



The Potential of Dual Purpose Fleckvieh to Improve the Efficiency of the New Zealand Dairy and Beef Industries Improving Environmental and Animal Welfare Outcomes

Craig Mckimmie*

Department of Genetics, Samen, New Zealand

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***Corresponding author:** Craig Mckimmie, Department of Genetics, Samen, New Zealand

Abstract

The agricultural industry stands at a critical juncture, driven by the simultaneous imperatives of sustainability, economic viability, and climate change mitigation. Within this context, the adoption of dual-purpose breeds such as the Fleckvieh dairy cow emerges as a promising strategy to meet these multiple ends, it was found in previous research at the Dohne research center in South Africa that Fleckvieh cross cattle could represent the best possible solution to improve the efficiency and environmental outcomes in this challenging future. Incorporating an array of references and data sources to ensure a comprehensive analysis. This includes studies from research farms in the Western Cape Province of South Africa, where Fleckvieh cows have utilized in various milk production systems, ranging from intensive zero-grazing to extensive pasture-based models. Crossbreeding programs involving Fleckvieh sires and Holstein or Jersey cows to assess the resulting progeny's performance and environmental impacts. Additionally, the evaluation of methane emissions, reproductive parameters, feed efficiency, health outcomes, and economic viability forms an integral part of this study. Previous studies on greenhouse gas emissions indicate a diurnal pattern, with emissions peaking post-feeding and gradually tapering off. Such nuanced understanding underscores the importance of grazing schedules and dietary compositions in mitigating environmental pollution.

This research paper aims to explore the utilization of Fleckvieh and Fleckvieh crossbred dual-purpose dairy cows under grazing conditions in New Zealand, delving into their performance, productivity, and suitability for bridging the gap improving the sustainability of both dairy and beef production. This paper provides valuable insights for farmers and researchers interested in integrating this breed into grazing-based dairy systems both in New Zealand and globally in this research we have analyzed the dairy performance in two New Zealand herds and the beef performance by entering a dual purpose dairy sire in the beef and lamb NZ dairy beef progeny test this bull with performance matching the best beef sires in the industry the results of this research are both exciting and offer a completely different perspective from the current solutions offer by the industry.

Keywords: New Zealand; Dairy; Sustainability; Grazing; Dairy Beef; Crossbred; Kiwi-Crossbred; Fleckvieh; Jersey; Friesian; Dual Purpose.

Introduction

Grazing systems in New Zealand face their own unique challenges to maintain environmental sustainability and economic viability. These systems necessitate a careful balance between production, environmental and animal welfare outcomes (Rangel et al., 2020) and what is now being referred to as the social license, dual-purpose dairy breeds offer a flexible solution by providing both milk and meat while reducing the carbon footprint of both milk and meat products and improving Animal welfare outcomes [1].

Dairy production systems in New Zealand are either grazing or intensive, and into seasonal or all-year-round calving systems with the majority of New Zealand farms seasonal calving grazing. The New Zealand national dairy herd is majority crossbred Friesian Jersey cross of varying proportions. Most dairy production systems in Europe are currently intensive and/or all-year-round systems with Holstein-Friesians as the main breed. In these countries there is intense pressure to profit and maintain these intensive Holstein systems in dairy farming and for grazing-based

systems to disappear. However, grazing-based, and dual-purpose production systems were, and are, important parts of dairy farming in Europe. This was for historical, and socio-economic reasons, as allocation of breed was relevant in the past [2]. Breeds such as Holstein in the early 60-s focused in areas with an abundant and cheap feed supply such as maize and cereals, resulting in a rise in the number intensive production system. One of the consequences of this focus is an inability to adapt to changes in milk quota and environmental legislation, as already experienced in countries such as the Netherlands. Such a situation can be a linkage to grassland depletion with environmental consequences, resulting in monocultures, loss of biodiversity and increased fertilizer use. Other herd types such as dual purposed breeds are better able to maintain grazing systems. Previous research already showed that both (dual purpose) breeds and grazing systems can keep grassland intact and are important mechanisms to maintain this dual-purpose breeding system [3].

The focus on Fleckvieh cows and their unique genetic characteristics, which enable them to serve dual purposes: efficient milk production and high-quality beef yield. This dual utility offers a significant advantage in diversified farming systems, particularly under grazing conditions that align with the breed's robust constitution and adaptability. Recognizing these traits, this research extensively explores various aspects of the breed, including its historical development, genetic traits, and current utilization within the dairy industry. Conducting comparative analyses to quantify the advantages Fleckvieh cows have over other dairy breeds, thereby establishing a comprehensive understanding of their geographical distribution and applicability across different farming landscapes.

This research paper investigates the intricacies of various grazing models, highlighting their significance, benefits, challenges, and environmental impacts. The comparison with conventional dairy systems provides a detailed landscape of how grazing models can foster sustainability and improved cow welfare. This approach in assessing the benefits of utilizing Fleckvieh cows in grazing systems, laying the groundwork for robust productivity analysis. Central to this analysis are factors such as milk yield and quality, reproductive efficiency, growth and meat production, and health and longevity of the cows. Examining Fleckvieh cows' adaptability to grazing conditions alongside a comparative study with other breeds further enriches the performance metrics and suitability criteria.

This research aims to address critical questions through a comprehensive discussion and interpretation of findings, this paper aims to provide n insights into these questions, drawing correlations between grazing practices and performance outcomes, and offering implications for the broader dairy industry.

The research methodology employed involves a blend of qualitative and quantitative approaches, including cluster analysis, life cycle assessments, attribute weighting analysis,

genetic evaluations, and environmental impact assessments. By contextualizing findings within previous studies, this paper presents a coherent narrative that aligns with contemporary research on sustainable dairy farming practices.

Grazing-Based Dairy Systems

Grazing-based dairy systems represent an integral component of sustainable agriculture systems, providing a natural and integrated approach to dairy farming. These systems, by virtue of allowing cattle to graze on pasture, significantly affect the environmental and economic aspects of dairy production.

Grazing also supports enhanced milk quality, as cows consuming a diverse range of pasture plants produce milk with higher contents of beneficial fatty acids, such as omega-3 and conjugated linoleic acid (CLA). Additionally, grazing systems can offer economic benefits by reducing feed costs and lowering the need for infrastructure investments, such as housing and feeding facilities [4].

Despite their benefits, grazing-based dairy systems are not without challenges. One significant issue is the dependency on weather and seasonal variations, which can affect pasture availability and quality. Periods of drought or excessive rainfall compromise the growth and nutritional quality of pasture, leading to variability in milk production. Another challenge lies in managing the nutrient balance within the grazing field to avoid soil depletion or nutrient runoff, an issue that requires precise management and planning. Furthermore, lower milk yields compared to high-input systems can be a limitation, offset by the higher milk quality and reduced costs [4].

Environmental impacts of grazing systems are a critical consideration in the current climate change narrative. Grazing can contribute to environmental benefits such as carbon sequestration, improved soil structure, and biodiversity enhancement. However, methane emissions from grazing cattle remain a significant environmental challenge. Methane, a potent greenhouse gas, is produced during the digestion process in ruminants. It is crucial to explore genetic selection for low methane-producing breeds and implement effective grazing management to mitigate this impact [4].

When compared to conventional dairy systems, grazing-based systems offer advantages and distinct differences. Conventional systems, which often involve confined housing and high concentration diets, can achieve higher milk yields per cow but at the expense of increased feed costs and potential health issues such as lameness and metabolic disorders. In contrast, grazing systems typically result in lower milk volumes but enhance cow health and milk quality, reduce feed costs, and contribute positively to environmental sustainability. These factors make New Zealand's grazing-based systems an integral part of a sustainable future.

In summary, grazing-based dairy systems provide a viable and sustainable alternative to conventional dairy farming. While

they come with their set of challenges, the benefits in terms of cow health, milk quality, environmental sustainability, and economic viability are considerable. The ongoing research and development in this field, particularly focused on breeds like the Fleckvieh, highlights the potential for these systems to lead the way in sustainable agriculture and dairy production.

Dual Purpose Dairy Cows: Characteristics and Breeds

The breeding of dairy cows has been part of Agriculture since these animals were first domesticated and kept in herds under the management of humans for the benefits associated with early human agriculture. Artificial selection for milk yield and other breeding goals, for example udder and feet and leg improvements, has made dairy breeding a special field of science. Dairy cows have reached high production levels, and these levels are still increasing. Changes caused by selection have not only imposed strains on animals as production has increased, but such a selection approach has also experienced criticism.

The criticism of the narrowly defined breeding goals for dairy cows has prompted the search for alternatives. Dual purpose breeds, bred for both milk and meat, representing an alternative to the high-yielding Holstein breed. However, the existence of dual-purpose breeds does not warrant their applicability as an alternative to Holstein.

Background of Fleckvieh Dual-Purpose Dairy Cows

The Fleckvieh breed, also known as Simmental, boasts a rich history and has established itself as a pivotal player in both dairy and meat production. The historical development of Fleckvieh can tracing back to the Simmental Valley of Switzerland, where it originated as a dual-purpose breed. Over the years, selective breeding practices have enhanced its desirable traits, making it a robust breed capable of producing substantial quantities of both milk and high-quality beef. These traits have cemented Fleckvieh reputation and expanded its geographical spread globally, including significant adaptation and utilization in countries like Germany and South Africa.

Genetic characteristics underpin the versatility of Fleckvieh cows bred for traits such as muscle development, strong skeletal structure, and optimal milk production. These genetic traits include not only high milk yield but also good milk composition, particularly in fat and protein content, but also favorable growth rates and carcass qualities suitable for beef production. Genetic selection has focused on elements like disease resistance and efficient feed conversion, which are critical for both dairy and beef performance. This genetic robustness enhances their adaptability to various climatic and farming conditions, making them ideal candidates for low-input grazing systems as well as intensive dairy operations.

The importance of Fleckvieh cows in dairy and meat production is well established, with approximately forty million

breeding cows worldwide it is one of the largest populations of domestic cattle. In dairy production, their milk yield, though sometimes lower in volume compared to specialized dairy breeds like Holstein, compensates with higher fat and protein percentages. This translates to a higher economic value of the milk produced. For meat production, the breed's ability to achieve desirable carcass weights and quality offers a dual income stream for farmers, thus increasing the overall efficiency and profitability of dairy herds [4].

Currently, Fleckvieh cows in South Africa are utilized by the dairy industry for crossbreeding programs, aimed at enhancing milk yield and composition, while maintaining or improving meat production potential. These crossbreeding efforts have yielded progeny that not only inherit the superior milk qualities of breeds like Holstein but also exhibit improved growth performance and meat quality, as evidenced in studies conducted in South Africa [4].

The crossbred cows have shown promising results in terms of reproductive performance, longevity, and adaptability to grazing conditions, thus providing a sustainable alternative to conventional dairy farming practices. When compared to other breeds, Fleckvieh cows offers competitive advantages, their dual-purpose nature allows for diversification in farm income, making them economically attractive in regions where both dairy and beef markets are significant. Additionally, their robust health and longevity reduce the need for frequent herd replacements, lowering overall farming costs [4]. The breed's high forage intake efficiency and adaptability to different grazing systems highlight its potential to thrive in low-input and variable environmental conditions, making it a preferred choice for farmers seeking sustainability and productivity in their dairy operations.

Geographically, Fleckvieh cows have a widespread distribution. Apart from their origin in Switzerland, Fleckvieh in Germany Fleckvieh cattle are well established, and remains one of the largest exporters of this breed. Their adaptability has seen them incorporated into dairy herds across Europe, Africa, and the Americas. In South Africa, research farms and commercial producers have increasingly adopted Fleckvieh cows for their dual-purpose benefits and environmental sustainability advantages [4]. These geographical spreads underscore the breed's versatility and the global recognition of its value in diverse farming systems.

The comprehensive suite of traits possessed by Fleckvieh cows positions them as a formidable breed in the ongoing pursuit of agricultural sustainability. By maintaining standards in milk production and beef quality, along with their adaptability to various farming practices and climates, Fleckvieh cows continue to offer promising prospects for farmers and researchers alike. The breed's capacity to contribute significantly to both dairy and meat markets, coupled with its reduced environmental footprint, makes it an exemplary model for future farming endeavors focused on sustainability and productivity. (Figure 1 &2)

Beef 112 (99)	
Daily net gain	108 99 %
Carcass percentage	117 99 %
Carcass grade	101 99 %

Figure 1: Increva PP Geman Beef value

Beef Performance	BI 114 99	
Daily net gain	109	99 %
Carcass perc.	107	99 %
EUROP trade cl.	114	99 %

Figure 2: Sisyphus German beef Value

Results of Fleckvieh cross in New Zealand

Farm 1 (system 3 grass + 1 kg meal in shed): in Canterbury, 10 two-year-old sired by Fleckvieh average 434 Milk Solids in 275 days. The average for all two-year-olds was 411 MS. 100% pregnant 9/10 to first mating, 1/10 to second mating.

Farm 2 (system 3 to 4): Milks 100 Fleckvieh in 360 cow herd in Northland, the herd test results from 2-year heifers average 389 MS season to 22nd of December verse Friesian 377 MS. 100% In Calf for Fleckvieh and 20% empty for Friesian.

In the Beef and Lamb trial for Beef Dairy progeny test, dairy Fleckvieh sire INCREVA PP that was 5th highest for carcass weight in cohort 5 among top 20 bulls for carcass weight his German beef value as shown below:

The above Result highlights that milk production and reproduction from dual purpose Fleckvieh is comparable or improved on the current New Zealand crossbred cow population

and that the beef value of these animals matches the current beef population giving a substantially better outcome than the traditional separate populations of beef and dairy production

This research seeks to contribute to the ongoing discourse on sustainable livestock management, offering actionable insights and recommendations for integrating Fleckvieh cows into New Zealand grazing-based systems. It underscores the potential of this breed to serve as a cornerstone in achieving a balanced, productive, and environmentally sustainable dairy industry, setting the stage for future research directions and policy implications that support sustainable agricultural development.

Discussion

The performance of Fleckvieh dual-purpose dairy cows under grazing conditions has been the focus of studies aimed at evaluating their productivity and suitability for sustainable dairy and meat production. Fleckvieh cows exhibit multiple traits that

make them particularly well-suited for grazing systems, including high milk yield and quality, impressive reproductive performance, robust growth and meat production, overall health and longevity, and remarkable adaptability to pasture-based environments.

Milk solids production and quality are paramount indicators of dairy cow performance. Fleckvieh crossbred cows, have shown their ability to similar levels of production to the typical New Zealand crossbred dairy cow, Fleckvieh cross cows have exhibited component percentages and total milk solids for their liveweight. In South Africa, the higher fat and protein content in Fleckvieh milk translates to a higher market value. This advantage is particularly evident in crossbred Fleckvieh x Holstein (F x H) cows, where milk performance is on par with their Holstein contemporaries. Grazing on a diverse range of pasture plants further enhances the omega-3 and conjugated linoleic acid (CLA) content in the milk, promoting better human health outcomes and adding economic value to dairy products derived from these cows.

Reproductive performance is another critical factor in evaluating the efficiency of dairy cows in grazing systems. Studies have indicated that F x H cows exhibit favorable reproductive parameters compared to their purebred Holstein counterparts. For instance, F x H cows tend to recover more quickly post-calving and show higher heat detection rates, these traits contribute to reduced calving intervals and sustained productivity, which are vital for maintaining the economic viability of dairy operations. The quick recovery and enhanced fertility enable farmers to optimize breeding schedules and improve overall herd efficiency.

In terms of growth and meat production, Fleckvieh cows have demonstrated impressive performance. Their genetic predisposition for muscle development and favorable carcass traits makes them excellent candidates for beef production. Crossbreeding Fleckvieh with other dairy breeds, such as Jersey and Holstein, has resulted in progeny that excel in both milk and beef production. The growth performance of Fleckvieh x Jersey and F x H calves, monitored from early rearing stages to marketing for veal and beef, has shown superior weight gain and carcass quality, underscoring the breed's dual-purpose utility [4]. In New Zealand Beef and Lamb Dairy Beef progeny test a dairy Fleckvieh sire with German breeding values for beef at a similar level to sires used in the Canterbury New Zealand case study finished 5th for carcass weight in his cohort of leading beef sires Sneden et al, [5], this gives rise to the possibility that New Zealand could run one dual purpose cow herd that was comparably efficient to the current separate beef and dairy herds removing the need for duplication in cow numbers to attain suitability to their prescribed industries.

The health and longevity of Fleckvieh cows are critical considerations in assessing their overall performance. Grazing-based systems, which align with the natural grazing behavior of cattle, have been associated with improved health outcomes. Fleckvieh cows in grazing systems tend to exhibit lower

incidences of ailments such as lameness and mastitis, owing to the diverse and natural diet provided by pasture. Their robust health translates to longer productive lifespans, reducing the need for frequent replacements and thereby lowering replacement costs, this longevity not only enhances the economic sustainability of dairy operations but also contributes positively to animal welfare.

Adaptability to grazing conditions is a standout trait of Fleckvieh cows. Their genetic hardiness and efficient forage utilization make them well-suited for varying pasture conditions. Fleckvieh cows can thrive in low-input systems, emphasizing high-forage diets and minimal concentrate feed, which are sustainable and environmentally friendly [4]. Their ability to maintain productivity in diverse climatic conditions further underscores their versatility and reliability for grazing-based dairy farming.

Comparing Fleckvieh cows to other breeds under grazing conditions, Fleckvieh cows consistently exhibit superior performance metrics across various parameters. Their dual-purpose nature provides a balanced approach to dairy and beef production, where other specialized breeds may fall short in either milk yield or meat quality. This versatility offers farmers increased flexibility and economic stability. The comparative advantage of Fleckvieh over other breeds is particularly evident in crossbreeding programs, where the progeny inherits the best traits of both parent breeds, resulting in enhanced overall farm productivity.

Conclusion

Adaptability to grazing conditions is a hallmark of the Fleckvieh breed. Their genetic robustness and efficient forage utilization make them well-suited for pasture-based systems. This adaptability is particularly significant in regions with variable climatic conditions, where the ability to thrive on native pastures and withstand environmental stresses becomes crucial. Fleckvieh cows exhibit strong grazing behaviors and excellent forage conversion rates, which align with the principles of low-input and sustainable dairy farming practices [4].

When comparing Fleckvieh cows with other breeds under grazing conditions, several advantages stand out. While specialized dairy breeds like Holstein may produce higher milk volumes, Fleckvieh cows offer superior milk quality and additional beef production benefits. This dual-purpose nature not only diversifies income streams but also spreads financial risk, making Fleckvieh cows a more resilient choice for farmers. Moreover, the breed's lower environmental footprint, due to efficient feed utilization and higher resistance to common ailments, presents a compelling case for their adoption in sustainable farming systems [6,7].

In summary, Fleckvieh crossbred dual-purpose dairy cows under grazing conditions exhibit a comprehensive suite of desirable traits, including high milk solids production and quality, impressive reproductive performance, robust growth and

meat production, superior health and longevity, and exceptional adaptability. These attributes highlight the potential of Fleckvieh cows as a viable choice for sustainable dairy farming an ideal choice for efficient dairy and meat production systems, aligning with modern agricultural goals of enhanced productivity balanced with environmental stewardship. As research continues to explore the full potential of this breed, the current results underscore the breed's suitability for Increasing overall production of combined dairy and beef products in New Zealand. By integrating Fleckvieh cross cows into our grazing systems, farmers can achieve a harmonious balance of productivity and environmental stewardship, and animal welfare contributing to a more sustainable agricultural future.

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