TRENDS IN DAIRY PRODUCTION AND SMART MONITORING: A CASE STUDY IN NORTH MACEDONIA

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ABSTRACT

The aim of this paper is to present trends in cow milk production in Macedonia over the period 2016–2025 and to assess the role of smart on-farm monitoring through a pilot study employing smart collars and pedometers. The main empirical contribution lies in the continuous collection of data on individual cows' activity, feeding-related behavior, health status, reproduction, and productivity, with the aim of enabling earlier detection of health and reproductive events and improving operational farm management. To contextualize the significance of this technology, the introductory analytical section utilizes official secondary data from the State Statistical Office (MakStat) at national level and for the eight planning regions. The analysis focuses on three core indicators: the number of dairy cows, average annual milk yield per cow, and total cow milk production, complemented by the number of pregnant heifers per 100 dairy cows and the share of milk delivered to dairies. Results from the secondary analysis reveal whether the production base is declining, whether productivity per cow is improving, and whether such improvements are sufficient to offset herd reductions. This allows an assessment of whether the future sustainability of milk production will increasingly depend on better management of health, reproduction, and productivity at the individual animal level. The combination of macroeconomic trends and pilot-farm data provides a clear picture of the development trajectory of dairy production and the potential of digital technologies to enhance efficiency. The paper concludes that smart monitoring represents a strategic tool for improving the competitiveness of dairy farms amidst declining dairy cow numbers and rising quality and traceability requirements.

Keywords: cow milk production, trends, smart monitoring, cow productivity, livestock health, R. North Macedonia

INTRODUCTION

Dairy production depends on both the size of the productive herd and the amount of milk produced per animal. Improvements in milk yield can partly offset a reduction in the number of dairy cows, but only when productivity increases sufficiently fast. When herd contraction exceeds productivity growth, aggregate milk production declines despite improvements at the individual-animal level. This relationship is particularly important in dairy sectors undergoing structural adjustment, where fewer animals, changing farm structures and higher productivity may occur simultaneously.

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Previous research shows that structural change in dairy farming frequently involves a combination of changes in herd size, productivity and the spatial distribution of production. Bender Filho et al. (2023) analyse the sources of milk-production growth and structural change in Rio Grande do Sul, while Toro-Mujica and Vera-Infanzón (2024) demonstrate that national dairy trends may conceal substantial regional differences and distinct structural trajectories. The OECD/FAO (2026) similarly projects that future global milk-production growth will be supported primarily by higher yields per animal, while growth in dairy-herd numbers is expected to remain more moderate.

These issues are particularly relevant for North Macedonia, where dairy farming has traditionally been characterised by a fragmented production structure, a large presence of small producers and comparatively low average productivity. Earlier studies identify constraints related to farm size, production efficiency, market organisation and the long-term sustainability of domestic dairy farming (Sekovska et al., 2015; Sulejmani & Iseni, 2023). Under such conditions, the simultaneous evolution of herd size and milk yield becomes central to assessing whether domestic milk production can be maintained over time.

However, establishing that dairy-cow numbers are declining while milk yield is increasing does not fully answer the production-sustainability question. A more informative question is whether the observed rate of productivity growth is sufficiently high to compensate for the rate at which the productive herd is shrinking. If it is not, it is also important to determine how much additional productivity growth, herd retention, or a combination of the two would be required to stabilise milk production.

Accordingly, this study examines cow milk production in North Macedonia from a production-stability perspective. It evaluates whether observed productivity growth has been sufficient to offset historical herd contraction, assesses how this relationship differs across the eight planning regions, and develops conditional production scenarios to identify combinations of herd retention and productivity improvement that would be consistent with stable milk output through 2030.

The analysis therefore moves beyond a descriptive account of historical trends. It operationalises a simple production-stability gap by comparing observed productivity growth with the productivity growth required to maintain constant output under the observed rate of herd change. This framework provides a common metric for national and regional assessment and makes it possible to translate historical trends into explicit stabilization requirements.

The framework is also relevant to the discussion of digitalization in dairy farming. Precision Livestock Farming and smart monitoring technologies increasingly allow continuous monitoring of animal activity, health, reproduction, feeding behavior and productivity. Sensor-based systems can support earlier detection of health disorders and reproductive events and improve the timeliness of farm-level decisions (Rutten et al., 2013; Saint-Dizier & Chastant-Maillard, 2012; Mottram, 2016). Their contribution, however, should be considered within the broader structural context of the dairy sector. Improvements in animal-level management may raise productivity and efficiency, but their aggregate effect also depends on the size and sustainability of the productive herd.

MATERIAL AND METHOD

Data collection

The analysis uses annual data from the State Statistical Office MAKSTAT database for the period 2016–2025. The dataset covers North Macedonia as a whole and the eight planning regions. The main variables are the number of dairy cows, average milk yield per cow, and total cow milk production. The principal data source is MAKSTAT table ES380M16, Production of milk, by regions, by years.

The officially published milk yield is rounded to whole litres. For this reason, the analytical calculations use a productivity measure that is fully consistent with the reported number of dairy cows and total milk production, while the officially published yield is retained for descriptive purposes.

The empirical analysis is organised in three related steps. First, the long-term rates of change in herd size, milk yield and total production are calculated. Second, observed productivity growth is compared with the productivity growth required to maintain stable milk production under the observed rate of herd change. Third, conditional scenarios are used to examine alternative combinations of herd retention and productivity growth through 2030.

Long-term growth dynamics

Changes over the 2016–2025 period are expressed using the compound annual growth rate (CAGR):

$$g_x = (X_{2025} / X_{2016})^{(1/9)} - 1$$

where X represents the variable being analysed, namely the number of dairy cows, milk yield per cow, or total cow milk production. The exponent 1/9 reflects the nine annual intervals between 2016 and 2025.

The resulting CAGR values make it possible to compare herd contraction, productivity growth and changes in milk production on a common annual basis.

Productivity requirement for stable milk production

Total milk production depends jointly on the size of the dairy herd and milk yield per cow. If the number of dairy cows changes at an annual rate g_n and milk yield changes at an annual rate g_γ, the corresponding annual change in total production is determined by the combined effect of the two rates.

For total milk production to remain unchanged, the combined effect of herd change and productivity change must equal one:

$$(1 + g_n)(1 + g_\gamma) = 1$$

where g_n denotes the annual rate of change in the number of dairy cows and g_γ denotes the annual rate of change in milk yield per cow.

The annual productivity growth required to exactly offset a given rate of herd change is therefore:

$$g_\gamma^{req} = 1 / (1 + g_n) - 1$$

where g_γ^{req} is the milk-yield growth rate required to maintain constant total cow milk production.

The difference between observed and required productivity growth is defined as the production-stability gap:

$$SG = g_\gamma^{obs} - g_\gamma^{req}$$

where SG denotes the production-stability gap, g_γ^{obs} is the observed annual growth rate of milk yield, and g_γ^{req} is the annual productivity growth required for stable milk production.

The indicator has a straightforward interpretation. A negative value means that productivity is improving too slowly to compensate for herd contraction. A value close to zero indicates that observed productivity growth is approximately sufficient to maintain production, while a positive value indicates that the observed combination of herd and productivity changes is consistent with increasing output.

Regional production-stability patterns

The same indicators are calculated for each of the eight planning regions. Regional comparison is based on three main measures: herd CAGR, milk-yield CAGR and the production-stability gap.

For interpretative purposes, the regions are grouped into four broad production trajectories. Regions with a stability gap more negative than the national benchmark are classified as experiencing deep structural contraction. Regions with a less severe but still negative gap are characterised by partial productivity buffering. Regions in which the gap is close to zero are interpreted as being near the production-stability threshold. A separate category captures the opposite structural pattern, in which herd expansion is accompanied by declining productivity.

This classification is used only as a descriptive framework for comparing the eight planning regions and is not intended as a universal typology of dairy-production systems.

Conditional production-stabilisation scenarios

To examine the medium-term implications of alternative herd and productivity dynamics, five conditional scenarios are constructed for the period 2025–2030.

The scenarios are not forecasts. They do not estimate the probability of future outcomes. Instead, they show how total milk production would evolve under explicitly defined annual rates of herd change and productivity growth.

For each year, the number of dairy cows is calculated as:

$$N_t = N_{t-1}(1 + g_n)$$

where N_t is the number of dairy cows in year t, N_{t-1} is the number of dairy cows in the preceding year, and g_n is the assumed annual rate of change in herd size.

Milk yield evolves according to:

$$Y_t = Y_{t-1}(1 + g_\gamma)$$

where Y_t is milk yield per cow in year t, Y_{t-1} is milk yield in the preceding year, and g_γ is the assumed annual rate of productivity growth.

Total cow milk production is then obtained from the combination of herd size and milk yield:

$$P_t = N_t \times Y_t$$

where P_t denotes total cow milk production in year t. When N_t is expressed as the number of cows and Y_t as litres per cow, production is initially obtained in litres and is converted to million litres for presentation in the results.

Five scenarios are considered

The business-as-usual scenario assumes that the historical annual rates of herd change and productivity growth observed over 2016–2025 continue through 2030.

The productivity-only stabilisation scenario assumes that the historical rate of herd contraction continues, while productivity growth increases to the exact rate required to maintain constant milk production:

$$g_\gamma = 1 / (1 + g_n) - 1$$

The herd-retention stabilisation scenario assumes that productivity continues to grow at its historical rate, while the maximum rate of herd decline compatible with stable production is calculated as:

$$g_n^{re}\text{ף} = 1 / (1 + g_\gamma) - 1$$

where g_n^{re} denotes the annual herd-change rate consistent with constant milk output at the assumed productivity-growth rate.

The balanced stabilisation scenario assumes that the historical rate of herd contraction is reduced by one half. The productivity-growth rate is then calculated endogenously as the rate required to maintain constant milk production under this slower rate of herd decline.

Finally, the full herd-stabilisation scenario assumes no further decline in dairy-cow numbers ($g_n = 0$), while productivity continues to grow at its historical rate.

The scenario framework therefore separates two distinct adjustment mechanisms: changes in the size of the productive herd and changes in productivity per animal. This makes it possible to identify whether stable milk production would require primarily stronger productivity growth, stronger herd retention, or a combination of both.

RESULTS AND DISCUSSION

National production dynamics and the stability gap

Between 2016 and 2025, the number of dairy cows declined from 132,332 to 80,605 animals, a decrease of approximately 39.1%. The corresponding compound annual rate of herd contraction was about 5.36%. Over the same period, the officially published milk yield rose from 3,046 to 3,596 litres per cow. On a compound annual basis, productivity increased by approximately 1.86%.

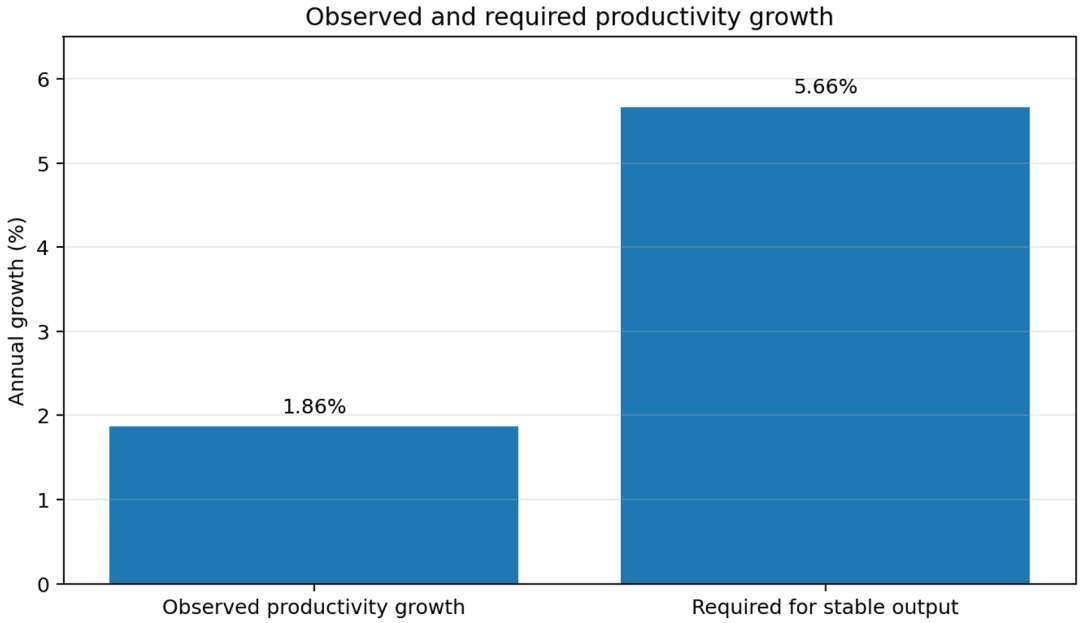
Despite this productivity improvement, total cow milk production fell from about 403.0 million litres in 2016 to 289.9 million litres in 2025, a decline of approximately 28.1%. The average annual rate of production decline was about 3.60%.

The central result is that, with dairy-cow numbers declining by approximately 5.36% per year, milk yield would have needed to increase by approximately **5.66% annually** simply to maintain total production at an unchanged level. Observed productivity growth was only about 1.86% per year, producing a national stability gap of approximately −3.80 percentage points.

Table 1. National production-stability indicators, 2016–2025

Indicator	2016 / historical value	2025 / required value	Change / analytical result
Dairy cows	132,332	80,605	−39.1%; CAGR −5.36%
Milk yield per cow	3,046 L	3,596 L	Observed CAGR +1.86%
Cow milk production	403.0 mil. L	289.9 mil. L	−28.1%; CAGR −3.60%
Required yield growth	—	5.66% p.a.	Rate required for stable output
Production-stability gap	—	—	−3.80 percentage points

Source: Authors' calculations based on State Statistical Office MAKSTAT table ES380M16



Source: Authors' calculations

Figure 1. Observed productivity growth versus the rate required for stable output

This distinction is economically important. Productivity was not declining; it was improving. The problem is that the improvement was too small relative to the speed at which the productive herd was contracting. The national dairy sector therefore combined positive animal-level productivity development with a weakening production base.

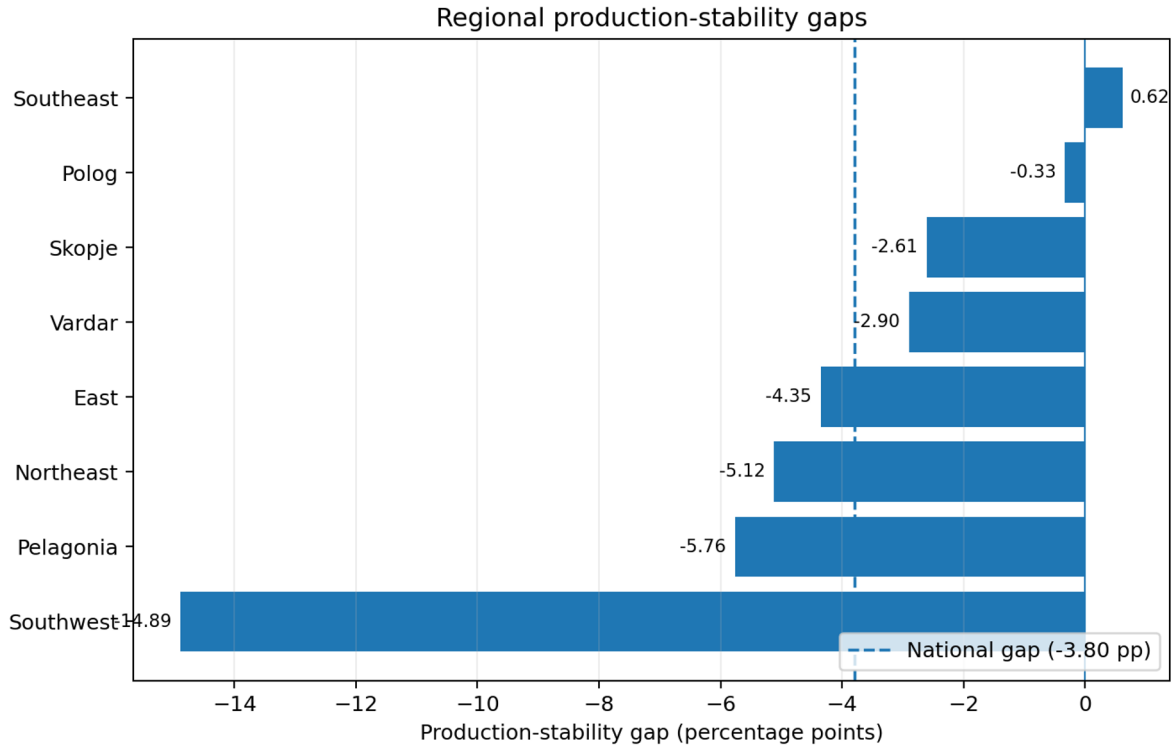
Regional production trajectories

The national result masks substantial regional heterogeneity. The production-stability framework reveals how different combinations of herd and productivity change lead to very different regional positions.

Table 2. Regional production-stability indicators

Region	Herd CAGR	Productivity CAGR	Required productivity CAGR	Stability gap	Interpretation
Southwest	-13.03%	0.09%	14.98%	-14.89 pp	Deep structural contraction
Pelagonia	-7.47%	2.32%	8.07%	-5.76 pp	Deep structural contraction
Northeast	-7.93%	3.49%	8.61%	-5.12 pp	Deep structural contraction
East	-6.27%	2.33%	6.69%	-4.35 pp	Deep structural contraction
Vardar	-5.25%	2.65%	5.54%	-2.90 pp	Partial productivity buffering
Skopje	-5.47%	3.17%	5.78%	-2.61 pp	Partial productivity buffering
Polog	-3.50%	3.29%	3.62%	-0.33 pp	Near-stability through productivity
Southeast	7.45%	-6.32%	-6.94%	0.62 pp	Herd expansion with productivity deterioration

Source: Authors' calculations based on State Statistical Office MAKSTAT table ES380M16



Note: Negative values indicate insufficient productivity growth relative to the rate required for stable output

Figure 2. Regional production-stability gaps

The Southwest recorded the most severe imbalance. Dairy-cow numbers declined at an average annual rate of about 13.0%, whereas productivity was almost unchanged. Under such a rate of herd contraction, productivity would have needed to increase by almost 15% annually to stabilise production, producing a stability gap of approximately −14.9 percentage points. This suggests that once herd contraction reaches such a magnitude, productivity growth alone becomes an increasingly unrealistic mechanism for maintaining output.

Pelagonia, the Northeast and the East also recorded clearly negative stability gaps. Productivity increased in these regions, but not sufficiently to match the decline in dairy-cow numbers. Vardar and Skopje were in a comparatively better position: productivity growth buffered a larger share of herd contraction, although the stability threshold was still not reached.

Polog represented the closest case to production stability among regions with declining dairy-cow numbers. Herd numbers fell by approximately 3.50% per year, while productivity increased by approximately 3.29%. The resulting stability gap was only **−0.33 percentage points**, indicating that the region was very close to a situation in which productivity improvement fully matched the rate of herd contraction.

The Southeast followed a different trajectory. Dairy-cow numbers increased strongly, while productivity declined. The expansion of the herd was nevertheless large enough to maintain a small positive production trend. This result illustrates the opposite side of the production relationship: herd expansion can maintain output despite falling productivity, but such a trajectory may still signal weaknesses in animal-level efficiency.

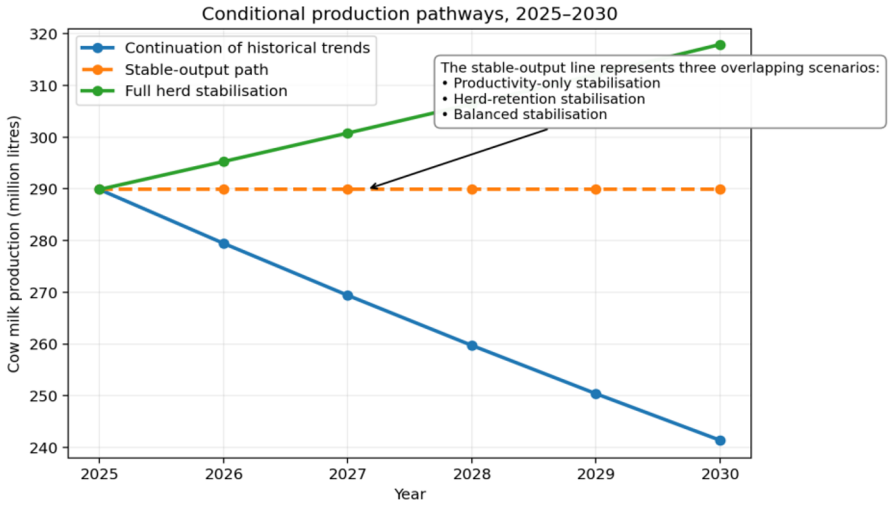
Production-stabilisation scenarios to 2030

The scenario analysis translates the historical relationship into explicit medium-term production requirements. The scenarios are not forecasts; they show what would follow if the stated assumptions about herd and productivity growth were to hold through 2030.

Table 3. Conditional production-stabilisation scenarios, 2025–2030

Scenario	Herd CAGR	Productivity CAGR	Implied production CAGR	Production in 2030
Business as usual	-5.36%	1.86%	-3.60%	241.4 mil. L
Productivity-only stabilisation	-5.36%	5.66%	0.00%	289.9 mil. L
Herd-retention stabilisation	-1.83%	1.86%	0.00%	289.9 mil. L
Balanced stabilisation	-2.68%	2.75%	0.00%	289.9 mil. L
Full herd stabilisation	0.00%	1.86%	1.86%	317.9 mil. L

Source: Authors' conditional simulations from the 2025 baseline



Note: The three stabilisation scenarios overlap at 289.9 million litres because each is constructed to maintain the 2025 production level through a different herd–productivity combination

Figure 3. Conditional cow milk production pathways, 2025–2030

Under the continuation-of-trends scenario, historical herd contraction of approximately 5.36% per year and productivity growth of approximately 1.86% per year are assumed to continue. Milk production would fall from approximately 289.9 million litres in 2025 to about 241.4 million litres in 2030, an additional decline of roughly 16.7%.

If historical herd contraction continued unchanged, productivity would need to increase by approximately 5.66% per year to stabilise output. This is roughly three times the productivity growth observed over 2016–2025.

The opposite calculation shows that, if productivity continued to grow at its historical rate of about 1.86%, the dairy-cow population could decline by no more than approximately 1.83% per year if milk production were to remain stable.

The balanced scenario is especially informative: if the historical rate of herd contraction were approximately halved to around 2.68% annually, stable production could be achieved with productivity growth of approximately 2.75% per year. This requirement is considerably closer to the historical productivity rate than the 5.66% needed under the productivity-only scenario.

Finally, if dairy-cow numbers remained at their 2025 level while productivity continued to increase at the historical rate, production would rise to approximately 317.9 million litres by 2030, about 9.7% above the 2025 level.

The findings indicate that the sustainability challenge facing cow milk production in North Macedonia is not simply a productivity problem. Productivity has increased, but herd contraction has been considerably faster. The central issue is therefore the relationship between the two processes rather than either indicator viewed in isolation.

The estimated national stability gap of approximately −3.80 percentage points provides a concise measure of this imbalance. It shows how far historical productivity growth falls short of the rate required to neutralise the observed contraction of the productive herd.

This result has an important strategic implication. Policies focused exclusively on increasing milk yield may be insufficient if the productive herd continues to shrink at the historical rate. Sustained productivity growth of approximately 5.66% per year would represent a major acceleration relative to past performance. The conditional scenarios show that production stabilisation becomes substantially less demanding when productivity improvement is combined with slower herd contraction.

The regional evidence reinforces this conclusion. Polog demonstrates that a comparatively moderate herd decline combined with strong productivity growth can bring a region close to production stability. The Southwest demonstrates the opposite: once herd contraction becomes sufficiently large, even positive productivity development provides limited protection against falling output. The Southeast reveals a third trajectory, in which herd expansion maintains total production despite deteriorating productivity. These contrasting cases show why a uniform interpretation of national averages would be misleading.

The results therefore support a differentiated approach. Regions experiencing severe herd loss face a production-base problem and may require measures related to herd retention, replacement, farm succession and the economic viability of continuing milk production. Regions with less severe herd contraction but a persistent productivity gap may benefit more from management and technology interventions that improve animal health, fertility, feeding and milk yield. Regions with expanding herds but declining productivity require stronger attention to animal-level efficiency.

Implications for Smart Monitoring

The production-stability results provide an economic context for the use of smart monitoring technologies in dairy farming. Precision Livestock Farming technologies, including activity sensors, accelerometers, pedometers and other monitoring systems, can provide continuous information on individual animals. Research shows their potential for detecting changes associated with health, locomotion, reproduction and oestrus, and for supporting faster management responses (Rutten et al., 2013; Saint-Dizier & Chastant-Maillard, 2012). Mottram (2016) similarly highlights the role of precision technologies in monitoring production, nutrition, fertility, health and welfare.

From the perspective of this analysis, such technologies are relevant because productivity growth is one of the two main adjustment margins available to the dairy sector. Better health monitoring, earlier detection of reproductive events, improved fertility management and more timely intervention may contribute to more efficient use of each productive animal. Precision technologies may also strengthen farm-level decision-making by transforming continuously collected data into management information (Lovarelli et al., 2020).

However, the scenario results identify a clear structural limit: animal-level productivity improvement cannot indefinitely compensate for rapid contraction of the productive herd. Under the historical herd trend, productivity would need to grow by approximately 5.66% per year merely to stabilise total production, far above the growth observed during 2016–2025.

Smart monitoring should therefore be interpreted as one component of a broader production-sustainability strategy rather than as a substitute for herd retention and renewal. Its greatest potential may arise when improved animal-level management is combined with measures that reduce involuntary losses, improve reproductive performance, support replacement and increase the economic viability of dairy farming. In this sense, the production-stability framework links sector-level structural trends with farm-level technological responses: aggregate data identify the scale of the productivity challenge, while smart monitoring represents one possible mechanism through which farms may improve health, reproduction and productivity management.

Limitations

Several limitations should be considered. First, the analysis uses annual aggregate data. It identifies the relationship between herd size, productivity and milk production, but it cannot establish why these variables changed. It therefore does not provide causal estimates of the effects of milk prices, feed costs, subsidies, farm size, genetics, disease, management practices or technology adoption.

Second, the regional classification is descriptive. Its purpose is to facilitate interpretation of the eight planning regions rather than to establish a general classification system applicable to other dairy sectors. Third, the 2025–2030 scenarios are conditional simulations rather than forecasts: they show the production consequences of specific assumptions but do not estimate the probability that any individual scenario will occur.

Finally, the national and regional data do not provide farm-level evidence on the effect of smart monitoring technologies. The smart-monitoring discussion is therefore based on the production requirements identified in the aggregate analysis and on evidence from the existing Precision Livestock Farming literature.

CONCLUSIONS

Cow milk production in North Macedonia underwent substantial structural change between 2016 and 2025. The number of dairy cows declined by approximately 39%, while milk yield per cow increased by approximately 18%. Nevertheless, total cow milk production fell by about 28%.

The central finding is that observed productivity improvement was insufficient relative to the rate of herd contraction. With dairy-cow numbers declining by approximately 5.36% annually, milk yield would have needed to increase by about 5.66% annually to maintain stable production. Actual productivity growth was approximately 1.86%, resulting in a national production-stability gap of around −3.80 percentage points.

Regional patterns differed substantially. Polog was close to the production-stability threshold, while the Southwest, Pelagonia, Northeast and East displayed considerably larger negative gaps. The Southeast followed a different path, with herd expansion compensating for a substantial decline in productivity.

The conditional scenarios demonstrate that milk production can be stabilised through different combinations of herd retention and productivity improvement. Requiring productivity alone to compensate for historical herd contraction would imply an unusually high rate of productivity growth. A more balanced adjustment, combining slower herd decline with moderate productivity improvement, represents a substantially less demanding production pathway.

The main implication is that the future sustainability of dairy production depends on both the performance of individual animals and the preservation of the productive herd. Smart monitoring technologies may contribute to better animal health, reproductive management and

productivity, but their aggregate contribution will be greatest when technological improvement is combined with measures that support herd retention and renewal.

The production-stability approach therefore provides a practical link between structural dairy-sector trends and farm-level management innovation. Rather than asking only whether productivity has increased, it asks whether productivity is increasing fast enough to maintain production under the observed evolution of the dairy-cow population. This distinction provides a clearer basis for assessing both the scale of the production challenge and the role that improved management and digital technologies may play in addressing it.

REFERENCES

Bender Filho, R., Favaretto, J., & Pott de Medeiros, A. (2023). Caracterização da produção de leite no Rio Grande do Sul: especialização, concentração e fontes do crescimento (1999–2020). Redes, 28(1). https://doi.org/10.17058/redes.v28i1.15634

Lovarelli, D., Bacenetti, J., & Guarino, M. (2020). A review on dairy cattle farming: Is precision livestock farming the compromise for an environmental, economic and social sustainable production? Journal of Cleaner Production, 262, 121409. https://doi.org/10.1016/j.jclepro.2020.121409

Mottram, T. (2016). Animal board invited review: Precision livestock farming for dairy cows with a focus on oestrus detection. Animal, 10(10), 1575–1584. https://doi.org/10.1017/S1751731115002517

OECD/FAO. (2026). OECD-FAO Agricultural Outlook 2026–2035. OECD Publishing, Paris/FAO, Rome. https://doi.org/10.1787/47874669-en

Rutten, C. J., Velthuis, A. G. J., Steeneveld, W., & Hogeveen, H. (2013). Invited review: Sensors to support health management on dairy farms. Journal of Dairy Science, 96(4), 1928–1952. https://doi.org/10.3168/jds.2012-6107

Saint-Dizier, M., & Chastant-Maillard, S. (2012). Towards an automated detection of oestrus in dairy cattle. Reproduction in Domestic Animals, 47(6), 1056–1061. https://doi.org/10.1111/j.1439-0531.2011.01971.x

Sekovska, B., Todoroska, M., & Risteska-Jovanoska, S. (2015). Dairy sector in Republic of Macedonia – yesterday, today, tomorrow. Economics of Agriculture, 62(4), 1109–1116. https://doi.org/10.5937/ekoPolj1504109S

State Statistical Office of the Republic of North Macedonia. (2026). Production of milk, by regions, by years [Data set, MAKSTAT table ES380M16]. https://makstat.stat.gov.mk/PXWeb/pxweb/en/MakStat/MakStat__Zemjodelstvo__DobitocnoProizvodstvo/400_DobPro_Reg_Mleko_ml.px/

Sulejmani, E. I., & Iseni, M. A. (2023). Sustainability and perspectives of the North Macedonian dairy industry. Journal of Agricultural Sciences (Belgrade), 68(1), 19–41. https://doi.org/10.2298/JAS2301019S

Toro-Mujica, P., & Vera-Infanzón, R. (2024). Evolving dairy cattle systems in Chile: Structural shifts and adaptation strategies. Animals, 14(15), 2245. https://doi.org/10.3390/ani14152245