



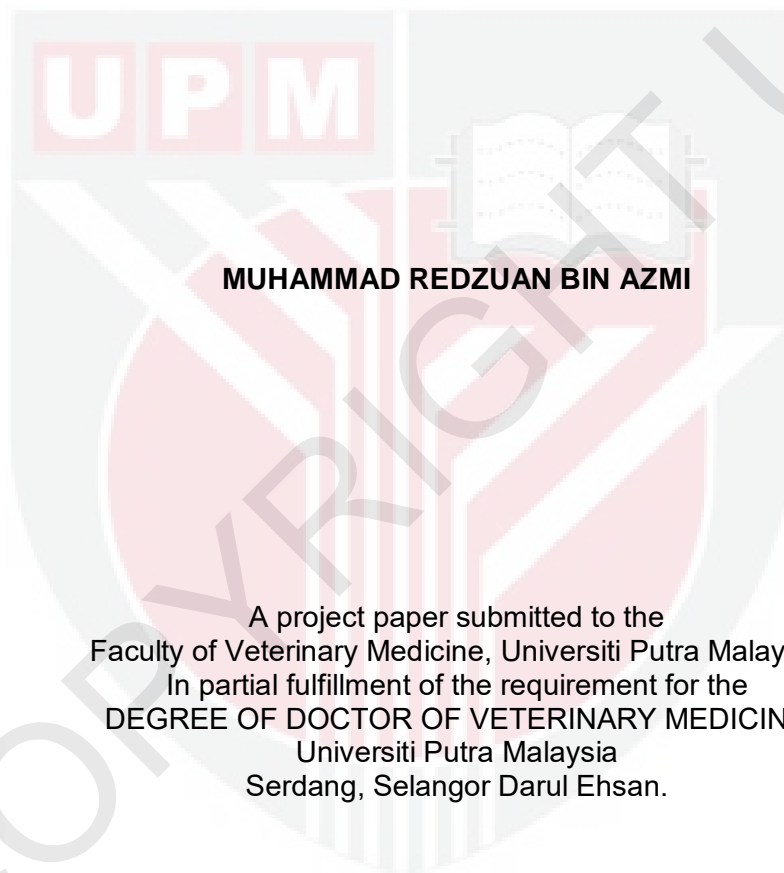
UNIVERSITI PUTRA MALAYSIA

COST OF DAIRY BUFFALO MILK IN PENINSULAR MALAYSIA

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FPV 2022 35**

COST OF DAIRY BUFFALO MILK IN PENINSULAR MALAYSIA



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A project paper submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia
In partial fulfillment of the requirement for the
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Appendix B

It is hereby certified that we have read this project paper entitled “Cost of Dairy Buffalo Milk in Peninsular Malaysia”, by Muhammad Redzuan Bin Azmi and in my/our* opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999 - Project.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 -Projek.

KOS PENGELUARAN SUSU KERBAU DI SEMENANJUNG MALAYSIA

Oleh

Muhammad Redzuan Bin Azmi

2022

Penyelia: Dr. Norhariyani Binti Mohd Nor

Tahap sara diri Malaysia untuk susu segar adalah 64.19%. Untuk memenuhi permintaan domestik, kerajaan Malaysia telah membentuk pelbagai program dan polisi untuk meningkatkan produktiviti di dalam industri tenusu. Kerbau tenusu mempunyai potensi untuk menyokong sasaran kerajaan ini kerana susu kerbau mempunyai nilai pemakanan yang tinggi berbanding susu lembu dan sesuai dalam penghasilan pelbagai jenis produk berasaskan susu. Objektif kajian ini adalah untuk menentukan kos pengeluaran susu kerbau di kawasan terpilih di Semenanjung Malaysia. Pertama sekali bajet perusahaan telah dibentuk dan dianalisis menggunakan Excel bagi tiga kategori ladang iaitu ladang tradisional dengan kapasiti bawah 29 ekor kerbau betina, ladang semi komersial dengan kapasiti 30 – 49 ekor kerbau betina, dan ladang komersial dengan kapasiti lebih 50 ekor kerbau betina. Kemudian data input bagi 14 ladang-ladang kerbau tenusu di Selangor, Pulau Pinang, Kedah, dan Pahang dikumpul, disunting dan dianalisis menggunakan Excel

dan SPSS. Keputusan kajian menunjukkan kos seliter susu bagi ladang tradisional adalah RM7.06, ladang semi komersial adalah RM3.25 dan ladang komersial adalah RM2.44. Kadar peratusan tertinggi kos berubah adalah pada kos makanan ternakan iaitu 53% bagi ladang semi komersial dan 48% bagi ladang komersial, tetapi ladang tradisional adalah pada kos pekerja sebanyak 45%. Keuntungan bersih masing-masing adalah sebanyak RM79,444.56 (51%), RM1,924,24.82 (103%) dan RM2,220,519.02 (200%) bagi ladang tradisional, semi komersial dan komersial. Kajian ini mendapati kos pengeluaran susu yang terendah adalah ladang komersial, kerana kecekapan perusahaan dengan pengeluaran yang tinggi telah mengurangkan kos per unit pengeluaran itu. Oleh itu, kerajaan mesti menggalakkan lebih banyak ladang-ladang komersial dibangunkan dan menghasilkan lebih ramai penternak yang berkemahiran tinggi.

Kata Kunci: *Kerbau tenusu; pengeluaran susu; bajet perusahaan, kos pengeluaran*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999- Project.

COST OF DAIRY BUFFALO MILK IN PENINSULAR MALAYSIA

by

Muhammad Redzuan Bin Azmi**2022****Supervisor: Dr. Norhariani Binti Mohd Nor**

The self-sufficiency level for fresh milk in Malaysia is 64.19%. To meet domestic demand, the Malaysian government has developed programmes and policies to increase productivity in the dairy industry. Dairy buffalo has the potential to support government goals because its milk has higher nutritional value than cow's milk and can be used to make a variety of milk-based products. The objective of the research is to determine the cost of dairy buffalo milk in selected regions of Peninsular Malaysia. First an enterprise budget was built and analysed using Excel on three farm's categories; traditional farm with fewer than 29 cows; semi-commercial farms with 30 – 49 cows; and commercial farms more than 50 cows. Next, input data for 14 buffalo farms in Selangor, Penang, Kedah, and Pahang were gathered, edited, and analysed using Excel and SPSS. The results showed that the cost of a 1-liter of milk in traditional farms was RM7.06, RM3.25 for semi-commercial farms, and RM2.44 for commercial farms. The highest percentage for variable costs was the feed cost, which was 53% for semi-commercial and 48% for commercial farms, but for traditional farms

it was labour costs with 45%. The net profit was RM79,444.56 (51%), RM1,924,24.82 (103%) and RM2,220,519.02 (200%) received from traditional, semi-commercial and commercial farms respectively. This study reveals that milk costs are lowest at commercial farms, indicating the efficiency of farms when more output is produced, the cost per-unit production is reduced. Hence, the government must encourage more commercial farms to be develop and produce more highly skilled farmers.

Keywords: *Dairy buffalo; milk production; budget enterprise; production cost*



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1.0 INTRODUCTION

Since ancient times, milk has been a staple of the human diet and is one of the most nutritionally natural foods. World dairy production is dominated by cow milk, similar to the scenario in Malaysia. While buffalo are primarily used as dairy animals in some nations, they also contribute a substantial 13% of the world's milk production. In South Asia, buffalo account for 68.35% of Pakistan's total milk production and 56.85% of India's total milk production (Murtaza et al., 2017; Menard et al., 2010). In contrast, the buffalo milk production in Malaysia is negligible. Malaysian government policies and marketing channels such as milk collection centres are focusing more on the development of cow milk production. While dairy buffalo are more commonly owned by small-holder farmers, who have only established close relationships and trust among individual consumers and households (Suntharalingam, 2019; Mohd Azmi et al., 2021).

According to DVS livestock statistics (2021), the number of buffalo in Malaysia is decreasing drastically from 114, 013 in 2017 to 64,250 in 2020. This decline has been attributed to decreases in the buffalo population, low reproduction rates, high mortality, slaughtering, reduced grazing areas, a decrease in farmers, and inadequate attention from policymakers and researchers. (Khalex et.al., 2021; Nanda et. Al., 2003). Despite of this issue, the buffalo milk still has potential to support the government's policy to increase the fresh milk SSL in the country. Previous studies mentioned the advantages of the nutritional value of buffalo milk that is higher than that of cow milk in terms of protein, fat, lactose, total solids and non-fat solids contents, and the buffer capacity (Yang et al., 2013) and contains more saturated fatty acids (Wahid & Rosnina, 2016). Buffalo milk is more suitable for the production of fat-based and solid non-fat (SNF)-based milk products, including cheese, butterfat,

many varieties of traditional pastries, chocolates, ice cream, ghee, and milk powder since it contains less water and more fat (Wahid & Rosnina, 2016). As a result, buffalo milk is well-suited for use in the dairy by-product industries and has the potential to enhance farmer incomes in this country.

In Malaysia, there hasn't been nearly enough research done on the cost of producing buffalo milk, and insight of the industry's current state is inadequate (Mohd Azmi et al., 2021). Thus, this study aims to determine the cost of dairy buffalo milk in selected regions of Peninsular Malaysia. The calculation of milk costs is important because it can provide information on the distribution of cost components on the overall cost of milk production. Thus it will be a useful tool for evaluating buffalo dairy farming in order to assess and investigate the viability of it as a business. Farm operating expenses are heavily influenced by feed and labour costs. Farmers can better plan and manage their enterprises based on production capacity if they are aware of this cost. Farmers can improve their practises and management, as well as to support their decision on what costs should be prioritised in order to reduce the cost of milk production. However, it's hard to get an exact data input for making cost calculation. This is because almost all Malaysian farmers do not keep better records, which is a critical process for maintaining accurate, detailed information about a business's financial and operational actions. Knowing where expenses occur and where revenue is generated accurately is useful in making decisions that can lead to a more profitable business. Therefore, with this study it also can help the visiting veterinarians or extension officers in supporting their decision making during consulting and advising farmer to improve their farm practices and management. This study is also important for stakeholders in this industry, specifically the Ministry of Agriculture and Food Security and the Department of Veterinary Services, to review

the potential of dairy buffalo in order to develop policies to support Malaysian dairy farms' long-term viability in terms of both milk production and economic sustainability.



2.0 LITERATURE REVIEW

2.1 Challenges in dairy sector in Malaysia

Dairy sector in Malaysia is currently expanding and thriving increasingly at slow rate that do not keeping up with the nation's rising milk demand (Suntharalingam, 2019). The output of milk production risen from 36.5 million litres in 2015 to 41.8 million litres in 2020. While the self-sufficient level (SSL) of fresh milk is lower than 100% (from 64.4 in 2015 to 64.19 in 2020) resulted from a higher milk consumption in the country that risen from 56.6 million litres in 2015 to 65.1 million litres by 2020 (DVS, 2021b). As a result, Malaysia has become one of the world's largest milk importers, with total milk imports of 2,389 thousand tonnes in 2018. (FAO, 2019c). Thus, the government aim to achieve 100% fresh milk SSL by 2025 by enhancing local milk production to 56 million litres (DVS, 2021a) through introduction of several policies such as Dasar Agromakan Negara 2.0 and Pelan Strategik Industri Tenuku Negara (Dairy Plan) 2021–2025.

Dasar Agromakan Negara 2.0, introduced by the Ministry of Agriculture and Food Security, has five core principles: the first is to support modernization and smart agriculture; the second is to strengthen the domestic market and increase output of high-demand and export-oriented products; the third is to develop talents to meet the industry's demands; and the fourth is to improve agricultural practises and the food system to ensure its sustainability; the fourth is to enhance sustainable agricultural practises and the food system; and the fifth is to provide a conducive business environment and a solid institutional framework. The livestock subsector is one of several subsectors included in this policy. Its objectives include increasing standards of hygiene, preventing animal diseases, enhancing good husbandry practises,

boosting productivity and production, and lowering the trade deficit in order to support the subsector's future growth (MAFI, 2021). Meanwhile, the Department of Veterinary Services' Pelan Strategik Industri Tenusu Negara (Dairy Plan) 2021-2025 aims to increase local milk production by an additional 20 million litres in five years by increasing the number of dairy cows by 10,000. The population of dairy cows will increase to 31,000, milk production will increase to 56 litres in the fifth year, and farmers' average net income will increase from RM3,200 to RM5,500 per month for every 20 dairy cows (DVS, 2021a).

The constrain of the industry are limited capital resources, a lack of farming skills and knowledge, insufficient skilled labour, poor breeds and animal feed, an unsuitable local environment, high costs, the inaccessibility of inputs and the ineffective marketing of dairy products (Faghiri et al., 2019; Sim & Suntharalingam, 2015; DVS, 2021a). Dairy farmers who run their operations inefficiently due to a lack of knowledge and training will continue to produce at a low level because of their generally poor management methods and record-keeping practises. A crucial component of effective livestock business management is record keeping. Farmers must rely on their memory when making decisions about their farming practises because they lack written records. However, memories can falter after a few hours, days, months, or even years. The ultimate goal of a recording system is to raise the level of herd performance by accomplishing tasks more effectively, managing the farm more skilfully, or lowering the likelihood of future underwhelming performances. (Yadeta et al., 2020).

Climate change poses a serious threat to the world's livestock systems, which will also affect food security by lowering livestock production. Heat stress is the primary direct effect of climate change on livestock production. Through reductions in milk component and production, meat production, reproductive effectiveness, and

animal health, heat stress places a significant financial burden on livestock producers (Singh, 2022). The heat-regulating mechanism is poorer in buffaloes which the buffalo's ability to sweat and lose heat through evaporative cooling is significantly reduced, with less than one-tenth the density of sweat glands found in cattle. Furthermore, their dark body coat promotes heat absorption from the sun's direct rays, whereas the thick epidermal layer prevents heat dissipation via conduction and radiation (Wahid & Rosnina, 2016). Meanwhile, according to Dash et al., 2016, the temperature humidity index (THI) of buffalo was above threshold THI 75, can affect the performance of reproductive traits such as service period, conception rate and pregnancy rate. By providing cooling facilities like wallows and shade during the hottest part of the day, as well as by sprinkling water on the skin and feeding roughage at night, thermal stress can be reduced (Wahid & Rosnina, 2016). Food and Agriculture Organization also has introducing the FAO Strategy on Climate Change 2022–2031. In order to help FAO Members better adapt to and mitigate climate change, FAO is working to develop climate-resilient and low-emission agrifood systems. It also aims to help members achieve the Sustainable Development Goals, particularly the elimination of hunger and malnutrition. Agrifood systems must be transformed in a coherent manner in accordance with and dependent upon national contexts and capacities, including for the pursuit of other environmental, social, and economic goals. This requires climate action at global, regional, national, and local levels (FAO,2022a).

2.2 The cost of dairy buffalo milk

Farm costs are related to the consumption of production resources during the budgetary year that relates to annual production. There is a specific cost for the livestock farming that include feedstuffs and other specific and other livestock costs such as veterinary fees, milk tests, cleaning equipment, and etc. The overhead costs in dairy farming include cost for labour and machinery, cost of transportation, general farm maintenance, and utility such as electrical and water (Cesaro, 2008). Other cost in estimation in dairy farming is depreciation of fixed costs such livestock value, farm buildings and machinery, and interest on the money invested in livestock that are foregone opportunities (Sahs and Bir, 2020). However, there are other element that do not take account in farm budgeting such as disease costs and mortality costs, which is calculated in animal health economic framework. This is because of coordination of the use of resources, production, and spending is a concern of budgeting. This procedure, also known as farming on paper or creating a financial road map for the upcoming production period to be included in the farm business plan, is frequently used. Unlike records, which are summaries of previous outcomes, budgets are created to project the results of future activities (Riggs et al., 2005).

A study by Memon and Khushk (2007) on the economic analysis of a buffalo dairy farm in Sindh, Pakistan, divided sample group based on 3 farm sizes categories: small (less than 10 buffaloes), medium (11–50 buffaloes), and large (above 50 buffaloes) showed the total income per year for small farm as 6,502.40 MYR (332,072.00 PKR), medium size farm, 29,080.96 MYR (1,485,140 PKR), and large size farm, 81,034.06 MYR (4,138,340 PKR). The total costs per farm per year were estimated as 5,187.83 MYR (264,938 PKR), 21,434.82 MYR (1,094,658 PKR), and 54,666.28 MYR (2,791,760 PKR), consequently the average net return per farm per

year was 1,314.57 MYR (67,134 PKR), 7,646.14 MYR (390,482.00 PKR), and 26,367.78 MYR (1,346,580.00 PKR), respectively, for small, medium, and large farms. The currency conversion of Pakistani rupee to Malaysian ringgit was done on the XE Currency Converter website on 8 December 2022.

Another study on the economic analysis of a cattle and buffalo dairy farm in Odisha, India, Acharya & Malhotra (2020) of three herd size categories: small (up to 18 milking animals), medium (18-24 milking animals), and large (over 24 milking animals). More investment of infrastructure showed by the highest total fixed costs per animal per day in large farms 2.34 MYR (43.82 INR) or 14.57%, followed by medium farms 2.08 MYR (39.00 INR) or 13.25% and small farms 1.44 MYR (26.99 INR) or 10.91%. The total variable cost consists of feed and fodder costs, labour costs, and miscellaneous costs. As expected, the lowest total variable costs per animal per day were on large farms 13.71 MYR (256.76 INR) or 85.42%, followed by medium farms 13.64 MYR (255.32 INR) or 86.74% and small farms 11.76 MYR (220.17 INR) or 89.08%. Concentrate feeding was the most expensive form of feeding for farms, accounting for about 70% of all feeding expenses. Therefore, it is important for dairy farmers to grow green forage and feed their animals a nutritious diet to increase animal productivity. In small and medium farms, labour costs were found to be higher, accounting for about 44% of total variable costs. There is a need for effective labour hour utilisation to reduce costs of production. The currency conversion of Indian rupee to Malaysian ringgit was done on the XE Currency Converter website on 8 December 2022.

Another study on the cost and revenue of milk production by cows and buffalo at a dairy enterprise in Faizabad District, Eastern Uttar Pradesh, India, Kumar Singh et al. (2017) stated that milk production costs and product net returns are directly correlated. Analysing milk production costs can show whether or not a business is

profitable. The costs and returns of milk production per animal per day were determined by farm sizes: small, medium, and large. The total production costs per animal per day for small, medium and large farm were 3.21 MYR (60.00 INR), 3.85 MYR (71.98 INR), and 2.38 MYR (44.51 INR), respectively. The milk yields per animal per day were 4.77, 5.41, and 6.00 litres, respectively. For all farm sizes categories, milk was priced at 2.14 MYR (40.00 INR) per litre. The gross returns per animal per day were 10.37 MYR (194.09 INR), 11.74 MYR (219.69 INR), and 13.00 MYR (243.29 INR), in that order. Meanwhile, net profits per animal per day were 7.17 MYR (134.09 INR), 7.90 MYR (147.71 INR), and 9.33 MYR (174.58 INR), respectively. The study found large farm are more profitable could be due to systematic farm management, adequate feeding of the livestock, good healthcare procedures, and better breeds of livestock. The currency conversion of Indian rupee to Malaysian ringgit was done on the XE Currency Converter website on 8 December 2022.

2.3 Economic methods to analyse the cost of dairy buffalo milk

Budgeting is an important element of today's enterprise integrated management system, especially for farming businesses. Each budget outlines the system of production, the necessary inputs, the annual flow of operations, and it also provides an overview of the associated costs and returns (Doye & Sahs, 2016). The budgeting process gives decision-makers in farm management a fundamental source of information and enables estimates to be made on paper before allocating money or resources to an endeavour, allowing for the anticipation and avoidance of issues that will probably arise based on past experience (Riggs et al., 2005). There are different types of farm budget which is enterprise budget, partial budget and cost-

benefit analysis that can provides a starting point for making farm management decisions.

The enterprise budgeting is used to estimate the anticipated profitability of a proposed enterprise. The foundation for preparing the activities for the upcoming season is provided by enterprise budgets. For either a year or a production period, enterprise budgeting can be computed on a per-unit basis, or per head of livestock. Comparing enterprises is made simple by using units (FAO,2022b). For the estimation, enterprise budget consists of four parts: gross income, variable costs, fixed costs, and measures of enterprise profitability. First, for the gross income, the quantity of milk production is calculated by multiplying the number of milking buffaloes by the average amount of milk each animal produces during one lactation period. Total milk sales revenue is calculated by multiplying the average milk price by total milk production. Next is the variable cost, costs that are associated with production factors that are flexible and subject to short-term change (Acharya & Malhotra, 2020). This component includes the feed cost, labour cost, veterinary cost, utility (electricity and water supply), transportation cost, and maintenance cost. The fixed cost, Costs that are fixed do not fluctuate with the amount of production. Whether or not a harvest is yielded, and regardless of income level, they remain the same (Doye & Sahs, 2005). There are components of depreciation of livestock value, farm buildings and machinery, and interest on the money invested in livestock that are foregone opportunities. The total cost is the sum of all variable and fixed costs. Lastly, for a measures of enterprise profitability, the gross margin is an indicator that provides you with a broad picture of how effectively a farm enterprise is operating and the net margin is an indicator that assesses the proportion of revenue that contributes to a farm enterprise's net income, or profit.

While partial budgeting is a planning tool used by farmers to estimate the impact of a specific change to a farm enterprise or activity on farm profit. It only considers income and expense items that are impacted by a proposed change, such as expansion, the introduction of a new enterprise, the purchase of machinery or equipment, or even the downsizing of the farm (FAO,2022b). On other hand, cost-benefit analysis compares the costs and benefits of an intervention in monetary units. Business decision maker can decide whether a planned action or expenditure is actually worth the cost. It aids in determining whether the gain from a business decision is worth the cost of that decision's execution (Reh, 2022). So in farming enterprise cost-benefit is suitable for animal health economic with costs of an intervention, including those associated with its implementation, and benefits of an intervention, such as savings on medical expenses, increases in productivity, and the monetary value of health improvements (CDC, 2021).

Thus, the enterprise budget can be a useful tool for evaluating buffalo dairy farming in order to assess and investigate the viability of it as a business. As a result, this enterprise budget analysis can therefore be used as a reference point for dairy buffalo farming operations in Peninsular Malaysia as a means of comparing system types and production levels, as well as a starting point for them to make revisions for assessing their farm's capability or putting together a plan for the future. The farmer's enterprise's viability could depend on how profitable the farming. Knowing the anticipated revenue and input costs, such as feed, operating inputs, investments in buildings and equipment, labour resources, and other inputs, will enable to calculate the profitability per-unit basis (Tranel, 2016).

3.0 MATERIALS AND METHODS

3.1 Model building of enterprise budget

An enterprise budget model has been developed in Microsoft Excel as an analytical tool to calculate the cost and return of milk production (Figure 1). The calculation was comprised of seven sections, which are milk production, revenue, variable cost, fixed cost, total cost, gross margin, and net margin.

The enterprise budget calculation in this study assumed dairy buffalo farming in Peninsular Malaysia from four states: Selangor (six farms), Kedah (four farms), Penang (three farms), and Pahang (one farm). In total, 14-farm sample was conveniently chosen from 50 registered farms with the Department of Veterinary Services, with each farm owner willing to be interviewed. All the sample were separated into three groups based on the buffalo population on the farm. The number of adult females on the farm is used as the scale parameter to categorize the group. A small-scale or traditional farm consists of a total of 29 or fewer adult female buffalos. Adult female buffalos range in size from 30 to 49 on semi-commercial farms. A large-scale farm, also known as a commercial farm, has 50 or more adult-female buffalos (DVS, 2021; Suntharalingam, 2019). There are six traditional farms, five semi-commercial farms, and three commercial farms.

Figure 1: Model building of enterprise budget

A. Milk Production/liter/year Heifer Cow		Total/liter
B. Revenue Milk sales	Total Per animal/year	Per liter/year
C. Variable cost Feed cost Labour cost Veterinary cost Utility (electricity + water) Transportation cost Maintenance cost	Total Per animal/year	Per liter/year
D. Fixed cost Depreciation of buffalo Depreciation of houses Depreciation of machinery Opportunity cost of investment	Total Per animal/year	Per liter/year
E. Total cost	Total Per animal/year	Per liter/year
F. Gross margin	Total Per animal/year	Per liter/year
G. Net margin	Total Per animal/year	Per liter/year

3.2 Model equation

The following equations were used in the enterprise budget:

$$Milkprod = n \times milk \times d \quad \text{Eq 1}$$

Where;

Milkprod = Milk production per farm per year (litre)

n = number of buffaloes per farm

milk = Milk production per buffalo per day (litre)

d = lactation period per animal per year (days)

$$TR = P \times Milkprod \quad \text{Eq 2}$$

Where;

TR = Total revenue per farm per year (RM)

P = Unit price of milk (RM)

Milkprod = Milk production per farm per year (litre)

$$\text{Depreciation} = \frac{\text{CA} - \text{SA}}{\text{UL}} \quad \text{Eq 3}$$

Where;

CA = Cost of an asset (RM)

SA = Salvage value (RM)

UL = Year of useful life

$$\text{OCI} = \text{MVA} \times \text{IR} \quad \text{Eq 4}$$

Where;

OCI = Opportunity cost of investment (RM)

MVA = Market value of asset (RM)

IR = Interest rate (%)

$$\text{TC} = \text{TVC} + \text{TFC} \quad \text{Eq 5}$$

Where;

TC = Total cost per farm per year (RM)

TVC = Total variable cost (RM)

TFC = Total fixed cost (RM)

$$\text{TCm} = \frac{\text{TVC} \times \text{TFC}}{\text{Milkprod}} \quad \text{Eq 6}$$

Where;

TCm = Total cost per liter of milk (RM)

TVC = Total variable cost (RM)

TFC = Total fixed cost (RM)

Milkprod = Milk production per farm per year (litre)

$$\text{TGR} = \text{TR} - \text{TVC} \quad \text{Eq 7}$$

Where;

TGR = Total gross return per farm per year (RM)

TR = Total revenue per farm per year (RM)

TVC = Total variable cost (RM)

$$\text{TGRm} = \frac{\text{TR} - \text{TVC}}{\text{Milkprod}} \quad \text{Eq 8}$$

Where;

TGRm = Total gross return per liter of milk (RM)

TR = Total revenue per farm per year (RM)

TVC = Total variable cost (RM)

Milkprod = Milk production per farm per year (litre)

$$\text{TNR} = \text{TR} - \text{TC} \quad \text{Eq 9}$$

Where;

TNR = Total net return per farm per year (RM)

TR = Total revenue per farm per year (RM)

TC = Total cost per farm per year (RM)

$$TNRm = \frac{TR-TC}{Milkprod} \quad \text{Eq 10}$$

Where;

TNRm = Total net return per liter of milk (RM)

TR = Total revenue per farm per year (RM)

TC = Total cost per farm per year (RM)

Milkprod = Milk production per farm per year (litre)

$$GM = \frac{TGRm}{TCm} \times 100 \quad \text{Eq 11}$$

Where;

GM = Gross margin per liter of milk (%)

TGRm = Total gross return per liter of milk (RM)

TCm = Total cost per liter of milk (RM)

$$NM = \frac{TNRm}{TCm} \times 100 \quad \text{Eq 12}$$

Where;

NM = Net margin per liter of milk (%)

TNRm = Total net return per liter of milk (RM)

TCm = Total cost per liter of milk (RM)

3.3 Model inputs

The inputs for this study was obtained from the results of interviews conducted by the research team for project number JKEUPM-2022-054. Inputs comprised of the sociodemographic, animal nutrition, housing, and management systems, labor, breeding management, control and preventative management, mastitis, waste management, milk and cheese production, operational costs, and fixed asset was edited in Microsoft Excel. All inputs were analyses descriptively based on types of farms through IBM SPSS Statistics for Windows for categorical data and continuous data.

The categorical data for the frequency of data consists of demographics of respondents, husbandry, nutrition, housing, health, and production management. Respondent demographics included: owner status, farm location, gender, age, race,

education level, and experiences. The farm management system included the buffalo breed, the breeding system, whether or not the MyGAP requirement was implemented, and the enterprise's future expansion. The nutritional management of calves, heifers, and cows included the type of feed as well as the timing of the feed. House size, farmland acreage, having a specific rearing compartment or not, and farm security monitoring were all factors in housing management. The health management included sanitary conditions, treatment and prevention implementation on the farm, the occurrence of diseases, and waste management. Lastly, for production management, there was frequency of milking, product storage, place of marketing, and cheese production.

The continuous data was analysed to determine the mean, median, and mode in order to estimate the average of each variable, which is the number of cow and heifer, price of cow and heifer, milk production, duration of milk production, price of milk, number of workers and salaries, mortality rate, calving rate and interval, culling and replacement rate, cost of pasture management costs, cost of concentrate feed, breeding cost, maintenance cost, utility, and value of fixed assets such as farm buildings, transportation vehicles, milking machines, churns, freezers, chillers, chopper, and heat stress systems.

Table 1: Input price for estimating variable cost

Variable cost	Small-scale farm Price (RM)	Semi-commercial farm Price (RM)	Commercial farm Price (RM)
Feed cost	41,815.20	73,639.88	193,663.97
Labor cost	58,200.00	47,760.00	138,000.00
Veterinary cost	2,400.00	2,160.00	34,000.00
Utility cost	19,900.00	7,080.00	26,400.00
Transportation cost	2,400.00	168.00	5,920.00
Maintenance cost	4,200.00	7,200.00	3,500.00

Table 2: Input for estimating depreciation of fixed asset

Variable	Scrape value	Duration	Source
Buffalo	10%	16 year	Wahid & Rosnina (2016)
Farm building	10%	10 year	Estimation
Transport vehicle	10%	10 year	Estimation
Milking machine	10%	5 year	Estimation
Freezer	10%	5 year	Estimation
Chiller	10%	5 year	Estimation
Churn	10%	5 year	Estimation
Chopper	10%	5 year	Estimation
Opportunity cost of investment	3.5%	-	Estimation

4.0 RESULTS

The results costs and returns for the three groups of dairy buffalo farms in Peninsular Malaysia (semi-scale farm, semi-commercial farm, and commercial farm) were observed in table 3. Firstly, for the small-scale farm, the total production was found to be 21,978 litres per 222 days of lactation period. At a price of RM10.67 per litre, the average income from that production is RM234,505.26 per farm per year. Total cost was RM155,060.70 per farm per year, or RM7.06 per litre per year. While the gross return and net return were RM105,590.06 per farm per year, or RM4.80 per litre per year, and RM79,444.56 per farm per year, or RM3.61 per litre per year, respectively.

Next, for the semi-commercial farm, the total production was found to be 57,456 litres per 180 days of lactation period. At a price of RM6.60 per litre, the average income from that production is RM379,209.60 per farm per year. Total cost was RM186,784.78 per farm per year, or RM3.25 per litre per year. While the gross return and net return were RM241,201.72 per farm per year, or RM4.20 per litre per year, and RM192,424.82 per farm per year, or RM3.35 per litre per year, respectively.

Lastly, for the commercial farm, the total production was found to be 454,472.5 litres per 250 days of lactation period. At a price of RM7.33 per litre, the average income from that production is RM3,331,283.43 per farm per year. Total cost was RM1,110,764.41 per farm per year or RM2.44 per litre per year. While the gross return and net return were RM2,929,799.46 per farm per year, or RM6.45 per litre per year, and RM2,220,519.02 per farm per year, or RM4.89 per litre per year, respectively.

Table 3: Costs and returns for the three groups of dairy buffalo farms in Peninsular

Malaysia

	Small-scale farm		Semi-commercial farm		Commercial farm	
	Per farm Per year (RM)	Per liter Per year (RM)	Per farm Per year (RM)	Per liter Per year (RM)	Per farm Per year (RM)	Per liter Per year (RM)
Total cost	155,060.70	7.06	186,784.78	3.25	1,110,764.41	2.44
Gross return	105,590.06	4.80	241,201.72	4.20	2,929,799.46	6.45
Net return	79,444.56	3.61	192,424.82	3.35	2,220,519.02	4.89

5.0 DISCUSSION

The data for the model's estimation is derived from a number of states in Peninsular Malaysia, which only includes those with active dairy buffalo enterprises. Although only 14 farms were used for calculation, representing only 28% of the Department of Veterinary Services registry, the sample distribution is sufficient to be studied while representing the three farming scale categories that have been established, in which three commercial farms, five semi-commercial farms, and six traditional farms are represented. There is information bias in the questionnaire's findings for a number of responses, including those about the price of buffalo, operating costs, fixed asset values, and animal feed prices. The farm owners are unable to provide a satisfactory response. The lack of effective record-keeping procedures on farms is the cause of this. Other than that, the calculation for the farm's revenue only takes into account milk sales since other farm outputs, like the sale of male buffaloes or the culling of buffaloes, are not reported in the questionnaire.

The net return of the product is directly correlated with the cost of producing milk. The profitability of the enterprise can be determined by looking at the costs associated with producing milk (Kumar Singh et al., 2017). According to the findings, the total cost and milk production per animal per lactation for different size groups of milking buffalo were RM155,060.70 and 21,978 litres, RM186,784.78 and 57,486 litres, and RM1,110,764.41 and 454,472.5 litres, respectively, for traditional, semi-commercial, and commercial farms. However, the total cost per litre is RM7.06, RM3.25, and RM2.44, respectively. In each category, the selling price of milk per litre is RM10.67, RM6.60, and RM7.33, respectively. Due to the lower cost of producing 1-liter milk compared to the selling price, these enterprise budget findings suggest that the commercial farm is more profitable than the other two farm categories. This

also can be determined by looking at the return and the margin for each category of farm, which reflect the effectiveness of the enterprise operation of the category farm. For each category, the gross return and gross margin per 1-liter milk were RM4.80 and 68%, RM4.20 and 129%, and RM6.45 and 264%, respectively. While the net return and net margin are, respectively, RM3.61 and 51%, RM3.35 and 103%, and RM4.89 and 200%. This meant that the commercial farm generated a higher percentage of revenue than the other two farm categories.

The total cost of producing any farm commodity is comprised of variable costs and fixed costs. During the course of the enterprise's production, variable costs are incurred. These costs would not occur if the enterprise did not exist. Fixed costs are prorated over the asset's expected life, which is typically several years (Doye & Sahs, 2005). In these studies, the traditional and semi-commercial farms have high total variable costs proportionate to their fixed costs, which are RM128,915.20 and RM26,145.50, and RM138,007.88 and RM48,776.90, respectively. In a commercial farm, the variable cost is lower than the fixed cost, which is RM401,483.97 and RM709,280.44. The reason for this situation is the greater investment made in farm assets by commercial farms, but the flexibility of fixed costs can decrease per unit when larger amounts of farm output are produced. In terms of variable costs, feed costs account for 53% of expenses on semi-commercial farms and 48% on commercial farms. Meanwhile, the traditional farm's highest variable expense is labour, which accounts for 45% of total variable expense. The situation of high feed costs is caused by the fact that semi-commercial and commercial farms rely more on concentrate feed and industrial waste as animal feed than traditional farms, which primarily use pasture grazing. Constraints on grazing area also contribute to this state of affairs for semi-commercial and commercial farms. High feed prices and a lack of land for grazing livestock continue to constrain the growth of the nation's milk

production (Sim & Suntharalingam, 2015). The conditions on traditional farms have a high labour cost because the number of workers used in dairy farm activities is not commensurate with the number of buffalo kept there. In this study, it was found that the number of workers in traditional farms is almost the same as that in semi-commercial farms. Commercial farms use their labour hours more effectively than other categories of farms, which results in lower labour costs (Acharya & Malhotra, 2020).



6.0 CONCLUSIONS AND RECOMMENDATIONS

Estimating the costs of dairy buffalo milk production in Peninsular Malaysia using the enterprise budget method is an important and useful tool for providing an overall picture of how well a farm enterprise is performing. This can improve farmer awareness and decision-making in terms of whether to expand their milk production capacity or stick with the old method. This can also help to support the long-term viability of dairy farms in Malaysia in terms of both milk production and economic sustainability. Therefore, it can be concluded that commercial dairy buffalo farms may be more profitable for farmers than other categories of farms because a greater quantity of output is produced, resulting in a decrease in the cost per unit of output. Thus, the government should do more to encourage traditional and semi-commercial farmers to expand their farms to become commercial farms. In determining government strategies and policies for encouraging the dairy industry, they must also take dairy buffalo farming into account. Milk marketing and products based on buffalo milk must be dynamic and technologically advanced in order to assist farmers in increasing farm productivity. Farmers that manage their dairy farms poorly due to a lack of skills and training will continue to produce at a low level since their management techniques and record-keeping procedures are still poor. Every time farmers receive training from the government, record keeping must be emphasised. It is because maintaining good records is a crucial practise in livestock farming, particularly on farms where decisions about financial planning, managing livestock, evaluating the overall operations of dairy farms, and providing information for government administrative and extension purposes all depend on it (Yadeta et al., 2020). Another approach that can be used to encourage farmers to improve their

record keeping is to create online record keeping or to provide incentives to farms that have good record keeping.



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APPENDICES

Appendix E: Ethical Approval JKEUPM-2022-054



PEJABAT TIMBALAN NAIB CANSOLOR (PENYELIDIKAN DAN INOVASI)

OFFICE OF THE DEPUTY VICE CHANCELLOR (RESEARCH AND INNOVATION)

Rujukan kami : UPM/TNCPI/RMC/1.4.18.2 (JKEUPM)

Tarikh : 29 March 2022

Prof. Dr. Md Zuki Bin Abu Bakar @ Zakaria
 Department of Veterinary Pre-Clinical Science
 Faculty of Veterinary Medicine
 Universiti Putra Malaysia
 Serdang, Selangor

Dear Madam/Sir,

RESEARCH PROJECT: ELUCIDATING THE MECHANISM TO ENHANCE MILK PRODUCTION, QUALITY AND THE SUSTAINABILITY OF DAIRY BUFFALO FARM.

REFERENCE NO : JKEUPM-2022-054

RESEARCHER : MUHAMAD AFFAN BIN AB AZID

SUPERVISOR : PROF. DR. MD ZUKI BIN ABU BAKAR @ ZAKARIA

The Ethics Committee for Research involving Human Subjects of University Putra Malaysia (JKEUPM) has studied the proposal for the above project and found that there were no objectionable ethical issues involved in the proposed study.

Please find the list of documents received and reviewed with reference to the study and committee members who reviewed the documents (as attached).

Notwithstanding above, we will not be responsible for any misconduct on the part of researcher in the course of carrying out the research.

Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

Thank you.

"WITH KNOWLEDGE WE SERVE"

Sincerely yours,

PROF. DR. ZAMBERI SEKAWI
 Chair
 Ethics Committee for Research involving Human Subjects
 Universiti Putra Malaysia

Appendix F: Enterprise budget estimation for small-scale, semi-commercial and commercial dairy buffalo farm

Table 4: Enterprise budget of traditional dairy buffalo farm

Milk production	Quantity	Average milk production per day (Litres)	Average lactation length (days)	Amount of milk production per farm per year (Litres)
No. of heifer	4	5.5	222	4884
No. of cow	11	7.0	222	17094
Total production				21978

	Price per litre (RM)	Unit	Quantity	Total per farm per year	Total per liter per year
Revenue					
Milk sales	RM10.67	Liter	21978	RM234,505.26	RM10.67
Total gross revenue				RM234,505.26	RM10.67
Variable cost					
Feed				RM41,815.20	RM1.90
Labor				RM58,200.00	RM2.65
Veterinary				RM2,400.00	RM0.11
Utility				RM19,900.00	RM0.91
Transportation				RM2,400.00	RM0.11
Maintenance				RM4,200.00	RM0.19
Total variable cost				RM128,915.20	RM5.87
Fixed cost					
Depreciation of buffalo				RM8,550.00	RM0.39
Depreciation of farm building				RM9,000.00	RM0.41
Depreciation of machinery				RM3,888.00	RM0.18
Opportunity cost of investment				RM4,707.50	RM0.21
Total fixed cost				RM26,145.50	RM1.19
Total cost				RM155,060.70	RM7.06
Gross return				RM105,590.06	RM4.80
Gross margin					68%
Net return				RM79,444.56	RM3.61
Net margin					51%

Table 5: Enterprise budget of semi-commercial dairy buffalo farm

Milk production	Quantity	Average milk production per day (litres)	Average lactation length (days)	Amount of milk production per farm per year (Litres)
No. of heifer	12	6.2	180	13392
No. of cow	24	10.2	180	44064
Total production				57456

	Price per litre (RM)	Unit	Quantity	Total per farm per year	Total per liter per year
Revenue					
Milk sales	RM6.60	Liter	57456	RM379,209.60	RM6.60
Total gross revenue				RM379,209.60	RM6.60
Variable cost					
Feed				RM73,639.88	RM1.28
Labor				RM47,760.00	RM0.83
Veterinary				RM2,160.00	RM0.04
Utility				RM7,080.00	RM0.12
Transportation				RM168.00	RM0.00
Maintenance				RM7,200.00	RM0.13
Total variable cost				RM138,007.88	RM2.40
Fixed cost					
Depreciation of buffalo				RM20,920.50	RM0.36
Depreciation of farm building				RM6,120.00	RM0.11
Depreciation of machinery				RM8,719.20	RM0.15
Opportunity cost of investment				RM13,017.20	RM0.23
Total fixed cost				RM48,776.90	RM0.85
Total cost				RM186,784.78	RM3.25
Gross return				RM241,201.72	RM4.20
Gross margin					129%
Net return				RM192,424.82	RM3.35
Net margin					103%

Table 6: Enterprise budget of commercial dairy buffalo farm

Milk production	Quantity	Average milk production per day (Litres)	Average lactation length (Days)	Amount of milk production per farm per year (Litres)
No. of heifer	65	8.33	250	135362.5
No. of cow	132	9.67	250	319110
Total production				454472.5

	Price per litre (RM)	Unit	Quantity	Total Per Farm/Year	Total Per Liter/Year
Revenue					
Milk sales	RM7.33	Liter	454472.5	RM3,331,283.43	RM7.33
Total gross revenue				RM3,331,283.43	RM7.33
Variable cost					
Feed				RM193,663.97	RM0.43
Labor				RM138,000.00	RM0.30
Veterinary				RM34,000.00	RM0.07
Utility				RM26,400.00	RM0.06
Transportation				RM5,920.00	RM0.01
Maintenance				RM3,500.00	RM0.01
Total variable cost				RM401,483.97	RM0.88
Fixed cost					
Depreciation of buffalo				RM239,062.50	RM0.53
Depreciation of farm building				RM302,550.00	RM0.67
Depreciation of machinery				RM18,917.94	RM0.04
Opportunity cost of investment				RM148,750.00	RM0.33
Total fixed cost				RM709,280.44	RM1.56
Total cost				RM1,110,764.41	RM2.44
Gross return				RM2,929,799.46	RM6.45
Gross margin					264%
Net return				RM2,220,519.02	RM4.89
Net margin					200%

Appendix G: Frequency table for small-scale dairy buffalo farm

Table 7: The demographic of respondents who benefited from small-scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Responden status	Owner	4	66.7
	Farm manager	2	33.3
State	Pulau Pinang	2	33.3
	Kedah	3	50.0
	Pahang	1	16.7
District	Seberang Prai	2	33.3
	Langkawi	1	16.7
	Kubang Pasu	2	33.3
	Kuantan	1	16.7
Gender	Male	6	100.0
Age	31 – 40	1	16.7
	41 – 50	3	50.0
	51 – 60	1	16.7
	61 – 70	1	16.7
Race	Malay	5	83.3
	Indian	1	16.7
Education level	Secondary	2	33.3
	Universities	2	33.3
	Others (college)	2	33.3

Experiences	<10 years	1	16.7
	11 – 20 years	3	50.0
	>20 years	2	33.3

Table 8: Farm profile of small-scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Management system	Intensive	2	33.3
	Semi-intensive	4	66.7
Breed of buffalo	Sapi cross	1	16.7
	Murah	6	100.0
	Nilliravi	6	100.0
Future increase number of buffalo	Yes	5	83.3
	No	1	16.7
Adding a replacement heifer	Yes	3	50.0
	No	3	50.0
MyGAP	Yes	1	16.7
	No	5	83.3
Breed selection in breeding	Yes	4	66.7
	No	2	33.3
Breeding systems	Natural breeding	6	100.0

Table 9: Nutritional management for small scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Milk type for calves	Buffalo milk	6	100.0
A liter of milk given	None	1	16.7
	0.5	2	33.3
	2.0	1	16.7
	2.5	1	16.7
	3.0	1	16.7
How many times is the milk given?	One	1	16.7
	Two	5	83.3
Method of giving milk to calves	Breastfeeding	6	100.0
Giving the concentrate pellet before weaning	Yes	4	66.7
	No	2	33.3
Ad libitum drinking water	Yes	6	100.0
Total mixed ration	Yes	3	50.0
	No	3	50.0
Forage for pre-wean	Yes	2	33.3
	No	4	66.7
Forage for post-wean	Yes	1	16.7
	No	5	83.3
Forage for 1 st calving	Yes	1	16.7

	No	5	83.3
Concentrate pellet for pre-wean	Yes	4	66.7
	No	2	33.3
Concentrate pellet for post-wean	Yes	5	83.3
	No	1	16.7
Concentrate pellet for 1 st calving	Yes	6	100.0
	No	0	0

Table 10: Housing management for small-scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
The calves are separated from the dam after birth.	Yes	5	83.3
	No	1	16.7
Calf placement	In group	6	100.0
Size of calf area	10 × 10	1	16.7
	13 × 19	1	16.7
	15 × 20	1	16.7
	16 × 20	1	16.7
	60 × 40	1	16.7
	Unknown	1	16.7
Weaner placement	In group	6	100.0
Size of weaner area	10 × 10	1	16.7
	12 × 19	1	16.7

	20 × 20	1	16.7
	20 × 30	1	16.7
	60 × 40	1	16.7
	Unknown	1	16.7
Cow placement	In group	6	100.0
Size of cow area	15 × 15	1	16.7
	20 × 20	1	16.7
	20 × 40	1	16.7
	22 × 23	1	16.7
	60 × 40	1	16.7
	Unknown	1	16.7
Calving area	Individual	4	66.7
	In group	2	33.3
Size of calving area	10 × 10	1	16.7
	15 × 15	1	16.7
	20 × 20	1	16.7
	60 × 40	1	16.7
	Unknown	2	33.3
Farm acreage	0.25	1	16.7
	2.50	1	16.7
	4.00	1	16.7
	12.00	1	16.7
	20.00	1	16.7
	97.59	1	16.7

Security monitoring	Daytime only	3	50.0
	Day and night	3	50.0

Table 11: Health management for small-scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Teat pre and post-dip with iodine	Yes	3	50.0
	No	3	50.0
Cleaning and disinfecting the milking machine	Yes	2	33.3
	None	4	66.7
The frequency of cleaning and disinfecting the milking barn	Once a day	3	50.0
	Twice a day	1	16.7
	None	2	33.3
Detergent or disinfectant type used	Enzyme	2	33.3
	Farmfluid	1	16.7
	Landirax and water	1	16.7
	Lindores 30	1	16.7
	Soap	1	16.7
Calf health problems	Endoparasites and diarrhoea	1	16.7
	Diarrhoea	1	16.7
	Diarrhoea	2	33.3
	Fever and diarrhoea		
	Fever, diarrhoea, endoparasites, hypothermia	1	16.7
	Premature	1	16.7
Heifer health problems	Downer cow syndrome	1	16.7

	Lumpy skin disease	1	16.7
	Dystocia and uterine prolapse	1	16.7
	None	3	50.0
Cow health problems	Diarrhoea	1	16.7
	Fever	1	16.7
	Uterine prolapse	1	16.7
	None	3	50.0
Dairy effluent pond	Yes	3	50.0
	No	3	50.0
Farm waste management	Use as fertiliser on your own pasture	2	33.3
	Not used	4	66.7
Mastitis occurrence	Yes	3	50.0
	No	3	50.0
Mastitis reduces milk production	Yes	6	100.0
Preventive measures against mastitis	Wash your hands and the cow udder with water	3	50.0
	Wash your hands and the cow udder with water and disinfectant	3	50.0
Own mastitis screening	Yes	1	16.7
	No	5	83.3

Antibiotic treatment	Yes	4	66.7
	No	2	33.3
Culled if mastitis is detected	Yes	1	16.7
	No	5	83.3

Table 12: Dairy production for small-scale dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Frequency of milking per day	One time	2	33.3
	Two times	4	66.7
Chiller storage after milking	Yes	5	83.3
	No	1	16.7
Product marketing	Publics	2	33.3
	Publics and restaurants	1	16.7
	Publics, restaurants and dairy plants	1	16.7
	Other	2	33.3
Milk collection centres	Yes	1	16.7
	No	5	83.3
Making cheese	Yes	1	16.7
	No	5	83.3
Cheese machine	Yes	1	16.7
	No	5	83.3

Table 13: Grouped frequency table for small-scale dairy buffalo farming.

Variable	Mean	Median	Mode
The no. of calves	10.67	9.00	9.00
The no. of heifer	3.83	4.00	2.00 ^a
The no. of cow	10.83	8.50	4.00 ^a
The average price of calves	3500.00	3500.00	0.00
The average price of heifer	8833.33	11500.00	0.00 ^a
The average price of cow	14000.00	15500.00	7000.00 ^a
The milk production of a heifer (Liters)	5.50	5.00	5.00
The duration of milk production	221.67	210.00	180.00
The price (RM/L)	10.67	8.50	8.00
The income	12245.00	10320.00	6120.00 ^a
The milk production of a cow (Liters)	6.9583	6.00	6.00
The duration of milk production	221.67	210.00	180.00
The price (RM/L)	10.67	8.50	8.00
The income	14557.50	12060.00	9180.00 ^a
The no. of worker	2.83	2.50	2.00
Salary (month)	4571.67	1965.00	1500.00
The milk feeding (minute)	7.33	5.00	5.00
The feeding (minute)	5.17	5.00	5.00 ^a
Barn cleaning (minute)	58.33	60.00	60.00
The birth mortality rate (%)	32.50	37.50	50.00
The wean mortality rate (%)	8.333	0.00	0.00
The heifer mortality rate (%)	9.50	0.00	0.00
The adult mortality rate (%)	2.917	0.00	0.00
The average age of weaning (month)	6.83	7.00	7.00
The average age of breeding (month)	24.50	24.00	24.00
The average age of 1 st calving (month)	34.33	34.00	34.00
The average weight of birth (kg)	28.75	36.25	0 ^a
The average weight of wean (kg)	103.333	107.50	175.00

The average weight of heifer (kg)	356.667	357.50	250.00 ^a
The average weight of cow (kg)	533.333	537.50	525.00 ^a
Calving interval (month)	2.917	3.00	3.00
Calving rate (%)	45.133	38.50	25.00 ^a
Cull rate (%)	3.7083	1.500	0.00
Replacement rate (%)	21.667	24.00	8.00 ^a
1 st colostrum given after birth (minute)	50.00	60.00	60.00
Quantity of colostrum given (liter)	2.00	1.250	0.00
Frequency of colostrum given	1.00	1.00	0.00 ^a
The cost of fertilization (RM)	14.33	0.00	0.00
The cost of pesticide (RM)	5.00	0.00	0.00
The cost of seeding (RM)	0.00	0.00	0.00
The cost of disinfectant (RM)	26.67	0.00	0.00
The cost of medicine (RM)	200.00	175.00	0.00
The cost of artificial insemination (RM)	0.00	0.00	0.00
Utility – electricity (RM)	1266.67	1250.00	0.00 ^a
Utility – water (RM)	391.67	175.00	0.00
The cost of transportation (RM)	316.67	200.00	0.00
The cost of maintenance (RM)	533.33	350.00	0.00
The quantity of milking machine	0.33	0.00	0.00
The price of milking machine (RM)	333.33	0.00	0.00
The total cost of milking machine (RM)	666.67	0.00	0.00
The quantity of chopper	0.83	1.00	1.00
The price of chopper (RM)	7108.33	0.00	0.00
The total cost of chopper (RM)	7108.33	0.00	0.00
The quantity of building	1.00	1.00	1.00
The price of building (RM)	393333.33	80000.00	0.00
The quantity of freezer	1.50	1.50	0 ^a
The price of freezer (RM)	1916.67	1250.00	0.00
The total cost of freezer (RM)	3166.67	3000.00	0 ^a

The quantity of transport vehicle	2.33	1.50	1.00
The price of transport vehicle (RM)	18666.67	6750.00	0.00
The total cost of transport vehicle (RM)	85666.67	11500.00	0.00
The quantity of heat stress system	0.17	0.00	0.00
The price of heat stress system (RM)	8333.33	0.00	0.00
The quantity of churn	1.50	1.00	0.00
The price of churn (RM)	66.67	0.00	0.00
The total cost of churn (RM)	166.67	0.00	0.00
The quantity of chiller	0.17	0.00	0.00
The price of chiller (RM)	1666.67	0.00	0.00
The quantity of forage for pre-wean	2.2917	0.00	0.00
The quantity of concentrate pellet for pre-wean	1.7083	0.75	0.0
The quantity of forage for post-wean	1.75	0.00	0.00
The quantity of concentrate pellet for post-wean	3.917	2.00	2.00
The quantity of forage for 1 st calving	2.083	0.00	0.00
The quantity of concentrate pellet for 1 st calving	10.433	10.55	1.5 ^a

a. Multiple modes exist. The smallest value is shown

Appendix H: Frequency table for semi-commercial dairy buffalo farm

Table 14: The demographic of respondents who benefited from semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Responden status	Owner	3	60.0
	Farm manager	2	40.0
State	Selangor	4	80.0
	Pulau Pinang	1	20.0
District	Kuala Selangor	1	20.0
	Sepang	1	20.0
	Hulu Langat	2	40.0
	Seberang Prai	1	20.0
Gender	Male	5	100.0
Age	21 – 30	1	20.0
	41 – 50	3	60.0
	51 – 60	1	20.0
Race	Indian	2	40.0
	Others (sikh)	3	60.0
Education level	Secondary	3	60.0
	Universities	2	40.0
Experiences	11 – 20 years	2	40.0
	>20 years	3	60.0

Table 15: Farm profile of semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Management system	Intensive	1	20.0
	Semi-intensive	4	80.0
Breed of buffalo	Murah	5	100.0
	Nilliravi	1	20.0
Future increase number of buffalo	Yes	5	100.0
Adding a replacement heifer	Yes	1	20.0
	No	4	80.0
MyGAP	No	5	100.0
Breed selection in breeding	Yes	2	40.0
	No	3	60.0
Breeding systems	Natural breeding	5	100.0

Table 16: Nutritional management for semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Milk type for calves	Buffalo milk	5	100.0
A liter of milk given	0.5	1	20.0
	1.0	1	20.0
	2.0	2	40.0
	2.5	1	20.0

How many times is the milk given?	Two	5	100.0
Method of giving milk to calves	Bottle	1	20.0
	Breastfeeding	4	80.0
Giving the concentrate pellet before weaning	Yes	3	60.0
	No	2	40.0
Ad libitum drinking water	Yes	3	60.0
	No	2	40.0
Total mixed ration	Yes	4	80.0
	No	1	20.0
Forage for pre-wean	No	5	100.0
Forage for post-wean	Yes	4	80.0
	No	1	20.0
Forage for 1 st calving	Yes	2	40.0
	No	3	60.0
Concentrate pellet for pre-wean	Yes	1	20.0
	No	4	80.0
Concentrate pellet for post-wean	Yes	4	80.0
	No	1	20.0
Concentrate pellet for 1 st calving	Yes	4	80.0
	No	1	20.0

Table 17: Housing management for semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
The calves are separated from the dam after birth.	Yes	4	80.0
	No	1	20.0
Calf placement	In group	5	100.0
Size of calf area	10 × 15	1	20.0
	20 × 10	1	20.0
	20 × 20	1	20.0
	8 × 6	1	20.0
	8 × 9	1	20.0
Weaner placement	In group	5	100.0
Size of weaner area	20 × 15	1	20.0
	20 × 40	1	20.0
	50 × 20	1	20.0
	9 × 25	1	20.0
	Unknown	1	20.0
Cow placement	In group	5	100.0
Size of cow area	100 × 30	1	20.0
	20 × 50	1	20.0
	60 × 100	1	20.0
	8 × 9	1	20.0
	Unknown	1	20.0
Calving area	Individual	1	20.0

	In group	4	100.0
Size of calving area	20 × 20	1	20.0
	30 × 20	1	20.0
	6 × 9	1	20.0
	Unknown	2	100.0
Farm acreage	0.50	1	20.0
	2.00	1	20.0
	4.00	1	20.0
	12.00	1	20.0
	20.00	1	20.0
Security monitoring	Daytime only	1	20.0
	Day and night	2	40.0
	None	2	40.0

Table 18: Health management for semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Teat pre and post-dip with iodine	Yes	2	40.0
	No	3	60.0
Cleaning and disinfecting the milking machine	Yes	2	40.0
	None	3	60.0
The frequency of cleaning and disinfecting the milking barn	Once a day	1	20.0
	Twice a day	4	80.0
Detergent or disinfectant type used	Dettol and water	1	20.0

	Clorox and soap	1	20.0
	None	3	60.0
Calf health problems	Diarrhoea	1	20.0
	Fever and diarrhoea	2	40.0
	Bloat	1	20.0
	None	1	20.0
Heifer health problems	None	5	100.0
Cow health problems	Endoparasites	1	20.0
	Predator	1	20.0
	None	3	60.0
Dairy effluent pond	Yes	5	100.0
Farm waste management	Use as fertiliser on your own pasture	2	40.0
	Use as fertiliser on other people's pastures	1	20.0
	Not used	2	40.0
Mastitis occurrence	Yes	2	40.0
	No	3	60.0
Mastitis reduces milk production	Yes	5	100.0
Preventive measures against mastitis	Wash your hands and the cow udder with water	3	60.0

	Wash your hands and the cow udder with water and disinfectant	2	40.0
Own mastitis screening	Yes	1	20.0
	No	4	80.0
Antibiotic treatment	Yes	5	100.0
Culled if mastitis is detected	No	5	100.0

Table 19: Dairy production for semi-commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Frequency of milking per day	Two times	5	100.0
Chiller storage after milking	Yes	5	100.0
Product marketing	Publics and restaurants	4	80.0
	Other (vendor)	1	20.0
Milk collection centres	No	5	100.0
Making cheese	Yes	1	20.0
	No	4	80.0
Cheese machine	No	5	100.0

Table 20: Grouped frequency table for semi-commercial dairy buffalo farming.

Variable	Mean	Median	Mode
The no. of calves	20.60	18.00	30.00
The no. of heifer	12.40	10.00	0.00
The no. of cow	24.00	25.00	12.00 ^a
The average price of calves	800.00	0.00	0.00
The average price of heifer	7360.00	7000.00	7000.00
The average price of cow	10400.00	10000.00	10000.00
The milk production of a heifer (Liters)	6.20	6.00	5.00
The duration of milk production	180.00	180.00	180.00
The price (RM/L)	6.60	6.00	6.00
The income	7260.00	7560.00	5400.00 ^a
The milk production of a cow (Liters)	10.20	10.00	10.00
The duration of milk production	180.00	180.00	180.00
The price (RM/L)	6.60	6.00	6.00
The income	12090.00	12600.00	7560.00 ^a
The no. of worker	2.80	2.00	2.00
Salary (month)	1240.00	1500.00	1500.00
The milk feeding (minute)	6.40	5.00	5.00
The feeding (minute)	1.80	0.00	0.00
Barn cleaning (minute)	87.00	120.00	120.00
The birth mortality rate (%)	3.70	4.00	4.00
The wean mortality rate (%)	0.50	0.00	0.00
The heifer mortality rate (%)	0.50	0.00	0.00
The adult mortality rate (%)	0.00	0.00	0.00
The average age of weaning (month)	6.00	6.00	5.00 ^a
The average age of breeding (month)	22.20	27.00	30.00
The average age of 1 st calving (month)	30.00	37.00	0.00 ^a
The average weight of birth (kg)	26.00	35.00	35.00
The average weight of wean (kg)	64.00	90.00	0.00

The average weight of heifer (kg)	190.00	275.00	0.00
The average weight of cow (kg)	270.00	400.00	0.00
Calving interval (month)	2.70	3.00	3.00
Calving rate (%)	39.25	40.00	0.00 ^a
Cull rate (%)	2.50	0.00	0.00
Replacement rate (%)	17.250	20.00	20.00
1 st colostrum given after birth (minute)	60.00	60.00	60.00
Quantity of colostrum given (liter)	0.70	0.50	0.50
Frequency of colostrum given	1.60	2.00	2.00
The cost of fertilization (RM)	0.00	0.00	0.00
The cost of pesticide (RM)	0.00	0.00	0.00
The cost of seeding (RM)	160.00	0.00	0.00
The cost of disinfectant (RM)	35.50	0.00	0.00
The cost of medicine (RM)	180.00	100.00	0.00
The cost of artificial insemination (RM)	0.00	0.00	0.00
Utility – electricity (RM)	500.00	500.00	0.00 ^a
Utility – water (RM)	90.00	0.00	0.00
The cost of transportation (RM)	14.00	0.00	0.00
The cost of maintenance (RM)	60.00	200.00	0.00
The quantity of milking machine	0.80	0.00	0.00
The price of milking machine (RM)	4000.00	0.00	0.00
The total cost of milking machine (RM)	8000.00	0.00	0.00
The quantity of chopper	1.60	2.00	2.00
The price of chopper (RM)	8600.00	5000.00	5000.00
The total cost of chopper (RM)	10200.00	6000.00	0.00 ^a
The quantity of building	1.00	1.00	1.00
The price of building (RM)	68000.00	20000.00	20000.00
The quantity of freezer	1.80	2.00	2.00
The price of freezer (RM)	1760.00	1800.00	1000.00 ^a
The total cost of freezer (RM)	3220.00	3600.00	1500.00 ^a

The quantity of transport vehicle	1.60	2.00	2.00
The price of transport vehicle (RM)	26400.00	7000.00	0.00
The total cost of transport vehicle (RM)	52800.00	14000.00	0.00
The quantity of heat stress system	0.00	0.00	0.00
The price of heat stress system (RM)	0.00	0.00	0.00
The quantity of churn	3.80	2.00	2.00
The price of churn (RM)	220.00	300.00	0.00 ^a
The total cost of churn (RM)	1220.00	600.00	0.00
The quantity of chiller	0.20	0.00	0.00
The price of chiller (RM)	3400.00	0.00	0.00
The quantity of forage for pre-wean	0.00	0.00	0.00
The quantity of concentrate pellet for pre-wean	0.60	0.00	0.00
The quantity of forage for post-wean	5.60	6.00	0.00 ^a
The quantity of concentrate pellet for post-wean	4.80	4.00	0.00 ^a
The quantity of forage for 1 st calving	4.40	0.00	0.00
The quantity of concentrate pellet for 1 st calving	7.00	5.00	0.00 ^a

a. Multiple modes exist. The smallest value is shown

Appendix I: Frequency table for commercial dairy buffalo farm

Table 21: The demographic of respondents who benefited from commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Responden status	Owner	1	33.3
	Farm manager	2	66.7
State	Selangor	2	66.7
	Kedah	1	33.3
District	Hulu Langat	1	33.3
	Petaling Jaya	1	33.3
	Bandar Baharu	1	33.3
Gender	Male	3	100.0
Age	<20	2	66.7
	41 – 50	1	33.3
Race	Malay	2	66.7
	Others (Sikh)	1	33.3
Education level	Secondary	2	66.7
	Universities	1	33.3
Experiences	<10 years	1	33.3
	11 – 20 years	1	33.3
	>20 years	1	33.3

Table 22: Farm profile of commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Management system	Semi-intensive	3	100.00
Breed of buffalo	Murah	3	100.0
	Nilliravi	3	100.0
Future increase number of buffalo	Yes	3	100.0
Adding a replacement heifer	Yes	1	33.3
	No	2	66.7
MyGAP	No	3	100.0
Breed selection in breeding	Yes	3	100.0
Breeding systems	Natural breeding	2	66.7
	Mixed	1	33.3

Table 23: Nutritional management for commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Milk type for calves	Buffalo milk	3	100.0
A liter of milk given	1.0	2	66.7
	1.5	1	33.3
How many times is the milk given?	None	1	33.3
	Two	2	66.7

Method of giving milk to calves	Breastfeeding	3	100.0
Giving the concentrate pellet before weaning	Yes	2	66.7
	No	1	33.3
Ad libitum drinking water	Yes	2	66.7
	No	1	33.3
Total mixed ration	Yes	3	100.0
Forage for pre-wean	No	3	100.0
Forage for post-wean	Yes	1	33.3
	No	2	66.7
Forage for 1 st calving	Yes	2	66.7
	No	1	33.3
Concentrate pellet for pre-wean	Yes	1	33.3
	No	2	66.7
Concentrate pellet for post-wean	Yes	3	100.0
Concentrate pellet for 1 st calving	Yes	3	100.0

Table 24: Housing management for commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
The calves are separated from the dam after birth.	Yes	2	66.7
	No	1	33.3
Calf placement	In group	3	100.0
Size of calf area	15 × 10	1	33.3
	200 × 160	1	33.3
	5 × 15	1	33.3
Weaner placement	In group	3	100.0
Size of weaner area	10 × 20	1	33.3
	200 × 160	1	33.3
	30 × 30	1	33.3
Cow placement	In group	3	100.0
Size of cow area	18 × 70	1	33.3
	200 × 160	1	33.3
	60 × 25	1	33.3
Calving area	Individual	1	33.3
	In group	2	66.7
Size of calving area	200 × 160	1	33.3
	25 × 25	1	33.3
	5 × 5	1	33.3

Farm acreage	1.00	1	33.3
	3.00	1	33.3
	27.00	1	33.3
Security monitoring	Day and night	3	100.0

Table 25: Health management for commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Teat pre and post-dip with iodine	Yes	2	66.7
	No	1	33.3
Cleaning and disinfecting the milking machine	Yes	1	33.3
	No	2	66.7
The frequency of cleaning and disinfecting the milking barn	Once a day	1	33.3
	Twice a day	2	66.7
Detergent or disinfectant type used	None	3	100.0
Calf health problems	Fever and diarrhoea	2	66.7
	Fever	1	33.3
Calf health problems	Dystocia	1	33.3
	None	2	66.7
Cow health problems	Abortion, brucellosis, mastitis and lumpy skin disease	1	33.3
	None	2	66.7

Dairy effluent pond	Yes	3	100.0
Farm waste management	Use as fertiliser on your own pasture	1	33.3
	Not used	2	66.7
Mastitis occurrence	Yes	2	66.7
	No	1	33.3
Mastitis reduces milk production	Yes	2	66.7
	No	1	33.3
Preventive measures against mastitis	Wash your hands and the cow udder with water	1	33.3
	Wash your hands and the cow udder with water and disinfectant	2	66.7
Own mastitis screening	No	3	100.0
Antibiotic treatment	Yes	3	100.0
Culled if mastitis is detected	No	3	100.0

Table 26: Dairy production for commercial dairy buffalo farming.

Variable	Parameter	Frequency	(%)
Frequency of milking per day	Two times	3	100.0
Chiller storage after milking	Yes	3	100.0
Product marketing	Publics and restaurants	2	66.7
	Restaurants and dairy plants	1	33.3
Milk collection centres	No	3	100.0
Making cheese	Yes	1	33.3
	No	2	66.7
Cheese machine	Yes	1	33.3
	No	2	66.7

Table 27: Grouped frequency table for commercial dairy buffalo farming.

Variable	Mean	Median	Mode
The no. of calves	88.33	50.00	15.00 ^a
The no. of heifer	64.67	30.00	14.00 ^a
The no. of cow	131.67	60.00	35.00 ^a
The average price of calves	3333.33	0.00	0.00
The average price of heifer	8333.33	0.00	0.00
The average price of cow	10000.00	0.00	0.00
The milk production of a heifer (Liters)	8.333	10.00	10.00
The duration of milk production	250.00	210.00	180.00 ^a
The price (RM/L)	7.33	8.00	8.00

The income	16500.00	14400.00	6300.00 ^a
The milk production of a cow (Liters)	9.667	8.00	7.00 ^a
The duration of milk production	250.00	210.00	180.00 ^a
The price (RM/L)	7.33	8.00	8.00
The income	20220.00	11520.00	8820.00 ^a
The no. of worker	7.67	5.00	3.00 ^a
Salary (month)	1500.00	1500.00	1500.00
The milk feeding (minute)	11.167	7.00	6.50 ^a
The feeding (minute)	25.00	10.00	5.00 ^a
Barn cleaning (minute)	180.00	180.00	90.00 ^a
The birth mortality rate (%)	4.333	0.00	0.00
The wean mortality rate (%)	0.00	0.00	0.00
The heifer mortality rate (%)	11.00	0.00	0.00
The adult mortality rate (%)	2.50	0.00	0.00
The average age of weaning (month)	6.50	6.00	6.00
The average age of breeding (month)	32.67	30.00	26.00 ^a
The average age of 1 st calving (month)	41.67	39.00	35.00 ^a
The average weight of birth (kg)	17.667	17.50	17.50
The average weight of wean (kg)	52.50	45.00	37.50 ^a
The average weight of heifer (kg)	216.667	225.00	0.00 ^a
The average weight of cow (kg)	400.00	550.00	0.00 ^a
Calving interval (month)	2.833	2.00	2.00
Calving rate (%)	51.50	75.00	2.00 ^a
Cull rate (%)	7.64	6.25	0.00 ^a
Replacement rate (%)	18.0833	16.25	5.00 ^a
1 st colostrum given after birth (minute)	50.00	60.00	0.00 ^a
Quantity of colostrum given (liter)	1.50	2.00	0.00 ^a
Frequency of colostrum given	1.33	2.00	2.00
The cost of fertilization (RM)	366.67	300.00	0.00 ^a
The cost of pesticide (RM)	133.33	0.00	0.00

The cost of seeding (RM)	0.00	0.00	0.00
The cost of disinfectant (RM)	0.00	0.00	0.00
The cost of medicine (RM)	2833.33	2000.00	1500.00 ^a
The cost of artificial insemination (RM)	16.67	0.00	0.00
Utility – electricity (RM)	2116.67	200.00	150.00 ^a
Utility – water (RM)	83.33	100.00	0.00 ^a
The cost of transportation (RM)	493.33	400.00	80.00 ^a
The cost of maintenance (RM)	291.67	375.00	0.00 ^a
The quantity of milking machine	0.33	0.00	0.00
The price of milking machine (RM)	33333.00	0.00	0.00
The total cost of milking machine (RM)	0.00	0.00	0.00
The quantity of chopper	1.33	1.00	1.00
The price of chopper (RM)	7000.00	3000.00	2000.00 ^a
The total cost of chopper (RM)	12333.33	3000.00	2000.00 ^a
The quantity of building	1.00	1.00	1.00
The price of building (RM)	3361666.67	60000.00	25000.00 ^a
The quantity of freezer	2.67	3.00	1.00 ^a
The price of freezer (RM)	1833.33	2000.00	2000.00
The total cost of freezer (RM)	5166.67	6000.00	1500.00 ^a
The quantity of transport vehicle	2.67	3.00	3.00
The price of transport vehicle (RM)	33555.33	50000.00	0.00 ^a
The total cost of transport vehicle (RM)	50666.00	0.00	0.00
The quantity of heat stress system	0.00	0.00	0.00
The price of heat stress system (RM)	0.00	0.00	0.00
The quantity of churn	2.00	2.00	0.00 ^a
The price of churn (RM)	900.00	700.00	0.00 ^a
The total cost of churn (RM)	1333.33	0.00	0.00
The quantity of chiller	0.33	0.00	0.00
The price of chiller (RM)	1666.67	0.00	0.00
The quantity of forage for pre-wean	0.00	0.00	0.00

The quantity of concentrate pellet for pre-wean	1.00	0.00	0.00
The quantity of forage for post-wean	3.33	0.00	0.00
The quantity of concentrate pellet for post-wean	5.167	4.00	1.50 ^a
The quantity of forage for 1 st calving	9.00	12.00	0.00 ^a
The quantity of concentrate pellet for 1 st calving	7.67	6.00	5.00 ^a

a. Multiple modes exist. The smallest value is shown

