The capacity to expand milk production in Ireland following the removal of milk quotas

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Given the imminent removal of milk quota in 2015, EU dairy farmers will be able to expand production without purchasing milk quota rights for the first time in 30 years. This paper uses Irish National Farm Survey data to simulate the expansion capacity of Irish dairy farms. Specifically, the likelihood of achieving the 50% increase in production target published in the Irish Government's Food Harvest 2020 Report is explored. Potential milk output is estimated accounting for structural change and the economic viability of production under three price scenarios for 2020. In addition, the number of new entrants that would be required to meet the 50% target is calculated. The results indicate that the 50% output volume growth target set in the Food Harvest report will be difficult to achieve and that future potential milk output depends importantly on the rate of structural change and productivity growth as well as on real milk prices in 2020. A regional analysis reveals that relative to other regions, the south has the greatest expansion capacity. This suggests that quota removal could cause significant regional restructuring of milk production, which is likely to present some challenges to the dairy processing sector.

Keywords: abolition of milk quota; economically viable production; expansion capacity; simulation

Introduction

The agri-food sector is Ireland's largest indigenous industry accounting for 7% of gross value added at factor cost of the economy in 2010 (DAFM 2012). Against the backdrop of an ailing macroeconomy, the Irish government published an ambitious plan for the agricultural sector in July 2010 (DAFF 2010). The plan is aimed at growing the value of the agricultural sector's output, with a view to the agriculture and food industries

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playing a key role in the overall recovery of the Irish economy. The Food Harvest 2020 report sets a target of increasing the value of primary agricultural output by 33% by 2020, relative to the average position in the 2007–2009 period (DAFF 2010). 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. The target for the dairy sector is to increase the volume of milk production by 50% by 2020.

The objective of this paper was to use economic modelling techniques to assess the likelihood of the Food Harvest 2020 target for the dairy sector being achieved. The analysis presented here highlighted the importance of productivity growth if this target is to be reached. Some of the implications for the Irish dairy processing sector are also discussed. As the analysis was conducted on a regional basis, conclusions were drawn about the possible future regional distribution of milk production in Ireland.

Background

The EU milk quota regime, which has been in place since 1984, will be removed in 2015 following a series of milk quota increases. The removal of milk quotas is expected to have significant implications for the dairy sector across Europe. A number of ex ante studies of the implications for Ireland have been published (e.g., Binfield *et al.* 2007; Donnellan, Hennessy and Thorne 2009; Hennessy 2007). To date, most of these studies have been conducted at an aggregate level using economic price supply response models and estimates of the quota rent. Quota rent can be interpreted as a measure of the extent to which quotas restrict production below the level that would exist if the quota was not in place.

The quota rent depends on both milk prices and production costs and therefore varies across Member States. Quota rent estimates provide some insight into how milk production may change following the removal of the quota constraint. In general these studies suggest that aggregate EU milk production will increase, while milk prices will decline and that the percentage increase in Irish production will be greater than the EU average. For example, Binfield *et al.* (2007) found that following quota removal milk production in Ireland would increase by up to 20% while aggregate EU milk production would increase by only 4%.

Production in Ireland is expected to increase by more than in other EU Member States, partly due to Ireland's favourable international competitiveness position, but also due to the relatively restrictive approach adopted in Ireland to the transfer of quota between farmers. Donnellan *et al*. (2009) argued that the restrictive quota transfer policies implemented in Ireland have resulted in a low output to resource ratio, small farm structure and a pent-up demand for production expansion when compared to Member States where a freer market for milk quota existed.

While the majority of milk quota removal impact studies have been conducted at the aggregate level, an exception is Hennessy (2007) where a farm level approach was used. Taking price and cost projections from the FAPRI-Ireland model (Binfield *et al*. 2007). Hennessy (2007) estimated the impact of a number of milk quota removal scenarios at the farm level.

The present paper adopts a similar approach to assess the likelihood of the Food Harvest 2020 target being achieved. For this purpose a simulation model based on the FAPRI-Ireland farm-level model (Hennessy 2007) was developed and used

to assess the possible milk output capacity in Ireland in 2020. Three milk price scenarios were considered and milk supply response on a national and regional level was simulated based on these conditions. Assumptions concerning structural change were made and the number of new entrants that would be required in order to achieve the 50% increase in milk production was calculated. This combined approach, involving an economic model and the estimation of new entrant requirements, provides insights into the expansion potential on existing Irish dairy farms. The results also include estimates of the additional land area, dairy cows and farm numbers required to meet the Food Harvest 2020 target.

Methodology

The FAPRI-Ireland farm-level model (Hennessy 2007) was used to simulate national and regional expansion capacity on the existing farms and agricultural land area that is currently in use for dairy production. The simulation accounts for economically viable expansion potential (i.e. expansion is a function of farm profitability) as well as structural change. The simulation period runs from 2010 to 2020 using 2008 National Farm Survey (NFS) data. Although data were available for 2009, they were not used as this was an atypical year. Very low milk prices coupled with harsh weather conditions meant that exceptionally low output, profit and productivity levels were recorded.

The simulation of milk output (Q_t) follows the general form:

$$Q_t = \sum_{i=1}^{n} C_{it} \cdot Y_{it} \qquad [1]$$

$$C_{it} = a_{itd} \cdot s_i \qquad [2]$$

$$Y_{it} = Y_{it-k} \cdot \delta_t \qquad [3]$$

with Q (Q_t) being the aggregate quantity of milk produced at time t with $t = 1,...,k$ on n farms $i = 1,...,n$. The quantity of milk is measured in both volume and solids. However, in order to avoid notational clutter in the presentation of the model we do not distinguish between volume and solids. C represents the size of the herd and Y is milk yield, both measured at time t for farm i (Buckwell 1984).

The size of the herd (C) is based on livestock density (a_d) and farm size (s). The livestock density itself depends on the soil quality of the farm.

Expansion capacity is estimated for the existing dairy platform and assuming that there is no change to the size of the ith farm's dairy platform during the simulation period. The dairy platform is defined as the land area within walking distance of the milking parlour. The maximum livestock stocking density a_d with $d = 1,2,3$ is guided by targets published in the Teagasc Dairy Roadmap (Teagasc 2010). The Roadmap recommends a stocking density of 2.6 Livestock Units per hectare (LU/ha) on the dairy platform, with only dairy cows stocked on this land. In this analysis the maximum stocking density on any given farm depends on the soil quality. Three soil classes are used and these are based on average soil class for each farm. Good soils are classified as those having no or minor limitations for use. Medium soils are classified as those having limited use range, which are unsuited to tillage but suited to permanent grassland systems. Poor soils are classified as those with very limited use range which restrict agricultural production. In our model, farms on good quality soil can increase stocking rates to a maximum of 2.6 LU/ha ($d=1$), farms on medium quality soil can increase to a maximum stocking density of 2.5 LU/ha

($d=2$) while farms on poor soils can at most achieve a stocking density of 2.0 LU/ha ($d=3$). These stocking densities are within the constraints imposed by current environmental legislation (Government of Ireland 2010).

Milk yield (Y) at time t is based on yield in the base year 2008 (t_0) and an annual rate of change in milk output, which is assumed to be the same for all farms but varies with t. Clearly some farmers will achieve productivity gains greater than those assumed, while some will not make any productivity gain. However, due to the existence of the milk quota it is very difficult to estimate from historical data which farmers are more likely to make productivity gains and at what rate. Hence, an assumption of a national average rate is used and applied to all farms.

Over the last 20 years milk yield (Y) increased by an average of 1.2% per year, while productivity gains per cow were greater in the years preceding the introduction of the milk quota system in 1984, with average annual increases in yield per cow of 4% between accession to the EEC and the introduction of the milk quota system (Dillon, O'Brien and Shalloo 2010). Higher increases in milk yields are likely in the immediate years after quota abolition as farmers, no longer restricted by quota, can lengthen lactations and reduce the amount of milk fed to calves. Further, this increase in output per cow will not incur any additional production costs as it will be achieved through improved breeding, herd and grassland management (Dillon et al. 2010). In this analysis it is assumed that yield per cow increases by

1.5% per year in each year between 2010 and 2020 apart from 2015 and 2016 when the annual increase in yield is assumed to be 4%. Given these assumptions, a compounded increase in milk yield of almost 24% over the simulation period from 2010 to 2020 is achieved.

The future rate of structural change and the economic situation of dairy farming are both considered in the analysis of future milk output capacity. Structural change rates are simulated on the basis of observed historical rates of restructuring and on the economic viability of individual dairy farms. The economic viability of milk production on all farms, including costs of expansion, in 2020 is simulated, with FAPRI-Ireland projections for output and input prices (Binfield et al. 2007) and the costs of expansion based on Hennessy et al. (2009).

Table 1 reports the number of farms producing milk in Ireland for selected years. In 2001 there were 27,814 dairy farms while in 2010 there were 18,294 dairy farms. The average rate of decline in dairy farm numbers was 4.5% between 2001 and 2010.

Given the policy constraints on milk production, it is difficult to reliably estimate how Irish dairy farm numbers may change when the milk quota constraint is removed. It is expected that the number of farms ceasing milk production will accelerate in the initial years following milk quota removal but following this initial period, the pace of restructuring may slow to a rate lower than that recorded in the quota years (Hennessy 2007).

To assess the importance of the assumptions made concerning rates of restructuring,

Table 1. Changes in the number of dairy farms

	2001	2003	2004	2005	2006	2008	2009	2010
Number of farms with milk quota	27,814	26,623	23,767	22,386	22,042	19,103	18,930	18,294

Source: Unpublished Department of Agriculture, Food and Marine data.

three alternative scenarios with differing rates of structural change were examined. Initially, the analysis was conducted with an annual rate of decline in the number of dairy farmers of 1.5% per annum; the sensitivity analyses conducted used alternative rates of 3% and 4.5% per annum reduction in farm numbers.

While data are available on the number of farms exiting production, no information is available on possible succession or the reasons for exit. Hence, it was assumed that over the simulation period the least profitable farmers exit production, which is based on the net margins (π) for i at time t_0 (i.e. 2008).

$$\pi_{it_0} = g_{it_0} - d_{it_0} - o_{it_0} \qquad [4]$$

where g is gross output, d and o representing direct costs and overhead costs respectively.

The economic viability of production on individual dairy farms is simulated under three milk price scenarios. Based on FAPRI-Ireland price projections (Binfield *et al.* 2007), and following consultation with industry experts, three output price scenarios were selected for 2020: 26, 28 and 30 cent per litre. The associated prices for fat, protein and volume (A, B and C) in each of these price scenarios are presented in Table 2 (Shalloo, 2010).

It is assumed that yield per cow increases by 23.6%, protein content by 2% and fat content by 4% between 2010 and 2020. To account for the heterogeneity in farm-level milk price, each individual farm's milk constituents, as recorded in t_0, are inflated by these assumed rates. For each farm i a milk price is projected for 2020 using the prices presented in Table 2, the projected constituents and the A+B–C milk pricing formula (Dillon *et al.* 2008).

In terms of costs, it is assumed that direct and overhead costs will increase by 9% and 11% respectively in the study period, which is based on FAPRI-Ireland projections (Binfield *et al.* 2007). Farm net margins (as calculated by equation 5) are projected to 2020 and all farms that are unable to generate positive net margins under the three milk price scenarios are assumed to have exited production by 2020.

$$\pi_{it} = (\delta \cdot \gamma_i \cdot g_{it_0}) - (\sigma \cdot d_{it_0}) - (\nu \cdot o_{it_0}) \qquad [5]$$

where δ is the accumulated change in milk yield from t_0 to 2020 and γ_i is the estimated change in milk price from t_0 to 2020 for each farm i. While, σ and ν are the rates of increase in direct and overhead costs respectively for the same period. That is, the number of farms reduces by the structural change rate μ as well as the number of farms that are unable to generate positive net margins under the various price assumptions.

$$m = n(1-\mu)(1-\vartheta) \qquad [6]$$

With m being the number of remaining farms, ϑ representing the proportion of farmers exiting production due to economic reasons based on the remaining

Table 2. Payments for milk solids and volume associated with various milk price scenarios

	Milk price scenarios		
	26 c/l	28 c/l	30 c/l
A – Fat (€/kg)	2.391	2.551	2.710
B – Protein (€/kg)	6.219	6.632	7.046
C – Volume (€/kg)	–0.04	–0.04	–0.04

Source: Shalloo (2010).

share of farmers in 2020 $n(1-\mu)$, with $0<\mu<1$ and $0<\vartheta<1$.

On those m farms that remain in production in 2020, expansion to the maximum stocking density on the dairy platform is restricted to those farms with positive net margins $[(\pi)_{Ei}]$ after the costs of expansion have been taken into account, as follows:

$$\pi_{Ei}=\pi_{it}-c_{iE}>0 \qquad [7]$$

with c_{iE} representing the costs of expansion.

Stocking additional cows results in investment costs and it is assumed that where possible, additional cows replace beef animals so as to minimize net investment costs. The expansion costs included in the analysis are: a cost for expanding bulk tank facilities, the cost of converting beef housing to make it usable for dairy cows, the additional labour required to stock a dairy rather than a beef animal, the cost of the replacement animal and any foregone profit from the beef animal. Investment costs are fully written-down over a 10-year period on a straight-line basis and are financed using a 10-year term loan at an interest rate of 6%. Further details on the expansion costs are available in Hennessy *et al.* (2009).

Given these assumptions, the aggregate quantity of milk supplied becomes:

$$Q_t=\left[\sum_{\substack{i=1\\i\neq j}}^{l}\xi_i C_{it_0}Y_{it}+\sum_{\substack{j=1\\j\neq i}}^{p}C_{jt_0}Y_{jt}\right] \qquad [8]$$

which using equation 3 can be re-expressed as:

$$Q_t=\delta\left[\sum_{\substack{i=1\\i\neq j}}^{l}\xi_i a_{it_0}s_i\ Y_{it_0}+\sum_{\substack{j=1\\j\neq i}}^{p}a_{jt_0}s_j Y_{jt_0}\right] \qquad [9]$$

where $l+p=m$, ξ_i accounts for stocking rate increase on the ith farm, farms indexed over h are those where $\pi_{Eit}>0$, and farms indexed over j are those farms for whom $\pi_{it}>0$ but where because of $\pi_{Eit}<0$ no change occurs in the stocking rate.

Data

The Teagasc NFS is conducted on a representative sample of approximately 1200 farms annually that, using population weights, can be aggregated to reflect the full population of approximately 120,000 farms. In this analysis a sub-sample, containing only dairy farms, taken from the 2008 NFS was used (Connolly *et al.* 2009). The sub-sample was then weighted to represent dairy farms nationally. The NFS data can also be aggregated to a regional level to provide a representative view of each region. After a data cleaning process, 8 farms with missing data on the dairy platform were eliminated and the final dataset comprised of 316 dairy farms which represented 19,103 dairy farms nationally.

Table 3 provides some summary statistics of the structure of Irish dairy farming in 2008. To account for the differing levels of farm-level profitability and productivity in Ireland, the sample is divided into four regions: the south-west, east and south region with the remaining counties grouped as "rest". The south and the south-west regions accounted for the majority of milk production, having more intensive farms and favourable soil and climatic conditions, while the "rest" region was typically characterized by farms with smaller herds and lower stocking densities than the national average.

Farms in the south had higher milk production per hectare and higher gross and net margins than the national average. Profitability levels were lowest in the "rest"

Table 3. National and regional[1] summary statistics

	National n = 316	South-west n = 63	East n = 86	South n = 100	Rest n = 67
Weighted population	19,103	5806	2769	5117	4331
Percentage of farms (%)	100	31.2	15.1	27.5	26.2
Percentage of national quota (%)	100	26.4	17.0	30.1	26.3
Total milk sales (millions litres)	4634	1191	793	1403	972
Average quota size (l)	243,000	213,000	286,000	275,000	224,000
Average size of dairy herd	50	48	58	55	46
Milk production (l/ha)	5448	4826	5790	5940	5473
Average deliveries per cow	4517	4069	4720	4766	4602
Stocking rate (dairy platform)	1.91	2.00	1.94	1.82	1.73
Total production costs (€)	0.256	0.246	0.253	0.243	0.262
Gross margin (€/l)	0.208	0.207	0.219	0.223	0.171
Net margin (€/l)	0.085	0.050	0.094	0.091	0.106

[1] Southwest = Kerry, Clare, Limerick and Tipperary. East = Kildare, Wicklow, Laois, Carlow, Kilkenny and Wexford. South = Waterford and Cork. Rest = Louth, Leitrim, Sligo, Cavan, Donegal, Monaghan, Galway, Mayo, Roscommon, Longford, Offaly, Meath, Westmeath and Dublin.

The regional weighting procedure differs slightly from the national one and hence when examining only dairy farms the sum of the regional populations does not always equal the national population.

Source: Authors' estimates based on NFS (2008).

region, where costs of production were high and net margin levels were low. The data show that the average stocking rate on the dairy platform in the south was 2 LU/ha compared to 1.73 LU/ha in the "rest" region.

Results

Table 4 presents the estimates of production in 2020 at various milk prices based on an annual exit rate of 1.5%.

Given this annual decline, dairy farm numbers reduce to 15,507 in 2020, even in the 30 cent per litre milk price scenario. This is a 19% decline on the 2008 level. Farm numbers decrease more in the lower milk price scenarios as more farmers find it unprofitable to continue in production, for example in the 26 cent per litre scenario, farm numbers decrease by 20% relative to 2008.

Expanding dairy farms are those that can generate a positive net margin per litre of additional milk produced when all investment costs are covered. Clearly, the number of farms that can expand profitably rises as the milk price

Table 4. Economically viable production in 2020

Milk price scenario	26 c/l	28 c/l	30 c/l
Number of active farms	15,225	15,389	15507
Number of expanding farms	5347	7941	10,007
Additional cows (in 1000)	–50	35	101
Milk output 2020 (million litres)	5579	6098	6524
National production relative to 2008 (%)	20.4	31.6	40.8
Increase in milk solids relative to 2008 (%)	20.7	31.8	41.1

Source: Authors' estimates based on NFS (2008).

increases. At a milk price of 30 cent per litre, national milk production increases by 41% relative to 2008. At a milk price of 26 cent per litre, national milk production would increase by 20% relative to 2008, while the national herd would decline by approximately 50,000 cows. The combination of an increase in national output with a decrease in national herd underlines the contribution of productivity gains to growth in milk output capacity.

This analysis does not explicitly account for new entrants, however it is possible to estimate the number of additional cows, land and new entrants that would be required to meet the 50% target as set out in the Food Harvest 2020 report. It is assumed that new entrants are, on average, farming a 100 cow herd on good soils with stocking densities of 2.6 LU/ha. This herd size is slightly larger than the average herd size for the whole population of farms but it is conceivable that new farm start-ups will be larger than average. Based on these assumptions, it is estimated that 760 new farms would be required if Ireland is to meet the 50% expansion scenario, assuming a 30 cent per litre milk price (see Table 5). Further, an additional 29,410 hectares of land would be required under this scenario. The number of new entrant farms required to reach the Food Harvest target increases to 2460 under the 26 cent per litre scenario.

There are significant differences in expansion capacity across the regions as shown in Table 6. This reflects the differences in profitability across the regions and the regional restructuring of milk supply that is likely to occur following milk quota removal. The south region has the largest capacity to expand production in all milk price scenarios. At a milk price of 30 cent per litre, production in the south would increase by almost 50% while production would increase by less than 30% in the "rest" region.

It is also evident from Table 6 that the milk price has a significant effect on future milk supply. In the "rest" region, for example, an increase of milk prices from 26 to 28 cent per litre causes an increase in production of over 20%. This is due to the fact that many farms in this region have low net margins. Under the 26 cent per litre scenario 3049 farms remain in production in 2020 and 776 farms are able to expand production in the "rest" region. Under the 28 cent per litre scenario farm numbers increase to 3421 with 1357 farms that can expand production.

Sensitivity analysis
The results presented above are based on an exogenously determined exit rate of 1.5% annually from 2010 to 2020 and productivity gains per cow of 1.5% and 4% per annum for 2015 and 2016, respectively. To examine the sensitivity of the results to these assumptions a detailed analysis

Table 5. New entrants required to meet 50% target

	26 c/l	28 c/l	30 c/l
Additional milk output required to reach target (million litres)	1,372	853	427
Additional cows required (in 1000)	246	153	76
Additional hectares required	94,477	58,742	29,410
Additional farms	2,460	1,530	760
(estimated herd size for 2020: 100 cows)			

Source: Authors' estimates based on NFS (2008).

Table 6. Economically viable production: regional analysis

Production relative to 2008 (%) (increase in milk solids relative to 2008)	Milk price scenario		
	26 c/l	28 c/l	30 c/l
South-west	19.8 (25.9)	35.0 (41.1)	37.7 (43.8)
East	12.7 (20.0)	23.3 (31.3)	39.0 (48.0)
South	23.9 (28.0)	39.1 (43.7)	49.7 (54.3)
Rest	4.3 (13.3)	25.2 (35.5)	28.4 (39.0)

Source: Authors' estimates based on NFS (2008).

was undertaken where three alternative sets of assumptions on structural change and productivity gains were used:

Scenario 1: Dairy farm numbers decline by 1.5% per year and productivity per cow increases by 1.5% and 4% in 2015 and 2016, respectively (as above).
Scenario 2: Dairy farm numbers decline by 3% per year and productivity per cow increases by 1.5% and 4% in 2015 and 2016, respectively.
Scenario 3: Dairy farm numbers decline by 4.5% per year and productivity per cow increases by 1.2% annually and 3% in 2015 and 2016, respectively.

As can be seen from Table 7 the results are sensitive to the assumptions made with regard to structural change and productivity gains. Under Scenario 3, a milk price of 30 cent per litre would not maintain current production levels. While at the same price, production would increase by almost 40% in Scenario 1 and would increase by just over 20% under Scenario 2. Clearly, the achievement of productivity

gains per cow will be crucial to the achievement of significant increases in national production.

Conclusions

This paper presents estimates of the potential milk output in Ireland on a national and regional level that accounts for the profitability of production and the process of structural change. In addition, the number of new entrants required to meet the Food Harvest 2020 Report target of a 50% expansion in milk output was estimated. Sensitivity analysis relating to the assumptions made concerning structural change and productivity growth was undertaken.

Our results indicate that the achievement of the Food Harvest growth target of a 50% increase in milk output on current dairy farms land base is unlikely. With a milk price of 30 cent per litre and productivity gains of 24% over the study period and a low rate of structural change, a 41% increase in aggregate milk supply on the existing land base is achieved. Even under

Table 7. Economically viable production – different scenarios

Milk price scenario	26 c/l	28 c/l	30 c/l
National production relative to 2008 (%) – Scenario 1	17.9 (20.7)	28.9 (31.8)	37.9 (41.1)
National production relative to 2008 (%) – Scenario 2	5.8 (8.0)	15.9 (18.3)	22.2 (24.7)
National production relative to 2008 (%) – Scenario 3	−19.8 (−18.2)	−13.3 (−11.8)	−3.5 (−1.5)

Increase in milk solids is reported in parentheses.
Source: Authors' estimates based on NFS (2008).

this optimistic price scenario 760 new entrants would be required to meet the target. Furthermore, with an annual exit rate of 4.5% and productivity gains of only 18% over the study period, national milk production would decline by 3.5% based on a milk price of 30 cent per litre. Clearly very large numbers of new entrants to dairy farming would be required under such a scenario. These results highlight the importance of both structural change and productivity gains as well as future milk prices to the achievement of milk output growth targets.

The results of the regional analysis suggest that the majority of the increase in milk production on existing dairy farms will occur in the southern half of the country. Such a regional concentration of milk production is likely to present some challenges for the Irish dairy processing sector that is already operating at close to full capacity during the peak milk production season.

The analysis only considers the expansion capacity on the farmland that is currently being used for dairy production. In terms of the simulation of the expansion potential, it would have been desirable to have information on farmers' access to additional land. Unfortunately, this information is not available. It is probable that some dairy farmers will be able to rent or purchase additional land and expand production further than our results indicate.

The results presented in this paper are based on the assumption that significant increases in stocking rates are possible. The maximum stocking rates assumed are within the limits of current environmental legislation. However, it is important to acknowledge that more restrictive environmental policies, especially in relation to greenhouse gas emissions, may be introduced before 2020. If this were to happen it is likely that the potential increases in production will be considerably less than those presented here. In conclusion, it is evident that if a 50% increase in national milk production is to be realised, significant gains in output per cow must be achieved. It is clear that investment in the development and adoption of output enhancing technologies is required. Even with assumed productivity gains of almost 24% over the study period, it is likely that significantly more land will need to be reallocated to dairy production and an influx of new entrants will be required to achieve the Food Harvest 2020 expansion target. Whether farmers will be able to acquire land that is accessible to the existing milking parlour will be a key limiting factor as expansion onto new land plots will prove costly. An examination of the role of farm partnerships in this regard would be useful.

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