plan and the position of Cork as a hub for the Irish dairy industry is discussed in more detail later.

Table 14 Estimated Increase in Employment Arising from Increased Milk Output to 2020

	Ireland 2007 - 2009 av. to 2020[1]	Cork 2013 to 2020[2]
Milk Output Increase %	50	50
Farm Level	4,192	1,150
Overall Economy	14,657	4,000

Source: Miller *et al*[1]*.,* (2013), Authors' estimate[2]

Finally, it should be recognised that the additional jobs created in Cork as a result of dairy expansion will be long term sustainable jobs mainly in rural Ireland with every prospect of further expansion beyond 2020.

Overall Contribution to Economy

While estimates of the specific contribution of the Cork or Irish dairy industry to the overall economy are limited, there are a number of estimates of the impact of the farming sector in total to the overall economy. While a considerable body of research has been completed, there is no consensus on the most appropriate method of measuring contribution. A major study was completed by Miller *et al.,* (2011) who used a social accounting matrix to estimate the effects on the overall economy of the different farming sectors. With regard to dairying it was concluded that *"if we assume an increase of €100 million in the exogenous demand for raw milk, we can see that overall the €100 million in demand for milk generates a total increase in aggregate output of €193 million. Income multipliers and GDP multipliers are also calculated. Assuming a similar €100 million increase in final demand in the milk sector, this would lead to an increase in GDP at factor cost of €104.9 million"*. Riordan (2008, 2012) also completed valuable work in this field, focussing in particular on the significant benefits for the overall economy of a lower import content of the output of agriculture and the biosector compared with other sectors. Taking Gross Value Added (GVA) as a measure, DAFM publish annually the contribution of the agri-food and dairy sectors. On this basis it is concluded that the agri-food sector is currently the largest indigenous sector in Ireland accounting for 7.1% of GVA at factor cost in 2012, 9.2% of employment in 2013-Q4, and 12.3% of merchandise exports in 2013. Also within the agri-food sector milk production is estimated to be currently worth about 34.2% of agricultural output at producer prices (excluding forage) (DAFM 2014)[2]. Fitzgerald (2010) has taken issue with the GVA approach stating that "*the current measurement of economic value based on GVA gives a distorted picture of the real value, due mainly to the transfer pricing activities in much of the modern economy. Much of this real value of the agri-food sector comes from the fact that the sector sources 80% of its spend on wages and salaries, services and raw materials in the Irish economy. No other sector of the economy has anything like the same linkages, for the modern economy sector the equivalent spend in the Irish economy amounts to on average 20% of their overall*

[2]http://www.agriculture.gov.ie/media/migration/publications/2014/2014APRILFACTSHEET010514.pdf

expenditure". He compares the agrifood sector with the pharmaceutical and ICT sectors using the GVA approach and employs a different measure based the proportion of turnover linked to the Irish economy. He also highlights the wide differences between the two, arising primarily from profit repatriation and transfer pricing in the multinational sector (Fitzgerald (2010). O'Connell (2012) reviews a number of studies and uses an output multiplier as a measure of the effect of the activities or output of a sector on the economy. This measures how much direct and indirect output is required across all domestic products per €1 final demand of a given product/service. In other words, the output multiplier measures how much additional output is produced in other sectors in order to produce €1 of agricultural output. For every €1 worth of output from Agriculture, Forestry and Fishing €1.734 worth of output (including that of Agriculture, Forestry and Fishing) in total is created. In 2010, Agricultural Output of €5.3bn created €9.25bn overall output in the Irish economy. The average for all sectors excluding Agriculture, Forestry and Fishing is a multiplier of 1.47. *"Thus, it can be seen that every €1 of agricultural, forestry and fishing production has a production impact on the economy that is 18% higher than the average of all other sectors combined. The difference is somewhat higher again when service sectors are excluded"*, O'Connell (2012). With regard to the agri-food sector in Cork, O'Dwyer (2012) has estimated the value of agricultural output and exports on a county by county basis, indicating for Cork in 2012 that the value of agricultural output was €1,046 million and that the additional output generated from farming was €764 million.

In relation to dairying, Loughrey (2012) for West Cork estimates that by 2020, based upon the work of Miller *et al.,* (2011), the estimated €68.2 million annual increase in milk output value will lead to a total increase in output of €131.4 million. In terms of GDP, it is estimated that GDP will increase by €71.3 million as a result of the €131 million increase in output in West Cork, Loughrey (2012).

Economic Impact of Increased Milk Output in Cork by 2020

The approach taken in this study is based in the first instance on a representative farm approach. The difference between the representative dairy farm as estimated for 2020 and that for 2012 is then aggregated to provide an estimate for Cork in total. Details of the estimation of economic output from dairy expansion as outlined in Table 15 shows an overall gross output on Cork dairy farms in excess of one billion euro by 2020 and an overall net annual increase at dairy farm level of €226 million.

Table 15 Dairy Farming Output - Cork

Average Farm	2012	2020	Difference
Cow Nos.	70	91 (+30%)	21 (30%)
Area Farmed, HA	60	65	5
Farm Output €'000	NFS 2012		
Milk	115	185	70
Other Farm Enterprises	40	25	-15
Other Payments (incl. SFP)	20	20	-
Total Per Farm	175	230	55
No. Dairy Farms	4,500	4,500	
Gross Output			
Dairy Farming €ml	787	1,035	248
Adjustment for Loss of Output from Additional Land Diverted to Dairy			-22
Net Increase €ml			226

Source: Authors' Estimates derived from NFS, Teagasc (2012)

The estimates in Table 15 are based on the following assumptions. As discussed earlier the average dairy herd size in Cork is 70 cows in 2013 and this corresponds almost exactly with the full-time dairy farming average herd size in the Teagasc NFS for 2012, hence the NFS 2012 dairying results are taken as the representative dairy farm for Cork for 2012. It is now assumed that the average dairy herd will increase by 30% or 21 cows to 91 by 2020. This is based on the prior assumption that milk output in Cork will increase by 50% from 2013 to 2020. The dairy herd increase implies a yield increase of 15% by 2020 as previously discussed (1.30 * 1.15 =1.5 approx.). It is assumed that the average area farmed will increase from 60 ha in 2012 to 65 ha in 2020 to accommodate the enlarged herd. This assumption is based on consultation with industry and Teagasc.

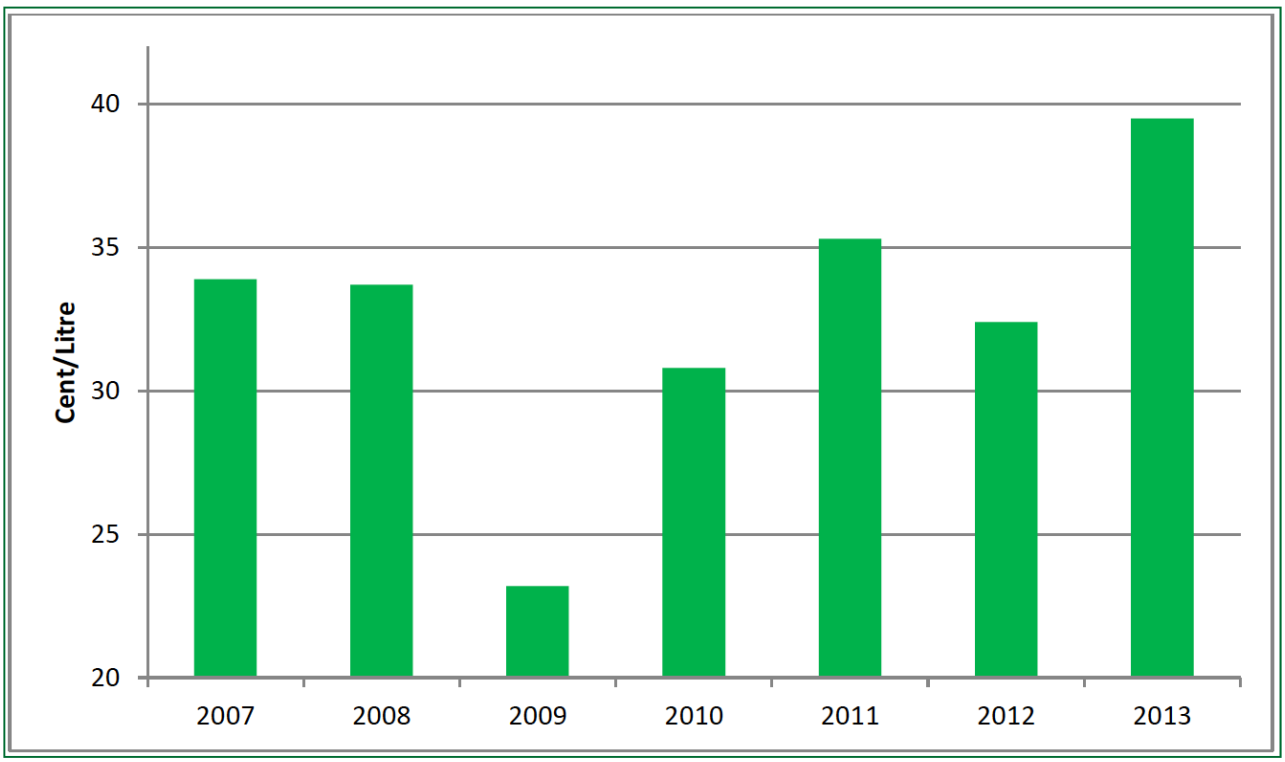
The value of milk output in 2012 on the representative farm was €115,000. Average milk price in 2012 was significantly lower than 2011, 2013 and 2014 at 32.4 cent/litre (c/l), Figure 8. Reviewing milk prices at farm level over the last 7 years a milk price of 35 c/l is chosen for 2020. When this is combined with a 50% increase in volume, the resultant milk output per farm is €175,000 approx. in 2020. Other farm enterprises on the 2012 NFS dairy farm (mostly cattle including calves and cull cows from the dairy herd) had an output value on the representative farm of €40,000. It is assumed that these are partly replaced by the additional dairy cows, hence it is assumed that the non-dairy enterprises will have output reduced to €25,000 by 2020. A larger herd size increases the output of cull cows and non-replacement calves, however, it is expected that cattle enterprises on mainly dairy farms will be substantially reduced. It is also assumed that other payments and adjustments (mainly Single Farm Payment in 2012) will remain unchanged. It is assumed that the number of dairy farms in Cork at 4,500 will remain unchanged

to 2020. This is not a critical assumption. The prior assumption discussed earlier is that total dairy cow numbers in Cork would increase by about 30% by 2020. On this basis if a higher number of dairy farms in Cork was assumed for 2020, it would be combined with a lower average herd size leaving the overall economic outcome essentially unchanged, and vice versa. The gross output showing an increase of €248 ml by 2020 merely involves multiplication of the average farm output by 4,500.

A further adjustment is required to account for the loss of output from other enterprises currently assumed to be operating on the 5ha per farm on average converted to dairy farming by 2020. As this is likely to be a combination of cattle and tillage crops, it is assumed that an average gross output of about €1,000 per ha applies, which is consistent with the output from these enterprises in the NFS 2012 report. Thus a total loss of €22 million arises when this estimate is applied to 4,500 dairy farms. These estimates result in a net overall output increase of €226 ml or over 30% on dairy farms in Cork by 2020.

It should be noted that these estimates are highly speculative. To take one example, if a different milk price was chosen for 2020, all estimates would change accordingly and the ongoing volatility in milk prices emphasises the speculative nature of the estimates.

Figure 8 Average Milk Price at Farm Level, Cent per Litre, Actual Fat



Source: CSO

Profit Monitor

The Teagasc e-Profit Monitor is an internet based system which allows farmers and their advisors to enter physical and financial data on their farm enterprises online, Teagasc (2014). It is available through the Teagasc client site. Clients self select and participation allows them to examine key indicators such as Farm Output, Variable and Fixed costs and Gross and Net Margin per hectare and per litre of milk. Being a self select system it is the above average farmers who tend to participate and results cannot therefore be taken as representative of average farming, unlike the Teagasc National Farm survey where random sampling occurs. Nevertheless the Profit Monitor results for dairy farms in 2013 could be viewed as perhaps a possible representation of the levels of performance that average dairy farming might attain in 2020. Participation in 2013 involved 1,329 spring calving dairy farms and the results show that average herd size and output are rather similar to the previously assumed 2020 average dairy herd for Cork in 2020, Table 16. More detailed analysis of the 2013 profit monitor results shows very large differences in performance between the top and bottom 10% of participants, Table 16, demonstrating the scope for improved performance in dairy farming which can be steadily attained with continuing input from advisory and training services.

Table 16 Profit Monitor, Dairy Farms, 2013 displayed overleaf:

- → Net margin represents a residual to provide return to the factors of production i.e. labour, capital invested and land
- → Own labour costs will average approximately 6 c/litre
- → (Provision for Taxation and Capital Repayments are not included as costs)
- → The Profit Monitor is completed by the most cost and profit focused farmers and is not representative of the 'national average'
- → The National Farm Survey should be used to compare financial performance on a national basis

Table 16 Profit Monitor, Dairy Farms, 2013

	Profit per litre			Profit per ha	
	Average	Top 10%	Bottom 10%	Top 10%	Average
	2013	2013	2013	2013	2012
Gross output	40.42	42.42	38.19	42.34	34.21
Co-op price	40.03	41.23	38.95	41.23	32.7
Stocking rate (LU/ha)	2.16	2.29	1.98	2.65	2.11
Herd size (no. of cows)	95.1	98.5	76.36	111.4	90
Yield (litres/cow)	5,138	5,300	4,866	5,570	5,017
Fat %	4.06	4.13	3.98	4.15	4.04
Protein %	3.44	3.50	3.38	3.51	3.43
Yield (kg MS/cow)	396.5	416	368.6	437	386
Variable costs					
Feed	6.7	5.2	8.97	5.83	5.31
Fert.	2.89	2.59	3.17	2.56	2.46
Vet	1.17	0.89	1.37	0.99	1.22
AI	0.59	0.52	0.66	0.53	0.61
Contractor	1.81	1.57	2.09	1.48	1.53
Other variable costs	1.94	1.57	2.37	1.65	1.85
TVC	15.08	12.34	18.61	13.05	12.98
Gross margin	25.34	30.08	19.58	29.29	21.24
Fixed costs	1.03	0.72	1.09	0.91	0.91
Labour	1.64	1.07	2.37	1.13	1.67
Machinery	1.45	1.21	1.88	1.21	1.43
Car/ESB/Phone	2.16	1.57	2.81	1.91	2.06
Depreciation	0.91	0.73	1.05	0.65	0.9
Leases	0.71	0.3	1.15	0.41	0.7
Interest	2.12	1.63	2.57	1.64	2.14
Other fixed costs	10	7.23	12.93	7.86	9.8
TFC	1.03	0.72	1.09	0.91	0.91
NM/litre	15.34	22.85	6.65	21.43	11.44
NM/cow	788.17	1,211.05	323.59	1,193.65	573.94
NM/ha	1,702.44	2,773.30	640.71	3,163.17	1,211.02
No farms	1,329	133	133	133	1,133

Source: Teagasc

Effect on Overall Economy

The estimate of the benefit to the overall economy in this report is based on the approach of Miller (2011) as was also applied to dairying in West Cork by Loughrey (2012). The estimated net increase in output at farm level as a result of dairy expansion in Cork of €226 million p.a. is estimated to result in an output increase in the overall economy of €442 million p.a. by 2020. This takes account of both the increase in output of milk and the decline in output of non-dairy enterprises. In terms of GDP, it is estimated that GDP will increase by €235 million p.a. by 2020 as a result of the expansion of dairying in Cork. This additional output will mostly be retained in Cork and the Southwest region and should be of great economic benefit to the region at a time of major need. It may also be noted that much of this increase is likely to occur quite early over the next two years. The increased output will also result in a substantial increase in tax take for the Irish exchequer. While again difficult to estimate, based on Department of Finance research, O'Connor (2013), it is likely that the increase in tax inflow to the exchequer by 2020 as a result of dairy expansion in Cork is likely to be about €100 million p.a.

Exports

Virtually all of the increased output of dairy products by 2020 will be exported, given the largely static overall size of the home market. Overall Irish dairy product exports reached €3 billion approx. in 2013, Bord Bia (2014). On the basis of a 50% increase in milk output and a continuing shift towards greater value added dairy products for export over time, it can be estimated that Irish dairy product exports may reach €4.5 million by 2020, even taking into account the exceptionally high dairy commodity product prices in 2013. Taking Cork specifically, with the sophisticated range of dairy products now manufactured by Cork dairies, including the very large Danone infant nutrition plant in Macroom, it can be estimated that Cork dairy firms may account for about 30% of the increase in national exports. A further increase of about €450 million p.a. in dairy product exports from Cork by 2020 may therefore be anticipated.

Cork - The Irish Dairy Heartland

The Irish Dairy Board July 2014 newsletter was titled *"**Kerrygold to build Global Home in the Heartland of Irish Dairying**"*. This refers to a major new IDB development in Cork with the newsletter stating that *"the IDB is pleased to announce plans to build a Centre of Excellence for butter production and packing in Mitchelstown Co Cork. The new facility is a key milestone in the IDB's strategy to grow the iconic brand. Located in the heartland of Irish dairy, Mitchelstown has a proven track record in dairy production and a skilled and experienced workforce to make it the ideal global home for the world famous Kerrygold brand. The new facility will support the future growth and development of the Kerrygold brand in a range of formats on a single site. It will provide full supply chain integrity, will centralise NPD and innovation capability for Kerrygold and will be a dedicated Customer Centre of Excellence for the Irish Dairy Board. It will also play an important business continuity role for group operations"* IDB (2014).

The place of Cork as the centre for global butter exports from Ireland as exemplified by the IDB plans is a modern manifestation of Cork's great heritage in global butter exporting.

Cork's Rich Dairy Heritage

The history of butter making in Ireland and Cork goes back thousands of years. The burial of butter in bogs as an early attempt at conservation dates back as far as the sixteenth century at least and continued until the end of the eighteenth century. The exclusion of air and the turf's antiseptic qualities would have prevented the growth of mould. In the seventeenth and eighteenth centuries, Ireland was the major butter exporter in northern Europe and the Americas. Indeed much of the butter shipped from Ireland to Europe was reshipped across the Atlantic to markets such as the West Indies and the Americas. All this butter was highly salted in order to preserve it on long voyages, often in warm latitudes. From the 1760's England, with the Industrial Revolution beginning to flourish and a rapidly expanding population, began to import Irish butter in quantity, and by the end of the century it had become the main export market for Irish butter. By the 1770's butter exports were twice the level of the 1680's and by 1835 they had almost doubled again, Synnott (2008), NDC (2014).

Cork in this period became the leading centre of the world butter trade, especially for distant regions. Butter was exported all over the world, particularly to America and the West Indies but also, later, to Australia and India. In the early 19th century, Cork controlled 88% of Irish butter exports to America. Most butter was packed into firkins or casks, with the addition of a pickle to ensure its preservation. The content of the pickle was a closely guarded secret – Cork butter travelled well on long-distance voyages to hot climates. It was generally highly salted and this acted as an important preservative. At its peak, there were 50 different butter merchants with 400,000 firkins of butter passing through the market annually. One firkin equals just under 25.5kg.

In 1769 the Cork butter merchants formed a voluntary organisation, the Cork Butter Exchange, to superintend the public inspection, branding and making of butter for export. For over a century every firkin of butter passing through the doors of the Cork market was rigidly examined and graded, and the price for each grade was fixed every day. The system survived in its original form until 1884 when new conditions had begun to make it redundant. This rich dairy heritage is currently preserved through the Cork Butter Museum, Rynne (1998). A recent publication comprehensively outlines the rich heritage of dairying in Cork and Ireland, Synnott (2014).

With this heritage it was no surprise that the Faculty of Dairy Science was established in University College Cork in 1926 where it continues to flourish as the School of Food and Nutritional Sciences in collaboration with the School of Food Business and International Development. Prior to this the Munster Institute was established in Cork in 1853, specialising in training in butter making and poultry science. Also a residential agricultural school was established in Clonakilty and this facility currently continues under Teagasc as a specialised college of education in dairying.

Intellectual Capital and Technical Capabilities - Cork

A recent report by Cork Chamber of Commerce (2014) stated the following: "*The internationalisation agenda and the requirement for world-class talent availability is a leading determinant of a region's status within any global industry and fundamental to a region's capacity to attract research and industry investment. As home to highly reputable Higher Education Institutions (HEIs), research institutes and cutting edge domestic and multinational industries, the Cork region has an extensive infrastructure in place to train and attract the world class talent required by leading industry and R&D investors.*"

With regard to education in dairy and food it was stated that "*UCC, CIT and Teagasc Clonakilty Agricultural College deliver an extensive range of reputable agri-related undergraduate and postgraduate courses ranging from Level 5 plus qualifications in Horticulture, Nutritional Sciences, Food Marketing and Entrepreneurship and International Development to Level 9 qualifications in Food Science, Food Business, Co-operative Organisation, Food Marketing and Rural Development and a range of PhD programmes delivered through Teagasc, UCC, and CIT to facilitate first class postgraduate research activity. UCC's Food Industry Training Unit also offers a range of diploma and Continuing Professional Development (CPD) courses across a range of agri-related areas such as Food Science & Technology; Seafood Innovation; Speciality Food Production, Business Management; Manufacturing Management; and Corporate Direction (Food Business). The commitment of the region's higher education institutions to implementing timely courses in co-operation with industry and national expert agencies ensure the optimum talent availability as the agri-sector's talent requirements expand and evolve. The Teagasc Clonakilty Agricultural College's Level 7 Diploma in Dairy Farm Management is a prime example of the region's capability to respond to evolving labour market and investment requirements*".

Cork is home to an impressive range of prolific research institutes ranging from Teagasc's world class dairy research centre in Moorepark to the extensive food research programmes at UCC, including the Alimentary Pharmabiotic Centre which is ranked number two in the world by Thomson and Reuters for probiotic research. The UCC/Teagasc Strategic Alliance, signed in 2010 further enhances the region's capacity to expand its R&D funding and its status as a world leader in the development of cutting-edge, high value consumer food products.

Dairy Business

At farm level it is generally recognised that many of Ireland's leading commercial dairy farmers are based in Cork. At processing level Cork is home to Dairygold, Ireland's largest farmer owned cooperative, which processes almost a fifth (18%) of all Irish milk in four separate sites in the county. Carbery, a major international food ingredients, flavours and cheese manufacturer is also headquartered in the region. Kerry PLC, a global leader in food ingredients, flavours and cheese manufacturing, also has two key processing plants in the county; Charleville and Newmarket. Macroom was chosen as a major European production site by Danone/Nutricia, a global leader in

infant formula manufacturer. Its new state-of-the-art infant formula production plant currently produces about 80% of the base powder for Europe with 22 different formulas. As mentioned earlier, IDB has chosen Mitchelstown as its new national centre of excellence for butter packing and exporting.

With regard to support services for dairying, as well as the educational and research institutions mentioned earlier, the Irish Cattle Breeding Federation (ICBF) based in Bandon operates the national cattle breeding database. The genetic evaluations and research performed by ICBF in close association with Teagasc are used by dairy farmers throughout the country to make Cork and Ireland a global leader in science based dairy herd improvement. SWS Business Services also headquartered in Bandon provides a wide variety of services for the Irish dairy sector including the national calf registration programme and has rapidly expanded to be a significant participant in international outsourcing services. Cork is also the location for a range of engineering and related services for the national and international dairy industry, with Charleville for example seen as a significant engineering hub. Moorepark Technology Ltd (MTL) is a Moorepark, Fermoy based joint venture company established by Teagasc and shareholders from the Irish dairy industry. It provides commercial pilot plant services and is a key link in the process of knowledge and technology transfer from research to industry. These and other services based in the county make Cork a leader in service provision for the national and international dairy industry.

Farmhouse and Small Scale Dairy Industry

Cork farmers were the originators of the rapidly growing and highly successful farmhouse cheese sector and continue to be leaders in this industry. The farmhouse and small scale dairy products sector in Cork has also become highly diversified with equal market success and employment in an impressive range of dairy products such as for example Glenilen farm products and Irish yogurts. With further growth plans such as those of Glenilen, there is every reason to expect the sector to grow further to 2020.

Overall it is clear that Cork is a national hub for the Irish dairy industry with leadership in both products and services for the domestic and international dairy sector.

Constraints and Risk Factors

The forecast of increased milk production post 2015 is based on future conditions for Irish dairying being similar to conditions which have prevailed in the recent past. However it is important to note that there are number of factors which could constrain future expansion as well as certain risks which could slow milk production volume increases in the short to medium term. A number of these constraints and risk factors are now discussed.

Land

Land was identified by interviewees as a major constraint in a dairying context. Dairying in Cork is mainly a grass fed system with the maximum usage of grazed grass being encouraged as this provides the cheapest feed source for dairy livestock. In such a system it is highly desirable to graze the cows as close as possible to the milking parlour as it reduces walking distances, and hence lameness and stress, while increasing grazing time. While it may be possible to increase stocking rates on some milk platforms by rearing fewer non milking livestock, as well as sourcing winter fodder away from the platform, these opportunities are finite.

Cork dairy farming currently involves an average herd size of about 70 dairy cows. The Teagasc NFS 2012 showed that full-time dairy farms with a herd size of 70 approx. had a total area farmed of 60 hectares of which 46 hectares was the area owned, Teagasc (2013). While this land area is comparable with some other EU competitors, it is very small compared with the leading countries with which Ireland competes on the global dairy market such as New Zealand and USA. The expansion of dairy farming will require an increase in area farmed to accommodate expanding herds. Land sales in Ireland are very low and this is a significant constraint for expanding dairy farmers. Nationally, just 31,250 hectares were offered for sale in 2013 which is less than 1% of the total land area, albeit this was an increase from the low point of just 17,200 hectares in 2010, Irish Farmers Journal (2014). Of total offerings in 2013, Cork accounted for 4,300 hectares or about 14% of the total which constituted just 0.56% of the total land area in Cork. This very low level of transactions, at an average price of about €28,000/hectare in Cork in 2013, highlights the difficulty in securing land in the county. This is further highlighted by the fact that 2013 represented the largest acreage transacted in the last 7 years and was 53% higher than the 2012 figure of 2,800 hectares, Irish Farmers Journal (2014).

This level of transactions is totally inadequate to accommodate farm expansion, hence expanding farmers must rely mainly on renting on an 11 months short-term basis or longer term leasing (minimum five years). It is estimated that nationally 640,000 hectares are rented, Irish Examiner (2014). The difficulty with short term renting, which is the dominant form of non-owned land use in Ireland, is that the farmer is unable to engage in any form of longer term investment in buildings, cattle handling facilities, roadways, drainage, other infrastructure or even adequate fertilisation, as the land may be rented to a different person in the following year. While longer term leasing has taxation benefits, at present it only accounts for little more than 100,000 hectares nationally. It is hoped that the current review of farm taxation will result in greater flexibility in land usage to the benefit of those who plan to expand.

As well as land availability farm fragmentation is also a very significant problem for farm efficiency. It is likely that fragmentation will get worse as active farmers expand. As stated in the Irish Farmers Journal 2013 review of land sales *"some dairy farmers are willing to buy land up to 10 miles away for silage or to graze replacement heifers with the land platform at the homestead to be used for the milking herd only"*. Inevitably this development, in terms of land ownership, renting and leasing, will involve increased road usage by farmers and contractors who will be

travelling longer distances on mostly tertiary roads with large heavily laden vehicles.

Labour

As discussed elsewhere there will be a demand for an extra 1,150 labour units at farm level in Cork to milk and manage the forecasted herd expansion. Given the specialist nature of dairy farming the skillset requirements of these workers will be high. The long working day and physically demanding nature of the work will also make the recruitment of suitable labour a challenge, in particular should competing farm enterprises or sectors such as construction see a return to more favourable economic circumstances.

Age of farmer is another negative factor that may constrain expansion in dairying. In the Teagasc National Farm Survey 2012, the average age of holder was 51.8 for full-time dairy farmers and 57.8 for part-time dairy farmers. This compares with 53.8 and 58.4 respectively for the average for all systems of farming. While the average age of holder in dairying is somewhat lower than for all systems of farming, it is still high for such an intensive full-time activity as dairy farming.

More positively, there has been very healthy growth over recent years in the numbers of young entrants to courses in dairying. This involves courses in third level institutions, including new courses in collaboration with Teagasc, as well as much higher numbers registering for Teagasc agricultural colleges. The emphasis on supporting younger farmers in the recently agreed CAP reform to 2020 is also welcome.

Farm partnerships are a recent but growing phenomenon which can help in terms of expansion and efficiency. A single farm facilities unit can be used thus achieving economies of scale, and work can become more specialised in relation to milking, heifer rearing, etc.

Capital

While some current dairy farmers engaged in modest expansion will be able to do so at limited cost, most expanding dairy farmers will incur very major additional costs. The additional costs are dependent on herd growth and the proportion of output growth accounted for by increased milk yields. Some estimates of the aggregate additional national investment in dairy farming to achieve a milk output increase of 50% by 2020 are available. For example, it has been estimated by IFA that €1.5 billion will be invested at farm level by 2020, Kiersey (2014). A study by Keane (2010) estimated that at an assumed 20% increase in yields by 2020 and a strong movement towards fewer and larger herds, an investment of €1.9 billion by 2020 would be required. A subsequent study assuming a more gradual movement towards larger herds resulted in an estimate of €1.3 billion to achieve the national target of 50% milk output growth by 2020, Keane (2011). While some of this investment may be financed by cash flow and Government/EU grant, a very substantial part will have to be borrowed.

In an interesting survey conducted on behalf of AIB in 2013 it was found that almost half (48%) of dairy farmers planned to invest in or develop their dairy business over the next 3 years, AIB (2013). Of those who planned to invest in the dairy business, 28% intended to invest in winter housing/slurry storage while 26% planned to invest in a new or upgraded milking parlour, In addition, 21% intended to invest in milking equipment/technology and the same proportion intended to increase herd size. On average 65% of future investment was planned to be funded from bank loans. Almost three in ten (31%) farmers intended to source in excess of 75% of their investment from bank loans while a further 27% intended to source in excess of 50% from borrowings.

As Cork is estimated to account for approximately 30% of the growth in milk output nationally by 2020, Table 7, as discussed earlier, it is estimated that additional investment of about €450 million at farm level in Cork by 2020 will be required. Investment and herd management requirements at individual farm level have been outlined in detail by Teagasc through demonstration farms including Shinagh, Bandon and Greenfields, Kilkenny. A detailed review of capital and credit requirements for Irish dairy farming in 2011 concluded that the overall level of indebtedness of Irish dairy farmers was low compared with international competitors and that in overall terms they had considerable repayment capacity, ICMSA (2011). A sensitivity analysis of the effect of lower milk prices concluded that, while some of the key debt ratios would be less favourable, the interest cover ratios at aggregate national level would continue to be strong, ICMSA (2011). However, at individual farm level, this would not necessarily be the case.

The availability of capital at competitive rates in Ireland relative to international competitors is a concern of farm organisations. The concerns relate in part to the lack of competition at present in the Irish market, with lending largely confined to the two pillar banks.

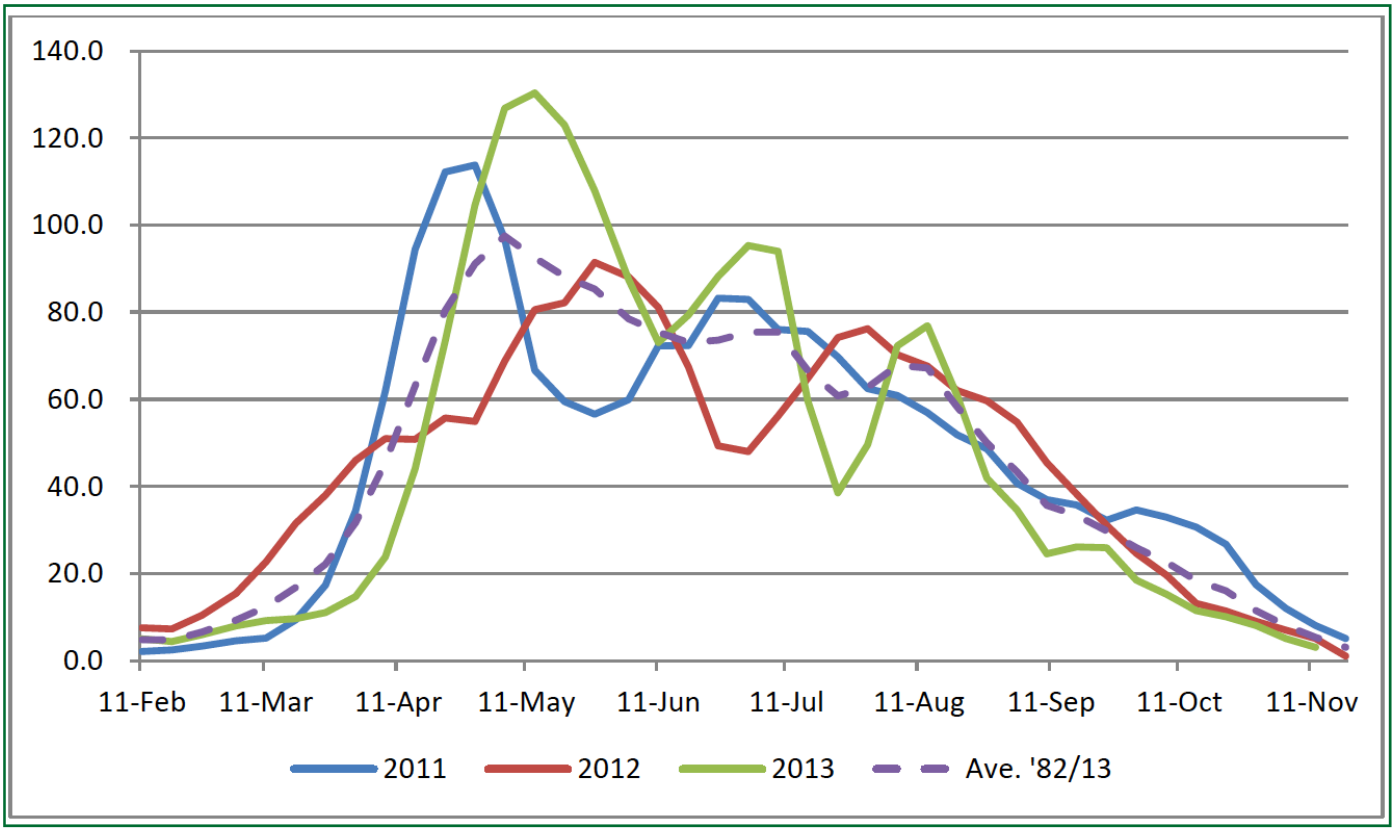
As well as additional investment at dairy farm level to 2020, very major investment will also be required at milk processing and milk transport levels. As already discussed, a combined investment of approximately €1.2 billion in dairy farming, milk processing, and milk transport by 2020 is projected for County Cork.

While the long lead time at processor level has allowed participants to arrange finance and in some cases stage investment, these borrowings will have to be repaid. It should be noted that this estimate primarily relates to construction costs and does not include other costs such as market development and research which can also be very substantial.

Weather and Climate Change

While the climate in Cork in general is very favourable for growing grass, and grass is the cheapest source of fodder, there are times when weather conditions are far from optimal or desirable. The length and timing of the grazing season can vary dramatically as witnessed in the first half of 2013, Figure 9 (note green line). While this can be viewed as atypical it should be noted that less extreme conditions, usually associated with prolonged or heavy rainfall or less occasionally prolonged dry conditions, are a feature of dairying in the county. Such events require supplemental feeding with expensive concentrates which adversely and significantly affect profitability.

Figure 9 Grass Growth Rates at Moorepark, Co. Cork (KgDM/ha/day)



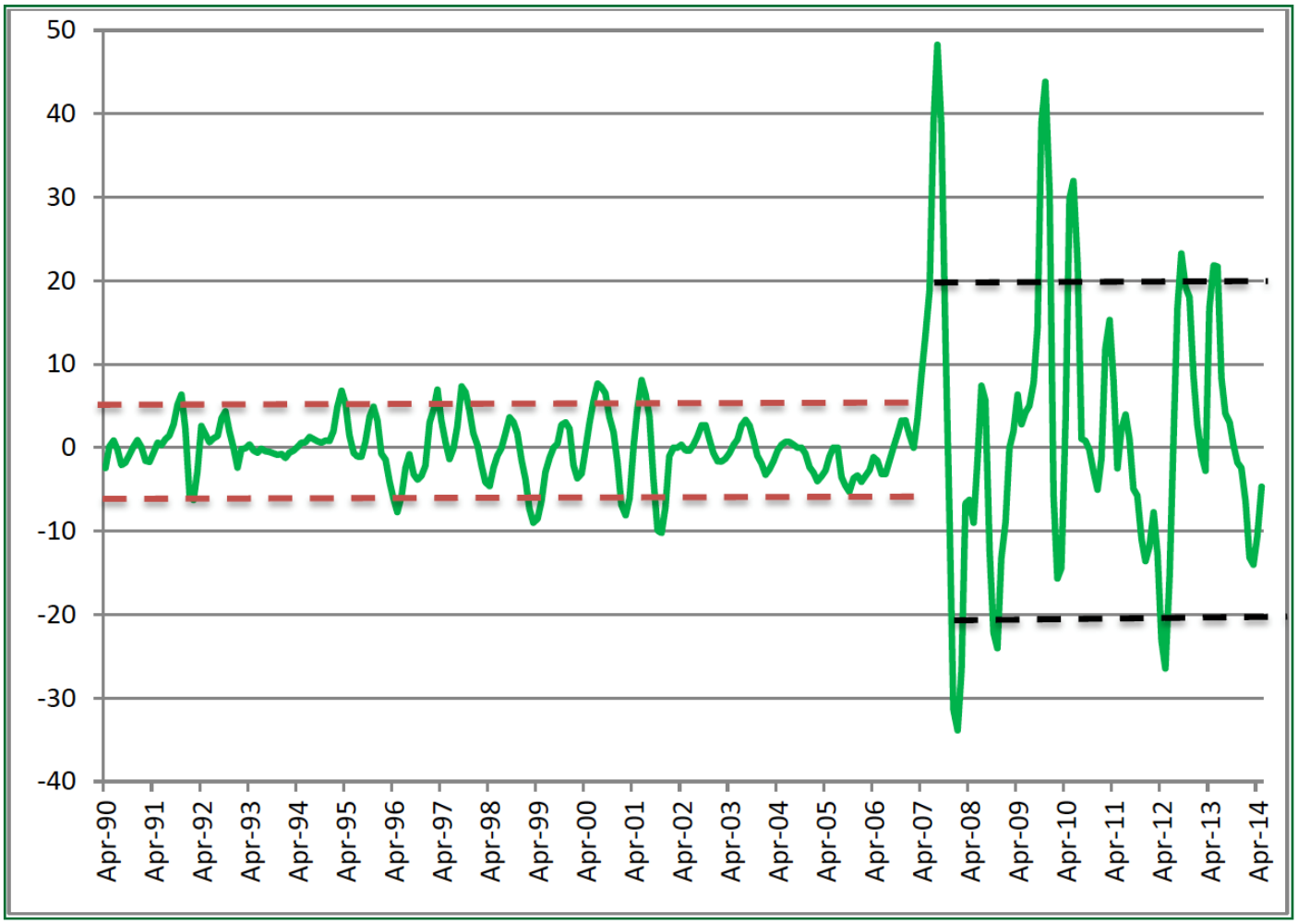
Source: Teagasc, Moorepark

Income/Price Volatility

The EU dairy industry is highly regulated and subject to the Common Agricultural Policy (CAP). In recent years CAP policy moved towards lower levels of price support (intervention buying, import tariffs and export refunds) and more towards income support via the Single Payment Scheme (SPS). This reorientation began in the 1990s with decreases in the intervention buying prices of butter and SMP (skimmed milk powder) and really gathered pace with the Luxembourg Agreement in 2003. The objective of these and the more recent policy changes was to align EU dairy prices more closely with world prices with the SPS providing compensation for EU dairy farmers as their prices dropped to the lower levels associated with world prices. This greater alignment of prices has also seen an alignment of price volatility. For example, volatility for EU dairy commodities has sharply increased since 2005 and has been historically high since then, O'Connor (2009), Keane (2011). This is very clear, for example, for EU

wholesale butter prices, Figure 10. Prior to 2007 prices rarely changed by more than 7.5% over any three month period (red dashed line) while post 2007 changes of 20% or more are not uncommon (black dashed line).

Figure 10 Three Month Percentage Price Change in EU Butter Wholesale Prices

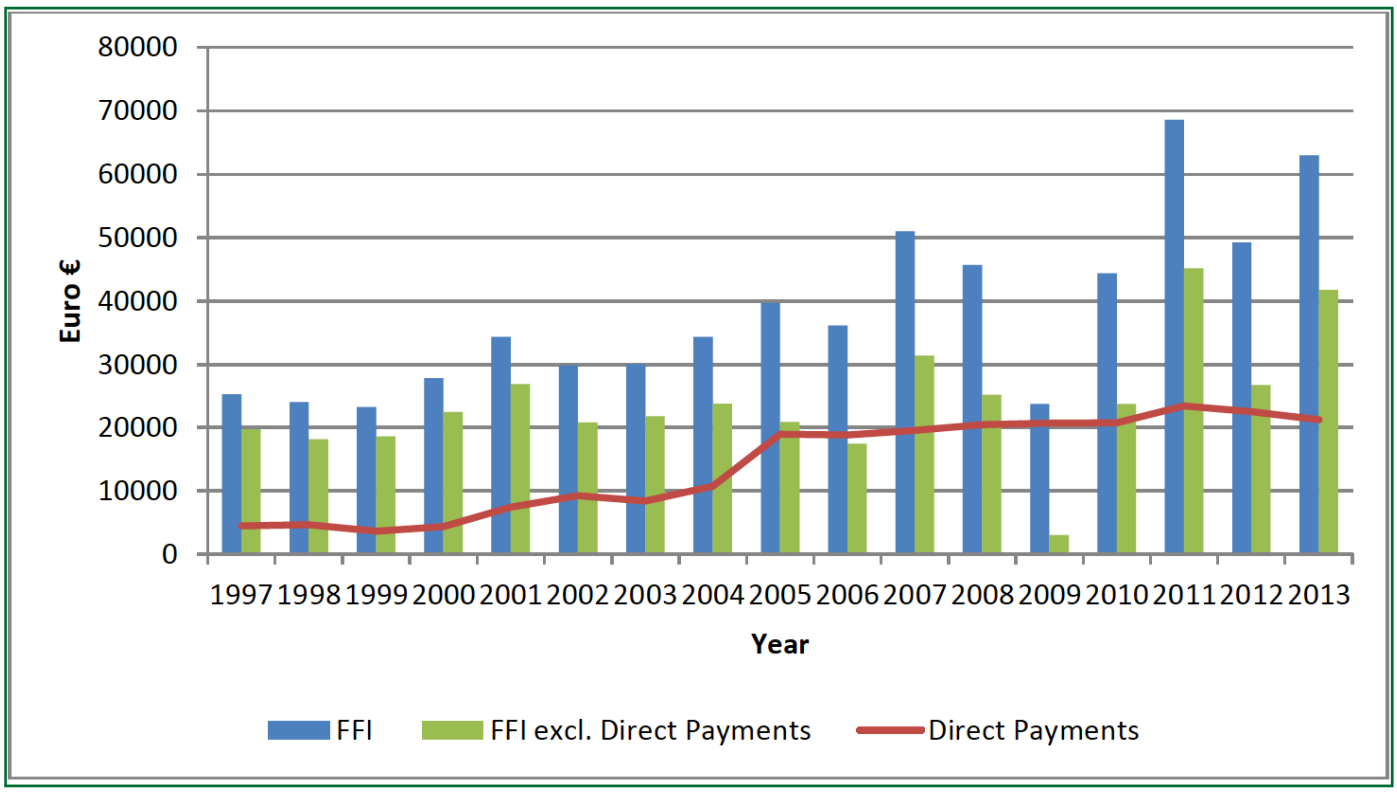


Source: Authors' calculation

This greatly increased volatility means that dairying in the EU is now a far more risky business at both farm and milk processing levels. Volatility makes planning and budgeting more difficult, finance harder to obtain and leads to reduced investment and R&D spending at processing level and in many cases product substitution. Ireland's reliance on export markets, together with greater seasonal and weather dependent reliance on grass as mentioned, means that the effects of volatility may be more keenly felt here than elsewhere in the EU.

The increased volatile nature of grass growth Figure 9, along with the volatile nature of the other farm input prices, (feed, fertiliser and fuel in particular), means that income at farm level is now far more volatile than in the past. Figure 11 shows the family farm income (FFI) for specialist dairy farmers in Ireland between 1997 and 2013 and highlights the income volatility experienced, even with the inclusion of direct payments.

Figure 11 Family Farm Income (€/farm) on Specialist Dairy Farms in Ireland 1997 to 2013



Source: Teagasc NFS

The successful management of price and income volatility will be most important if Ireland is to fully capitalise on the opportunities available from dairy expansion. There are a number of options available, including forward contracting, use of futures markets, etc., and these methods of stabilising prices may be more widely used in the future, O'Connor (2009).

Alternative Employment Opportunities

During the period of rapid economic growth (2000-2007) many attractive employment opportunities were available to young people. Entry to farming including dairy farming was sometimes not viewed as an attractive proposition. This viewpoint has greatly changed and agricultural colleges now have a full complement of students. If, however, a period of sustained economic growth occurs again and attractive job opportunities emerge, for example, in construction and elsewhere, numbers of new entrants to dairy farming could again be constrained. This point was emphasised by staff directly involved in teaching in Teagasc agricultural colleges and with direct involvement in Teagasc advisory services.

Policy

The threat posed by volatility is well recognised and in some cases feared by some member states who have a preference for an EU policy led response to this issue as was the case in the past. Their view is that supply management offers the best solution to volatility and they argue strongly against total abandonment of supply quotas. This view, for example, was strongly expressed in the so called "Dantin" proposal at EU Parliament level. This viewpoint was

incorporated in the report of the Committee on Agriculture and Rural Development (COMAGRI) on CAP Reform (2013) where article 156a included the following statement:

"From 1 April 2015, In the event of a severe imbalance in the market for milk and milk products, and notably when a price of EUR 0.24/litre is reached, the Commission may decide, by means of implementing acts adopted in accordance with the examination procedure referred to in Article 162(2), to grant, for a period of at least three months which may be extended, aid to milk producers who voluntarily cut their production by at least 5% compared with the same period in the previous year... The Commission shall also impose a levy on milk producers who increase their production during the same period and in the same proportion."

Such an approach has little support in Ireland and a study on the policy proposal indicated that it would also be counter-productive at overall EU level as it would allow competitors to increase market share in the expanding global market at the expense of the EU, Keane and O'Connor (2013). However, some countries continue to raise this issue. It should also be acknowledged that there are other areas where policy decisions at EU level may also have potential to limit expansion. For example, reductions in the levels of nitrogen that can be applied and alterations to derogation rules could reduce stocking intensity. Likewise changes to ground water legislation could have a negative impact on dairy expansion.

Herd Health & Fertility

There are a wide range of bovine diseases that can affect dairy herds and inhibit dairy expansion. These can have very serious consequences for individual herd owners and could be of even greater consequence as herds become larger and more intensive. Traditionally TB and brucellosis have been seen as major herd health problems and while the incidence of TB has reduced in recent years it continues to be a significant issue in dairy herds. However, as outlined by Sayers (2013), there are a variety of other diseases that can affect dairy herds. Viral and bacterial diseases that should be considered include Leptospirosis, Salmonellosis, IBR, Clostridial diseases (e.g. blackleg), Rotavirus/Coronavirus, E. Coli and BVD. Parasitic diseases that should be considered include liver fluke, lungworm (hoose), gutworms, cryptosporidium, and coccidiosis. Some of these diseases require movement restrictions or herd depopulation while others can severely reduce milk yield and profitability. These effects can cause great stress at individual dairy farmer level. A number of interviewees believe that great animal movement post 2015 will increase the risk associated with animal health as farmers buy in additional stock and replacements. The requirements to achieve a healthy dairy herd as expansion occurs have been outlined by Sayers (2013).

Water Quality/GHG Emissions

Both water quality and GHG emissions also constitute potential constraints to milk output expansion. Both are later discussed in detail in the infrastructure requirements section which follows.

Overall Assessment

While there are a wide range of risk factors and constraints that could affect attainment of 2020 targets, these should only be seen as constituting a potential delay in the achievement of targets. In effect there should perhaps be less emphasis on the year 2020 as such, and 2020 targets are best interpreted as attainable targets in a band of years surrounding 2020 depending on the future interplay of the various constraints and risk factors above.

Infrastructure Requirements

In a recent report by Cork Chamber ***"Cork's Agri-Food and Drinks Opportunities"***, (2014) it was stated that "*Cork, with its long and rich heritage, abundant natural resources, intellectual capital and technical capabilities has a major competitive advantage and distinctive opportunity to position itself as an agri-food region of leading capability in the global market. However and critically, in order to fully exploit and capitalise on these opportunities, it is critical that the optimal infrastructure, services, resources, supports and capabilities are in situ so that Cork's competitive advantage is harnessed and the now existing very rich and unique opportunities are not missed"*. In terms of all of the above Cork's dairy industry is the leading provider of agri-food opportunities, especially with the abandonment of milk quotas in April 2015, provided optimal infrastructure in put in place.

In this report it was found that the infrastructure requirements could be classified under the following broad headings, roads: water, environmental, planning and other. Each is now dealt with in turn.

Roads

Cork County Council is responsible for more than 12,400 km of roads, placing approximately 12.5 % of the nation's roads under its remit, Table 17. The challenge of developing and maintaining such a large and varied road network has been amplified in recent years given that the budget allocation for the regional and local road network has nearly halved from a 2008 peak of circa €82 million to a current figure of circa €45 million. This reduced funding and the forecasted future requirements of the network was expressed as a primary source of concern amongst all of those interviewed for this study and was identified as a major barrier to attaining the growth forecast for the dairy sector mentioned above.

Table 17 Road Network Cork County (kms)

Local Primary	Local Secondary	Local Tertiary	Regional	National Primary	National Secondary	Total
3,223	5,026	2,264	1,381	265	260	12,419

While road surfaces within the county vary substantially, the view that recent improvements in road quality were at risk of reversing are supported by studies such as the Regional Road Network Pavement Condition Study report (PMS May 2012). In this study an international roughness index (IRI) is one of the measures used to measure road quality and in this specific case ride quality. It shows a major improvement in Cork from 2004 to 2011 with the score dropping from 6.2 to 4.8. Table 18, also taken from the report, shows the percentage length of regional roads in each of the four maintenance categories in 2011 at national and county level. This table shows that in 3 out of 4 categories the regional roads in Cork could have been considered a higher priority for funding vis a vis the national average. Both anecdotal evidence and replies to this survey indicate that the quality of the road network in Cork has deteriorated significantly since 2011. A good representative example of the responses received in the survey with regard to roads is as follows:

Q: Do you consider the current road network adequate? If no, please elaborate.

We are collecting milk and delivering farm inputs to farmers. Our biggest issue with the road network at the moment is overgrown hedges and ditches. In some areas ditches are not cut and neglected. In other cases where ditches are cut back the current practice is to cut up to 2 metres high from road level. This is sufficient for cars but not for lorries. Over grown hedges are reducing vision of on-coming traffic, damaging lorries and reducing road space on narrow roads. This is an everyday problem for our drivers and when taken into account replacing broken mirrors, disruption to transport services and time lost getting repairs carried out it is also a significant problem for our business. We would like to see this practice change with ditches, hedges and over hanging trees cut back to a higher height.

Road surfaces are allowed to deteriorate too much before being repaired. Roads with potholes and road erosion cause damage to trucks and thus affect transport plans.

No, it is very poor and has not been maintained to the standard required for HGV use.

There are areas on by-roads where bends are too severe for articulated lorries. Small bridges are also an area that needs attention.

Bridges, gulleys were never meant to take the weights they are now taking or the increased weights they are likely to have to take.

Secondary roads are coming under increased pressure due to increasing tanker size.

……..

Q: Will you have additional future road network requirements? If yes, please elaborate.

Our plan is to modernise our transport fleet and thus the road network will need to improve accordingly. We are also forecasting an increased demand for farm inputs such as fertilizer and feed as the dairy industry expands. This will also require us to expand our transport fleet.

Strengthen bridges, gulleys, and remove corners.

……..

Q: Are there other infrastructural requirements which are critical for the dairy industry?

Yes, we feel that there is a requirement for improved control measures to be in place in times of severe weather conditions (e.g winter 2011). Roads were very dangerous and there was a significant disruption to our services. When this weather happens again we would like to see adequate control measures in place to be able to deal with the situation efficiently.

……..

Q: What infrastructural deficits do you think Cork County Council should address by 2020 to support the planned dairy expansion?

Improve the quality of the roads by firstly removing overhanging trees and cutting hedges on existing roads.

Improving road surfaces - subsiding roads and erosion are allowed to go too far before being repaired.

Severe bends need to be altered to allow access for lorries.

Over grown hedges, the danger to road users and cost to hauliers caused by this problem cannot be over stated, poor road surface, dangerous blind bends, and junctions.

……..

Q: What in order of priority are the specific roads in Cork that may require immediate attention and what is the specific problem that you think is required?

N72/N73 Mallow bypass (many respondents).

N22 Macroom bypass (many respondents).

N28 Cork to Ringaskiddy (many respondents).

N73 Mitchelstown to Mallow (many respondents). Has several very narrow sections, were two HGVs to meet must reduce speed to almost a stop to pass safely. Only remedy is to widen these sections of road.

R585 Crookstown to Coppeen. Very narrow section where asphalt surface is laid. When meeting another vehicle at this section of road it is very easy to misjudge the edge of the road due to the grass margin concealing it. An Armco barrier along this section would be a great benefit as you would be alerted if keeping too close...

N72 Mallow to Rathmore. There are several narrow bridges on this route where it is very dangerous when two HGVs meet. Only remedy is make the bridges wider and one is already done.

N22 Macroom to Ballincollig. Bad for both milk tankers and health and safety for the public, many fatalities.

N71 Bandon and Innishannon are two choke points, particularly Bandon. Diverting this traffic around Bandon will cut costs and improve these towns.

R619 Donoughmore to Mallow.

……..

Table 18 Maintenance Category 2011, Cork

	Routine Maint.	Skid Resist.	Surf Rest.	Reconstruction
National	21.8%	39.4%	23.7%	15.1%
Co. Cork	16.4%	41.4%	23.8%	18.5%

With regard to the current condition of the greater network, the results from the visual conditioning rating collated from the mobile survey app is presented in Table 19. This survey uses the Pavement Surface Condition Index (PSCI) to rate the condition of individual roads. The PSCI rating system along with recommended treatment measures are presented in Appendix 3.

Table 19 Road Rating by Class, Cork

	Overall PSCI Rating								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Local Primary	0%	1%	1%	11%	7%	16%	22%	28%	14%
Local Secondary	1%	2%	4%	16%	10%	15%	23%	18%	10%
Local Tertiary	6%	7%	9%	17%	11%	10%	20%	13%	6%
National Primary	0%	5%	6%	11%	1%	4%	8%	17%	48%
National Secondary	0%	0%	1%	12%	6%	8%	7%	15%	8%
Regional	0%	1%	1%	7%	7%	16%	19%	27%	20%
Grand Total	**1%**	**2%**	**4%**	**14%**	**9%**	**14%**	**21%**	**21%**	**11%**

Table 19 shows that 44% of the network has a rating of 6 or less indicating that these roads should only be classified as poor to fair and in need of significant work. Based on these data the Department of Transport estimates that the requirement to bring the local road network up to standard (rating of 8 or 9) would be approximately €435 million.

Dairy is a very transport intensive industry. Unlike cereals and other livestock sectors where road traffic is confined to a small number of trips over short time windows, dairying requires transportation on a near continuous basis. With milk having an ex farm water content of circa 86% the transport requirement from farm to processor is particularly large. As an estimate the current production of 1.41 billion litres in Cork in 2013 would require at least 56,400 milk tanker loads[3]. An additional 50% farm level production would see this requirement grow pro rata to in excess of 84,600 loads. It should be noted that there is an industry move to larger capacity milk tankers which when completed may reduce the number of loads but will see the gross laden weight of milk tankers in many cases increase from around 35 - 40 tonnes which is typical at present towards 46 tonnes (industry consultation). The

[3]Assuming an average milk tanker load of 25,000 litres

consensus from interviewees is that some secondary and nearly all tertiary roads were not originally designed for vehicles of this size. It was suggested by many that traditional stone constructed culverts and drains would need to be replaced by concrete alternatives, while areas prone to water lodging would need immediate attention. The fact that milk transportation continues throughout the winter, albeit at a smaller scale, mean that the effects of heavy rain and frost are accentuated during this season. In addition, it was suggested that, due to the weight and size of the vehicles, junctions and turning areas in particular should be constructed in macadam overlaid with a hot rolled asphalt finish. While this finish is expensive at circa €35 per square metre versus €20 for crushed stone and surface dressing, the addition lifetime (20 years versus 10 years), better grip and reduced maintenance cost more than compensates. It was also stated that on many of these roads the strengthening and elevation is complete and thus the roads are ideal candidates for this more durable finish. The move to larger milk tankers will also create access problems for some farmers as it will require the repositioning of some farm entrances to accommodate the larger vehicles. While clear guidelines[4] are provided by Cork County Council a fear exists among farming respondents that planning applications for remedial work may be rejected in favour of new entrances.

While milk transportation from farms is spread throughout the county (see Figure 1) and involves a large part of the county's 12,419km road network Table 8, it terminates largely in a few locations (primarily Mitchelstown, Mallow, Kanturk, Newmarket, Ballineen, Charleville, Mogeely, Clonakilty, and Cork City). In addition the distribution of drinking milk, short shelf life products and other consumer dairy products see these routes somewhat reversed as it involves travel to all corners of the county. Even with current volumes, processor interviewees have referred to considerable congestion and difficulty on the key routes leading to and from their processing sites. The substantial and ever growing inter plant movement of milk and commodities was also highlighted. The former is in part due to the seasonal nature of milk production with milk diverted at the shoulder seasons (late autumn, winter and early spring) to a few plants in order to maximise economies of scale. Examples of the latter were cited, such as the large concentrated milk and milk powder requirements of the Danone infant formula facility in Macroom and the projected shipments to the planned Irish Dairy Board site at Mitchelstown. Again note should be made of the requirement to transport the final product from these plants to the consumer who will be located almost entirely in international markets. With these issues in mind the N22, N72, N73, and R619 were identified as critical roads but substandard, and in need of significant investment in the North and Mid Cork region while the N71/R586 (Bandon to Dunmanway) artery and R585 were deemed critical in West Cork. However, as stated, the increased usage on many of the feeder secondary and tertiary routes means that investment is also warranted in those cases. With regard to such routes and in particular private roads it was mentioned that co-financing with the aid of grant schemes such as the community involvement scheme should be considered. Congestion in and around the following towns, Mallow, Bandon, Macroom, and Innishannon was also mentioned by a number of respondents.

[4]In February 2014 Cork County Council published "Guidelines for sight distances at private entrances onto public roads"

The transportation of bulk dairy commodities for exports is channelled through a small number of key routes to port namely Cork, Ringaskiddy, Waterford, Dublin, and Rosslare. From Table 20 we can see that these volumes are forecast to increase by more than 52% or 176,000 tonnes between 2013 and 2020. With expanded transport volumes it is important that road development can allay congestion on these key routes. Even with current volumes, processor interviewees have referred to considerable congestion and difficulty on these key routes with specific mention of city traffic to Cork port and the N28 Cork-Ringaskiddy road. Difficulties on the latter road will be further accentuated if the proposed major redevelopment of port facilities in Ringaskiddy occurs.

Table 20 Dairy Commodity Exports

	Tonnes	**2013 = 100**
2013	334,000	100
2016	435,000	130
2020	510,000	152.5

Note: The survey involved dairies with milk intake of about 95% of all milk in Co. Cork

Concentrated feed forms an important component of dairy cows diet, with an estimated one tonne consumed per dairy cow plus followers on Cork dairy farms at present. Thus in total about 300,000 tonnes are currently being consumed on dairy farms in Cork. This involves major importation through Ringaskiddy and Cork ports, compounding in various feed mills throughout the county and distribution to the 4,500 dairy farms. Assuming a continuation of present consumption levels per cow, it can be estimated that close to 100,000 additional tonnes will be required by 2020 based on the additional dairy cow numbers estimated earlier. A limited survey of feed compounders was completed and from this it was estimated that a 30% increase in supply may arise in 2020 which is consistent with the above estimate based on increased cow numbers. This increase in feed supply to farms will involve a major increase in transport activity from the two major Cork ports to feed compounders and then further distribution to the many dairy farms throughout the county.

In order to maximise the use of grazed grass in cows' diet an increase in the use of fertilisers is also forecast. Based on consultation with the fertiliser industry in the county it is estimated that at present about 270,000 tonnes are used on Cork dairy farms. This is also forecasted to increase by 70,000 tonnes by 2020. In addition, there is expected to be a steady increase in the distribution of ground and granulated lime to dairy farms. These activities will also involve a large increase in transport, with initial importation of bulk product through Cork and Ringaskiddy and then domestic transport by fertiliser manufacturers and distributors ultimately reaching dairy farms throughout the county.

As previously mentioned the land constraint around the milking platform on the home farm will require that more

farmers will either grow or purchase silage and spread slurry at an increased distance from this platform. Again the main effect will be a considerably increased transport requirement involving farmers and silage contractors with increasingly larger vehicles over time. The additional traffic outlined makes a strong argument for more passing lanes as suggested by a number of interviewees. It was stated that along with the loss of time involved in pulling over and stopping to allow traffic to overtake, the fuel demands of such action are also considerable as the vehicle rebuilds cruising speed. The development of substantially more passing lanes in appropriate locations would also greatly assist tourism and the local non-farming community. It must however be acknowledged that such lanes are expensive in terms of land purchase and construction so the provision of passing zones may provide a more immediate and affordable solution.

The condition of hedgerows and road verges was mentioned with great frequency as a cause of concern. It should be noted that the responsibility for the maintenance of roadside hedgerows lies with landowners and not the local council. This was highlighted on safety as well as financial grounds[5]. Reference was made to the fact that over-hanging branches and limbs were slowing traffic; causing damage requiring expensive repairs to vehicles and obscuring views.

One area recognised as a possible win-win situation for all involves the construction of cattle underpasses. From a road's perspective they eliminate the danger of collisions, traffic congestion, and road wear as a result of slurry deposit, while from a husbandry perspective, they reduce the requirement of additional herdsmen, improve safety, reduce lameness, and allow 24 hour access to the milking platform for animals. However, the cost of construction is very significant with interviewees estimating a cost in the region of €50,000 to €60,000 per underpass. Cork County Council acknowledged that the number of planning applications received for underpasses has increased significantly in recent years and in response it has published guidelines for their construction. It was suggested that where construction met the guidelines that future maintenance on national roads should be the responsibility of the National Roads Authority. It was also suggested that the provision of capital grants would encourage the construction of underpasses.

Increased Dairy Traffic – Impact on Transportation Infrastructure in County Cork

The impact of additional traffic on existing infrastructure is multifaceted and includes the deterioration of road pavements and bridge structures. Across all transportation networks, the responsible authority is charged with intervening at regular intervals to address deterioration and to maintain a safe network for the users. There are established methodologies for establishing the current condition of road pavements and bridge structures. These methodologies are repeated at regular intervals to monitor deterioration and generate intervention schemes. Cork County Council, for example, regularly conducts pavement surveys across its network. Such surveys classify road pavements into various categories in terms of condition. Intervention schemes are generated from this data to

[5]Replacement wing mirrors for certain trucks were reported to cost in the region of €800

assist with preparation of maintenance budgets. Intervention schemes include: full road reconstruction, structural overlays (resurfacing), surface restoration (thin overlays) and resealing (surface dressing). The most recent pavement condition survey conducted by Cork County Council indicated that the maintenance backlog across the Regional and Local Road network is €79m (Department of Transport, Tourism and Sport (DTTaS) Pavement Management System). In a similar manner to road pavements, bridges are inspected at regular intervals and works proposals generated to maintain the functionality of the structures. The maintenance backlog for bridges across the Regional and Local Road network in County Cork is €3.6m (NRA Eirspan Bridge Management system).

Expansion of the dairy industry in County Cork will be accompanied by an increase in traffic on the road network. It is prudent for Cork County Council to evaluate the impact of the additional traffic on its network in terms of infra-structure deterioration and budget requirements for maintenance interventions. Dairy industry traffic comprises:

- Milk tankers
- Movement of end product
- Movement of feed
- Movement of fertiliser
- Farm related traffic including the movement of silage, slurry and the like

Table 21 summarises the anticipated increase in dairy industry traffic (excluding farm related traffic) in County Cork to 2020.

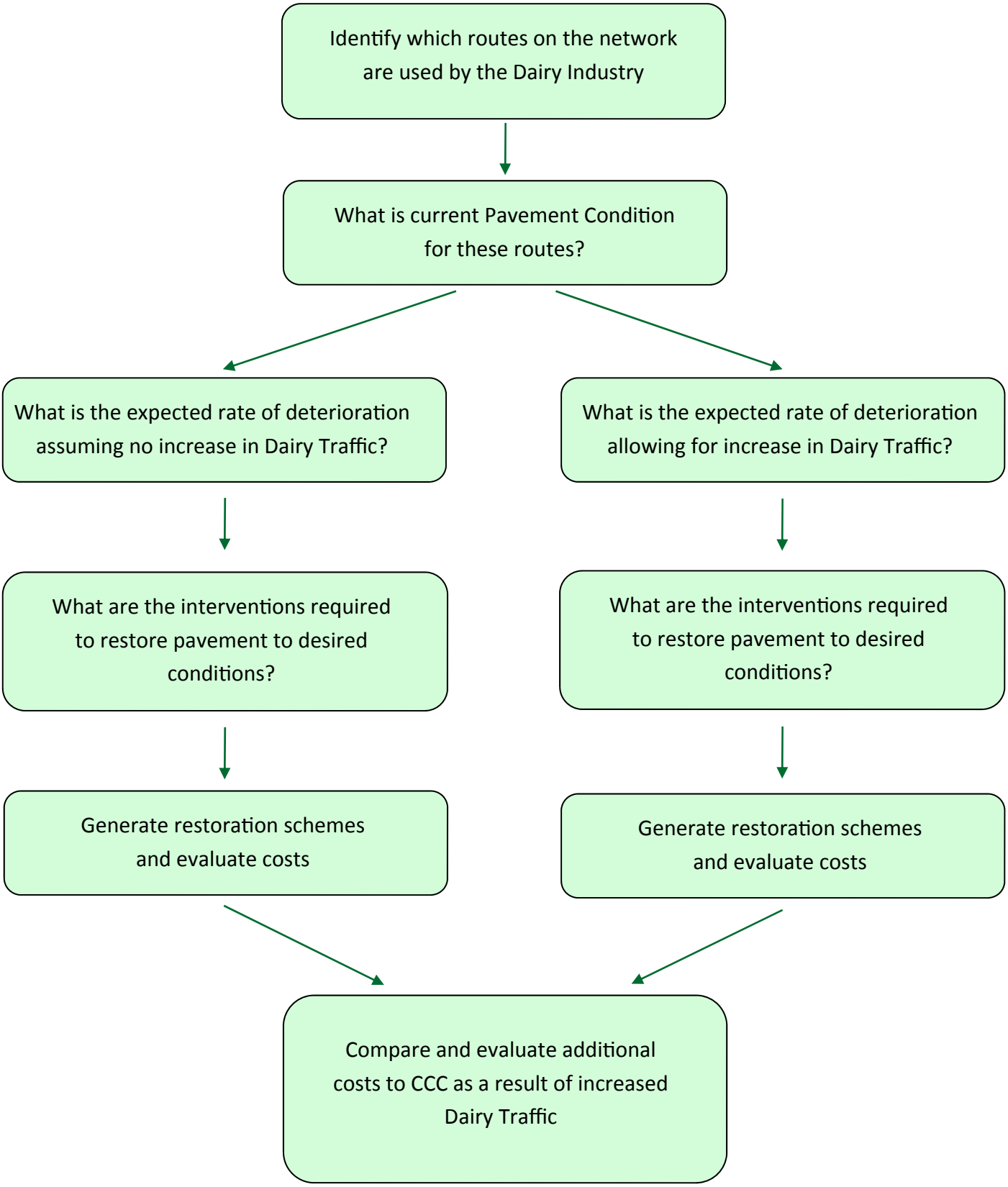
Table 21 Anticipated Increase in Dairy Industry Traffic in County Cork to 2020.

Vehicle Type	2013 (Tonnage)	2020 (Tonnage)	2013 (Loads)	2020 (Loads)
Milk Tankers			56,400	84,600
Dairy Product	214,700	370,790	8,591	14,832
Feed	300,000	400,000	12,000	16,000
Fertiliser	270,000	340,000	10,800	13,600
Total	784,770	1,110,790	87,791	129,082

A methodology for evaluating transportation infrastructure deterioration and budget requirements for maintenance interventions is presented in Figure 12. The methodology focusses on the road pavement elements of infrastructure deterioration. Structural pavement renewal and maintenance of existing pavements, by resurfacing, typically accounts for 58% of the annual transportation infrastructure maintenance budget in County Cork (*2014 Regional and Local Road Grant Allocations, DTTaS*). The methodology allows the consideration of pavement deterioration in the period 2014 to 2020 for two scenarios:

1. No additional increase in dairy industry traffic
2. An increase in dairy industry traffic in accordance with the data presented in Table 21

Figure 12 Methodology for Evaluating Transportation Infrastructure Deterioration and Budget Provision for Maintenance Interventions



The methodology presented in Figure 12 is currently being implemented for a Masters-level research project in CIT. The completion date for the research project is September 2015. For the purposes of this report the methodology was applied to a sample 10km route on the Regional and Local Road (RLR) network in County Cork and the results were extrapolated across the whole network. The purpose of this interim study was to make an initial estimate of the increase in budget provision required by Cork County Council to maintain its RLR network in a safe condition allowing for the expansion of dairy industry traffic.

Pavement deterioration is related to the fourth power of the axle load applied to the pavement ("The Highway Engineering Handbook", CRC Press, Taylor & Francis, 2006). In general terms, this means that heavy axles are the cause of most of the traffic-related deterioration of pavements. The term 'heavy axles' is taken here as Heavy Goods Vehicle (HGV) axles as opposed to car or Light Goods Vehicle axles. Given that the additional dairy traffic considered here is predominantly HGV's the pavement deterioration effects related to dairy traffic are significant. The majority of the RLR pavements in County Cork comprise surface dressing on crushed stone. These pavements are prone to rapid deterioration under heavy axle loading. The result of the interim study, on a very limited sample, is a recommendation that Cork County Council will require an additional transportation infrastructure maintenance budget provision of approximately €4.2 million for the period to 2020 and at least €1.5 million per year thereafter (2014 costs), for pavement rehabilitation alone, to cater for the additional traffic loadings generated by the expansion of the dairy industry.

In view of the very significant increase in dairy related transport, there is a major need for a targeted and focused increase in national funding to local roads' funding to assist in addressing this concentrated impact in County Cork. Furthermore, there may also be a need to consider a level of prioritisation of allocation of funding to those DEDs/ Areas which have both a combination of a high concentration of dairying and a lower than average PSCI rating for roads.

Water

Water is an essential input to dairy farming. Not alone is it an essential part of cows' diet it is also required for washing the milking equipment, parlour and yard and in some cases milk cooling. These requirements mean that not alone is a high quality of water required, it must be also come from a consistent and reliable source with adequate water pressure. Dairy farmers on group schemes and public supply have often felt that the inconsistent nature of these supplies meant that they have had to invest themselves in water provision on the farm. As a result dairy farmers have increasingly invested in private wells rather than rely on public or group water schemes for both consistency of pressure and cost reasons. However, to ensure security of supply and provide backup if required, many dairy farmers continue to avail of dual sources of water supply. This has meant that those who have private wells continue in many cases to be members of group water schemes or are connected to the public water supply where available.

Water Requirements and Conservation

The average dairy farm in Cork with about 70 dairy cows produces over 300,000 litres of milk p.a. A useful rule of thumb is that six litres of water are required on a dairy farm for each litre of milk produced. Hence on average close two million litres of water per farm are required on an annual basis. Given that there are about 4,500 dairy farms in Cork producing 1.41 billion litres of milk, about 8.5 billion litres of water annually are now required on Cork dairy farms. The projected milk output increase of 50% on Cork dairy farms from 2013 to 2020 represents an increase of slightly over 0.7 billion litres of milk. Based on the rule of thumb above, this would require the usage of a further 4.2 billion litres of water on dairy farms, bringing the total usage on dairy farms in Cork by 2020 to 12.7 billion litres.

There will also be major increases in water usage by milk processors who are already very large users of water. Processors largely have access to their own water supply and did not envisage any major difficulties in obtain their increased water requirement.

With regard to water usage and conservation on dairy farms, a very relevant recent study was completed by Teagasc in collaboration with Carbery Milk Products under the Carbery greener farms project, Murphy (2013). Water meters were installed on 25 commercial dairy farms in 2012. Average herd size was 104 dairy cows, which ranged from 45 to 194. Up to eight water meters were installed on each farm to record total direct water use including water used in the milking parlour and water consumed by livestock. Domestic water use was measured where necessary and subtracted from total water supply to give water supply to farm only. The water meter data were categorised from the supply into parlour and other uses. Parlour included the water heater, plate cooler, and wash-down readings. 'Other' consisted of livestock drinking water and miscellaneous water use on the farm. The direct water use of milk production from the sample farms was quantified as 6.40 litres of water per litre of milk. There was a wide range of usage going from 1.16 to 12.01 litres water/litre milk. Consumption by livestock and other miscellaneous use accounted for two thirds of water use on farms. The second largest use of water was the plate cooler. It was indicated that finding efficient recycling strategies for this plate cooler water would be one key factor in reducing the direct water footprint of dairy farms while maintaining energy efficiency, Murphy (2013).

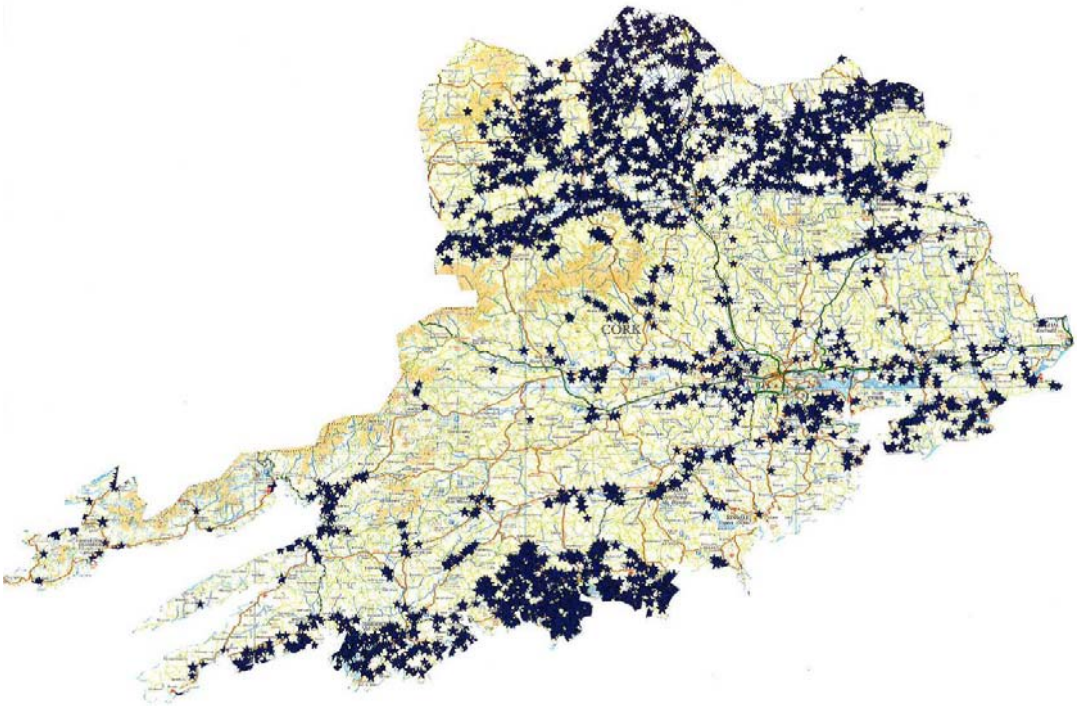
A number of interviewees also emphasised the importance of rainwater harvesting on dairy farms which, while the presence of ammonia may limit usage, can play an important role in water conservation. With regard to private water sources the requirement for a large sterile area (buffer zone) around the well was seen by farmer interviewees as onerous, in particular where sealed wells were constructed and they felt that mitigating circumstances should be applied in such cases.

It should be noted that for private water sources such as on-farm water supplies the buffer zone requirements under the European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014 are as follows:

- Organic fertilisers or soiled water shall not be applied to land within 25m of such borehole spring or well, (Article 17.(2).(c)). This is equivalent to approx. 0.2 ha of land which cannot be used for the spreading of slurry, farmyard manure, soiled water, etc.
- This distance of 25m may be reduced to 15m in certain circumstances subject to a Technical Assessment being carried out, (Article 17.(3).& (4)).

While data on the water consumption of dairy farmers supplied by public or group schemes is not readily available, it is possible to use data for aggregated agricultural enterprises which probably approximate dairy farm usage. Data provided by Cork County Council shows that there are approximately 7,000 agricultural holders in the county supplied by public water. Of these, only 2,285 use a daily average in excess of normal domestic consumption (600 litres/day). The distribution of these holdings is presented in Figure 13 and is mainly concentrated in the north of the county and in areas west and south of Kinsale. There are areas in mid, east, and west Cork where reliance on public water supplies is low or non-existent.

Figure 13 Distribution of Significant Consumers of Public Water for Agriculture Use

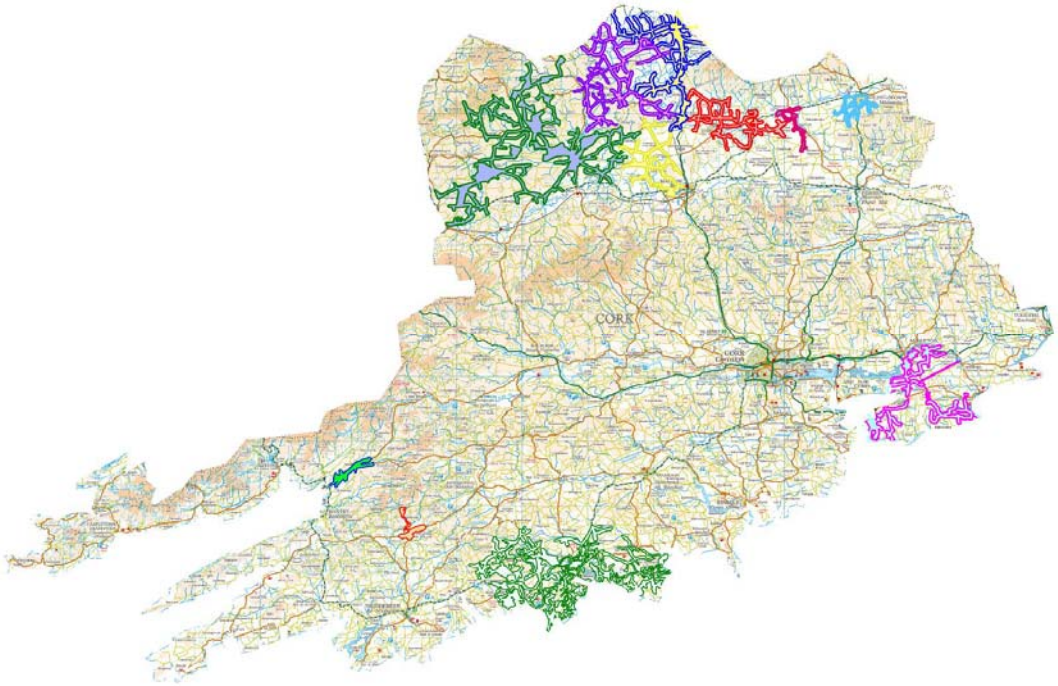


Source: Cork County Council

Cork County Council advises that several schemes in the county are currently close to capacity or are unable to supply current peak demand. These include a number of schemes where there is significant water usage by dairy farmers. While it is acknowledged that some farmers may opt to provide their own water supplies, initial analysis suggests that those water supply schemes highlighted in Figure 14 are potentially at risk of being unable to meet demand, in the event of the predicted demand increase from the dairy industry. The schemes include:

- North Cork: Newmarket/Ballinatona, Allow, Doneraile Regional, Ballyclough, Kildorrery, Mitchelstown South, Charleville.
- East Cork: Whitegate.
- West Cork: Clonakilty, Drimoleague, Kealkill.

Figure 14 Schemes at Risk of Being Unable to Meet Demand



Source: Cork County Council

It is known that some of these schemes require significant maintenance and capital investment including an increase in storage capacity and/or leakage detection/repair. Since January 2014, Irish Water has responsibility for the provision and management of water services and it is strongly recommended that it carries out further examination of the public water supplies associated with high dairy usage and particularly the schemes highlighted above to ascertain their ability to cater for demand.

Water Quality and Legislation

National legislation and regulations in relation to water are principally derived from the EU Water Framework Directive 2000/60/EC, the Groundwater Directive (2006/118/EC), Nitrates Directive (91/676/EEC), and Local Government (Water Pollution) Act, 1977, (No. 1 of 1977), and amendments. Of particular relevance to the protection of drinking water is the European Communities (Drinking Water) Regulations 2007 (S.I. No. 106 of 2007). Groundwater protection as it is impacted by agricultural activity is regulated at a national level by the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010). Both surface waters and groundwater are governed by the European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014, and Amendment, (S.I. 31 of 2014, & S.I. 134 of 2014). Monitoring and enforcement of water regulations is undertaken by the EPA, DECLG, Local Authorities, and DAFM, (through inspections carried out by DAFM inspectors under the Good Agricultural Practice Regulations and cross compliance inspections). Surface water and groundwater is monitored by the EPA and the Local Authorities in accordance with commitments under the Water Framework Directive.

Ireland is required to achieve good status for all surface waters under the Water Framework Directive by 2015. Where good status cannot be achieved by 2015 the reasons why this is not achieved must be documented in the relevant River Basin Management Plan. Extended deadlines for certain waters are proposed to 2021 or 2027. These deadlines are reviewed in subsequent planning cycles. Protected areas (including drinking, bathing and shell fish waters, nutrient sensitive areas, protected habitats and species) must without exception satisfy the objectives by 2015.

Farrelly (2014) in a major recent study for the DAFM indicated that "the increased loading of nutrients predicted under Food Harvest 2020 was deemed to be a risk factor. However, it should be noted that the legislative and Good Agricultural and Environmental Condition (GAEC) framework under which individual farmers operate means that this risk is fully acknowledged and a mitigation strategy developed. The overall predicted impact before mitigation was found to be slight negative for water quality. This finding nationally is based on risks associated with projected increases in inputs of organic and inorganic nitrogen and phosphorous fertilisers along with strict adherence to existing legislation and GAEC. With careful implementation of appropriate mitigation and monitoring at an individual farm basis greater regional/localised impacts can be avoided and nutrient thresholds as recommended by the Nitrates Directive, Phosphorus Regulations and the Surface Water Regulations can be met. *"Adopting an iterative approach to expansion, monitoring and application of best practice will assist in working towards a target of reducing potential impacts below slight negative both nationally and regionally/locally",* Farrelly, (2014). Thus it may be concluded from this study that good farm practice supported by adequate advisory input can achieve both water quality requirements and the output objectives of FH2020.

Environmental

European Union members are obliged to achieve the overall goals of the 20-20 by 2020 initiative. This initiative aims to reduce greenhouse gas (GHG) emissions by 20% compared to 2005 levels, to increase the share of renewables in energy use to 20% and to improve energy efficiency by 20% by the year 2020, European Commission (2008). The proportion of emissions from agriculture in total national GHG emissions is quite high in Ireland at about 32.3% in 2013, EPA (2014). This reflects the large volume of dairy and beef production and the relative absence of heavy manufacturing industry in Ireland. By way of contrast, the corresponding average EU27 figure for the share of GHG emissions represented by agriculture is just 9%, Breen *et al.,* (2010). Hence Ireland's requirement to reduce its GHG emissions from those sectors not covered by the Emissions Trading System (ETS) by 20% by 2020 relative to 2005 is a major challenge, particularly for the agricultural sector. According to the EPA, Ireland will breach its annual obligations for GHG emissions under the EU 2020 target in 2017 taking account of the increased emissions from agriculture if the growth targets in the FH2020 plan are met, EPA (2012).

Miller *et al.,* (2014) developed detailed models to assess the effect of FH2020 on GHG emissions. Three scenarios were compared, S1 where agricultural output was consistent with the achievement of FH2020 targets with no consideration of the GHG reduction targets, S2 where an agricultural emission reduction of 20% by 2020, relative to 2005, is achieved and S3 where an agricultural emission reduction of 10% by 2020, relative to 2005, is achieved.

Studies conducted by Teagasc using the FAPRI-Ireland model generate projections of GHG and other emissions to air that are associated with agricultural production and this work shows that in the absence of abatement technologies significant reductions in agricultural activity would be required, Donnellan (2012). Miller *et al.,* (2014) assume that abatement technologies have only limited scope in the short term and that if a substantial GHG emissions reduction target were imposed on Irish agriculture, in the short term, it would need to address this target through a reduction in agricultural activity. It was assumed that if a targeted, least cost, GHG reduction strategy was prescribed for the agricultural sector then, due to its low farm profitability, reduced production of beef from suckler cows would likely be selected as an economically efficient strategy to reduce agricultural GHG emissions. Therefore, it was assumed in the analysis that the reductions in GHG emissions required to achieve each of the emission reduction scenarios (Scenarios 2 and 3) were brought about through a reduction in the number of beef cattle (i.e. suckler cows, and their progeny). This meant that the beef target for FH2020 was not achieved in the two GHG emission reduction scenarios, although the other sectoral FH2020 targets, including a milk output increase of 50% by 2020, were met. It was estimated that Irish beef production, which was 0.545 mt. in 2005, was projected to be 0.558 mt. in 2020 under FH2020. However, beef production would need to be reduced to 0.389 mt. to achieve the 20 % reduction target, Miller *et al.,* (2014).

The consequences for GHG emissions globally arising from the replacement of EU beef consumption coming from Ireland and other EU countries with increased beef imports into the EU to meet the 20% GHG reduction target also requires consideration. In other research it was concluded that the replacement of Irish beef production with imports from non-EU countries would potentially result in a larger increase in GHG emissions globally than the emissions saved in Ireland, O'Mara (2012). It was in this context that Miller et al (2014) also gave consideration to the consequences of a 10% reduction in GHG emissions by 2020. Under this scenario Irish beef production, which was 0.545 mt. in 2005, would be reduced to 0.453 mt. in order to meet the 10% reduction target, Miller *et al.,* (2014).

In a similar vein to the above, O'Brien (2012) used a systems approach through developing a life cycle assessment (LCA) to compare contrasting milk production systems, a seasonal pasture based dairy farm as practiced in Ireland and a confinement dairy farm as practiced in many EU and non-EU countries. The study found that, when expressed per unit of milk and per on-farm area, all total environmental impacts were greater for the confinement system compared with the grass-based system.

GHG Mitigation potential

Research at Teagasc, Moorepark has demonstrated that on-farm GHG practices can be adopted to lessen GHG emissions on dairy farms, O'Brien (2013). *"The evaluation of GHG mitigation strategies demonstrated that improving the efficiency of production increases profitability and reduces GHG emissions/kg of milk solids (MS). The key farm strategies that can be readily applied to reduce GHG emissions are improving genetic merit via the Economic Breeding Index (EBI), extending the length of the grazing season and increasing N use efficiency. The analysis showed that for every €10 increase in EBI (i.e. genetic merit), GHG emissions/kg of MS declined by*

two per cent. Increasing the EBI of a dairy herd improves genetic herd traits for fertility and survival, which reduces costs and GHG emissions from replacements required to maintain the herd. Extending the grazing season by one day reduces GHG emissions by 0.14-0.17 per cent/kg of MS by reducing GHG emissions from energy use and manure storage and reduces the proportion of grass silage in the diet, which improves overall feed digestibility. Improving the digestibility of feed increases animal productivity and reduces the proportion of dietary energy lost as methane. Improving N use efficiency by increasing the utilisation of slurry, synchronising slurry and fertiliser application with grass growth and incorporating clover into the sward reduces GHG emissions from artificial N fertiliser. The GHG model showed that increasing N efficiency via decreasing the farm N surplus by 10kg/ha reduces GHG emissions/kg of MS by one per cent", O'Brien (2013).

The overall conclusion that can be drawn is that, given the need to expand milk production to meet the steadily growing demand for dairy products globally, it is clear that expanding milk production on a pasture based production system in Cork and the south of Ireland is environmentally superior to any other production system in Europe where greater animal confinement exists.

Planning

While some building work has been completed in advance there is a sense that this is not nearly adequate to meet future projections. At farm level it was stated by interviewees that a short time window for building (expansion) at farm level exists, namely from November to January (e.g. modifications, or additions, to the milking parlour, dairy, or parlour collecting yards). This requires that all planning, banking, engineering, building and grant approval have to dovetail on a very tight timeline. The non-alignment of one function could require postponement of the project for 12 months. Given that most building work on farm is financed largely by loan and dependent on availing of grant aid where possible, it is felt that it is difficult to finalise plans until near the construction start date. This in turn means that any additional requirements and planning issues can lead to lengthy postponement.

The farmer interviewees also highlighted the possibility of a surge in planning applications in 2016. They felt that farmers who had expanded milk output rapidly in the previous year would at this stage feel a large strain on their time and workload and would reorganise their facilities in order to cope. The DAFM grants scheme (TAMS1) which has now ended was recognised as having made a very valuable contribution over the past few years. There was the hope among the farmer interviewees that the expanded milk production would in part finance the expansion of facilities while TAMS II schemes may at that point provide grant aid for such work.

Other

While it is acknowledged that Cork County Council may have limited powers in relation to the provision of energy and communications networks it was felt that it should become a greater advocate for both. As stated, the dairy

industry is a key industry within the county so its growth and success will greatly benefit the county overall. However, it was also argued that reliable and ubiquitous energy and communications networks will benefit all. With regard to energy it was stated that both 2 and 3 phase networks were inconsistent leading to equipment damage. It was stated that the greater adoption of technology at farm level meant a greater use of electronic components which are very susceptible to interrupted power supply. As the cheapest form of energy it was also felt that natural gas should be available throughout the county. Given that a growing proportion of farm business is now conducted online, farming apps have become an increasing important tool on many farms, with most reliant on mobile networks. Hence a fast and reliable broadband service was also considered a necessity for the farming community.

Conclusions

The elimination of EU milk quotas in April 2015 provides a great opportunity for Cork and Irish dairying to expand milk production with major associated benefits throughout the economy. Given the natural advantages of the mild year round climate associated with the Gulf Stream, favourable soils and rainfall, Ireland in general and Cork in particular are uniquely placed to benefit from the opportunities now presented. Various studies of the competitiveness of Irish dairy farming all show that Ireland is one of the most highly competitive milk producers among all the major suppliers to the world market.

Cork is Ireland's leading dairy county with over 1.4 million litres milk output in 2013 which is in excess of 25% of total Irish output. A survey of dairies in Cork resulted in an estimated expansion for the County from 2013 to 2020 of almost exactly 50% in milk output. This estimate was further supported with opinions of interviewees from the wider industry. The estimated increase in output suggests that the average herd size may increase in the County from 70 to 90 cows approximately by 2020.

While precise estimation of the employment benefits of dairy expansion in Cork by 2020 is difficult and any estimate is inevitably subject to a margin of error, it is estimated that a total increase in jobs of 4,000 in the County is estimated by 2020 associated with a 50% increase in milk output. This includes direct employment increases in dairy farming, milk processing and dairy farm inputs as well as indirect and induced employment in the wider economy in Cork. These would be long-term sustainable jobs with the prospect of further steady growth in the decade beyond 2020. In economic terms a net increase in output at farm level in Cork as a result of dairy expansion of about €225 million p.a. by 2020 is estimated. This may result in an output increase in the overall economy of close to €450 million p.a. by 2020. As virtually all of the increased output will be exported, this also represents increased exports from Cork of about €450 million on an annual basis by 2020.

A number of constraints were considered, including land, labour, capital and EU environmental constraints. With regard to the latter, studies indicate that good farm practice supported by adequate advisory input can achieve both the environmental requirements and the 2020 milk output targets. There are also a number of risk factors in relation to growth in milk output, such as volatility in price (milk and farm inputs) and in income, Also there are a wide range of bovine diseases that can affect dairy herds and inhibit dairy expansion While the climate in Cork is in general very favourable for growing grass, and grass is the cheapest source of fodder for dairying, there are times when weather conditions are far from optimal or desirable, Overall, while there are a series of significant constraints and risk factors, Cork is particularly favoured to achieve 2020 targets in dairying, At worst, these various constraints and risk factors would only slightly delay the achievement of the targets.

In this report, infrastructure requirements were classified under the broad headings, roads, water, environmental, planning and other. Cork County Council is responsible for more than 12,400 km of roads, placing approximately

12.5% of the nation's roads under its remit. The challenge of developing and maintaining such a large and varied road network has been amplified in recent years given that the budget allocation has halved from a 2008 peak of circa €82 million to a current figure of circa €45 million. Cork dairying is serviced by a very large fleet of milk tankers, animal feed and fertiliser trucks, farmer owned and contractors' silage and related equipment and product distribution both to and from Cork and other ports as well as to domestic wholesalers and retailers. All are steadily becoming larger and heavier and will increase substantially in numbers and travel longer distances in line with dairy expansion. The reduced funding and the forecasted future requirements of the network was expressed as a primary source of concern amongst all of those interviewed for this study and was identified as a major barrier to attaining the growth forecast for the dairy sector as mentioned previously. Based on the result of the interim study, on a very limited sample, it is estimated that Cork County Council will require an additional transportation infrastructure maintenance budget provision of €4.2 million for the period to 2020 and at least €1.5 million per year thereafter (2014 costs), for pavement rehabilitation alone, to cater for the additional traffic loadings generated by the expansion of the dairy industry.

Dairying is an industry that requires very large volumes of water at both farming and milk processing levels. A high quality of water is required on dairy farms, coming from a consistent and reliable source with adequate water pressure. Dairy farmers on group schemes and public supply have often felt that the inconsistent nature of these supplies meant that they have had to invest in private wells themselves rather than rely solely on public or group water schemes for both consistency of pressure and cost reasons However, to ensure security of supply and provide backup if required, many dairy farmers continue to avail of dual sources of water supply and it is important that all sources of supply meet the farmers water needs. The distribution of holdings fully reliant on public water supply is mainly concentrated in the north of the county and in areas west and south of Kinsale. It should be noted that several schemes in the county are currently close to capacity or are unable to supply current peak demand. These include a number of schemes where there is significant water usage by dairy farmers. It is known that some of these schemes require significant maintenance and capital investment including increases in storage capacity and/or leakage detection/repair.

Given that only a short time window exists for some of the major building activity at dairy farm level, namely from November to January, this requires that all planning, banking, engineering, building and grant approval have to dovetail on a very tight timeline and it is important that all parties involved are fully coordinated to avoid extended postponement. Also the provision of state-of-the art energy and communications networks is increasingly important if modern dairy farming and processing are to be internationally competitive.

With its rich dairy heritage going back to the leading international role of the Cork butter market in past centuries and its current strengths, Cork can properly be regarded as a significant international dairy hub. As well as being leaders in large commercial farming, Cork farmers were also the originators of the rapidly growing and highly

successful farmhouse cheese sector and continue to be leaders in this industry. At processing level Cork is a base for international leaders such as Dairygold, Carbery, Kerry PLC and Danone. The Irish Dairy Board has recently announced that it has chosen Mitchelstown as its new national centre of excellence for butter packing and exporting, thus reinventing Cork's leading role of past centuries. With regard to support services for dairying, Teagasc Moorepark is recognised as a global leader in dairy research, while in dairy education and research UCC and CIT are also seen as international leaders. The Irish Cattle Breeding Federation (ICBF) based in Bandon operates the national cattle breeding database while SWS Business Services also headquartered in Bandon provides a wide variety of services for the Irish dairy sector including the national calf registration programme. Cork is also the location for a range of engineering and related services for the national and international dairy industry. These and other services based in the county make Cork a leader in service provision for the national and international dairy industry.

Overall, it is clear that Cork is a significant hub for the Irish and international dairy industry with leadership in both products and services for the domestic and international dairy sector. However to maintain its position it is important that the planned expansion to 2020 is not constrained by infrastructural weaknesses within the county.

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Appendix 1 Contributors

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Appendix 2 Supplementary Maps

Figure A1 Crops as % Total Area Farmed 2010

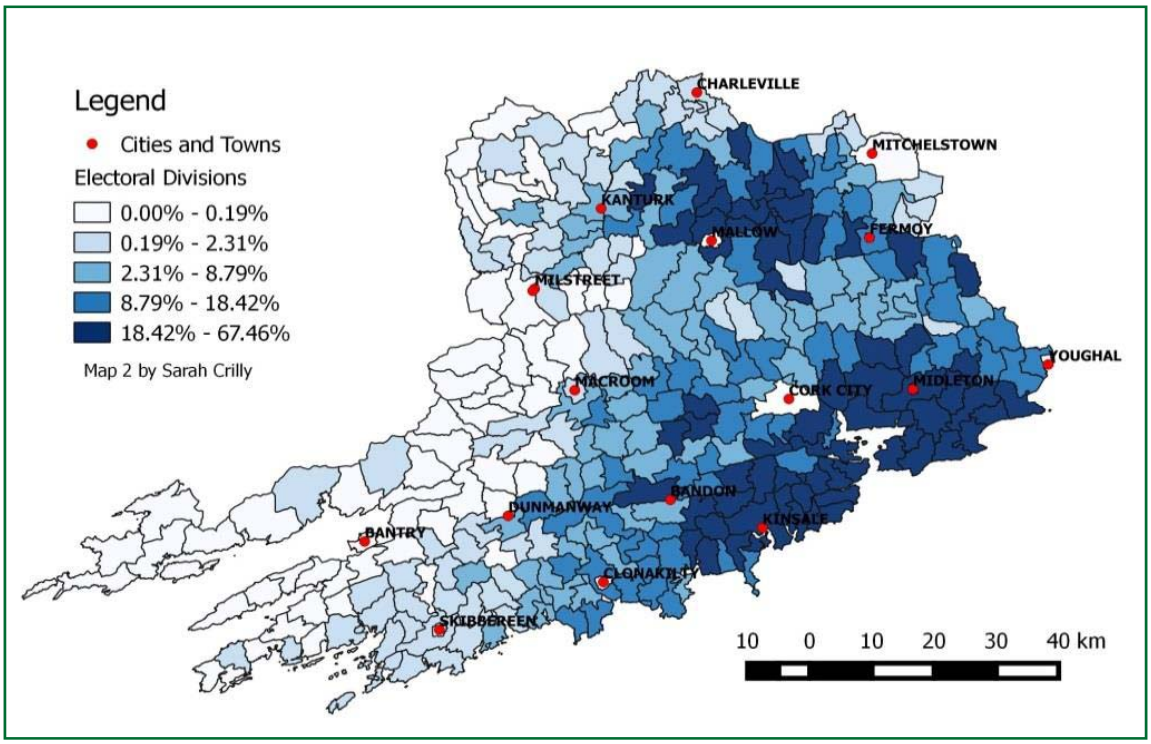
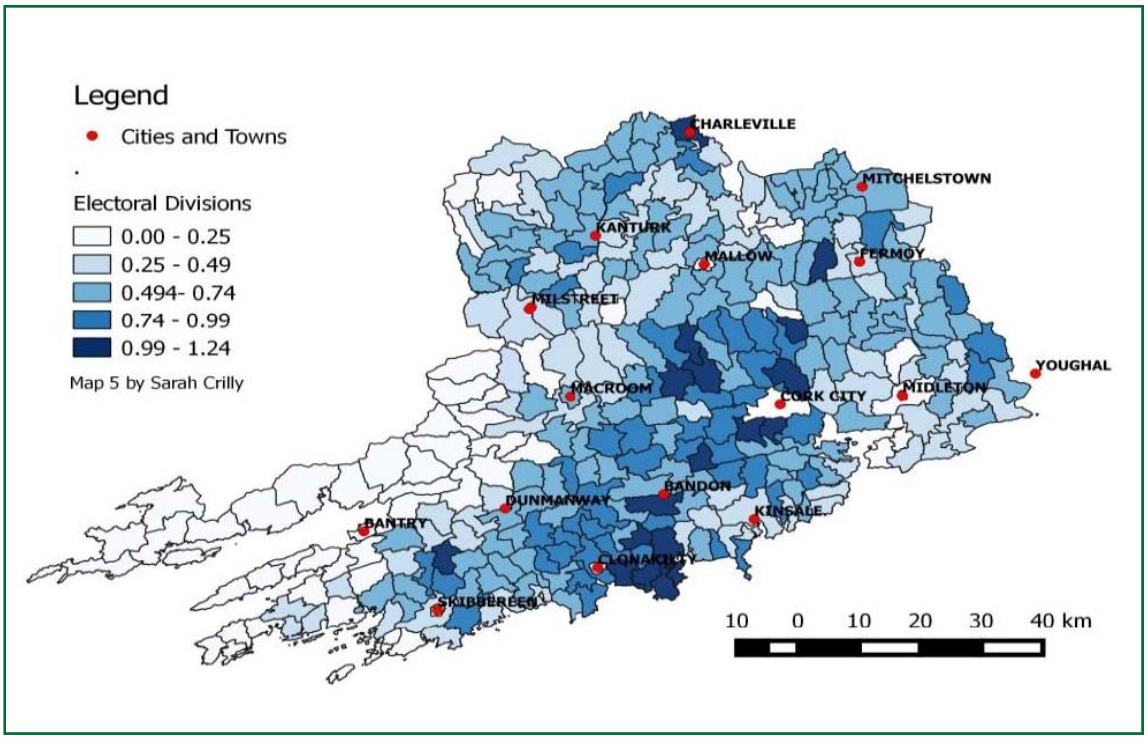


Figure A2 Dairy Cows per Hectare Farmed 2010



Appendix 3 PSCI Rating System and Road Treatment Measures

Table 1: The PSCI Rating System

Overall PSCI Rating	Primary Rating Indicator	Secondary Rating Indicator*
10	No Visible Defects	Road surface in perfect condition
9	Minor Surface Defects Ravelling or Bleeding < 10%	Road surface in very good condition
8	Moderate Surface Defects[1] Ravelling or Bleeding 10% to 30%	Little or no other defects
7	Extensive Surface Defects[1] Ravelling or Bleeding > 30%	Little or no other defects Old surface with aged appearance
6	Moderate other Pavement Defects[2] Other cracking < 20% Patching generally in good condition Surface blistering requiring reduction in speed	Surface defects[1] may be present. No structural distress[3]
5	Significant Other Pavement Defects[2] Other cracking > 20% Patching in fair condition Surface distortion requiring reduction in speed	Surface defects[1] may be present Very localised structural distress[3] (<3m^2 a few isolated potholes)
4	Structural Distress[3] Present Rutting, Alligator cracking or poor patching for 5% to 25% Short lengths of Edge Breakup/cracking Frequent potholes	Other defects may be present
3	Significant Areas of Structural Distress[3] Rutting, Alligator cracking or poor patching for 25% to 50% Continuous lengths Edge Breakup/cracking More frequent potholes	Other defects may be present
2	Large Areas of Structural Distress[3] Rutting, Alligator cracking or very poor patching for > 50% Severe rutting > 75% Extensive very poor cracking. Many potholes	Very difficult to drive on
1	Extensive Structural Distress Road disintegration of surface Pavement failure Many large and deep potholes Extensive failed patching	Severe deterioration Virtually undriveable

**Individual pavements will not have all the types of distress listed for any particular rating.*
They may have only one or two types.

Note 1: Surface Defects = ravelling or bleeding.
Note 2: Other Cracking = longitudinal, transverse, reflection or slippage cracking.
Note 3: Structural Distress =Load-related defects comprising Rutting, Alligator Cracking, Edge Breakup/Cracking, Poor/Failed Patching, Potholes or Road Disintegration.

Table 2: Treatment Measures

Overall PSCI Rating	Treatment Measures	Surface	Structure
10	Routine Maintenance	Excellent	
9		Very Good	
8	Resealing & Restoration of Skid Resistance	Fair	Good
7		Poor	
6	Surface Restoration – Carry out localised repairs	Fair	Fair
5		Poor	
4	Structural Overlay – Required to strengthen road	Poor Overall	
3			
2	Road Reconstruction – Needs full depth reconstruction with extensive base repair	Very Poor	
1		Failed Overall	

Acknowledgements and Authors' Contact Details

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Future Expansion of the Dairy Industry in Cork:

Economic Benefits and Infrastructural Requirements

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