RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume 45 Issue 3: 525-530 (June 2026)

The Management System of Dairy Buffalo in Peninsular Malaysia

Fadzlin Afiqah A. Samad[1], Norhariani Mohd Nor[1,2], Muhammad Redzuan Azmi[2], Hasliza Abu Hassim[1,2], Mark Buda[1,3], Md Zuki Abu Bakar[2], Annas Salleh[2], Mohd Zamri Saad[2] **10.18805/ajdfr.DRF-388**

ABSTRACT

Background: In Malaysia, there has not been enough the research on the cost of producing buffalo milk and the in different management system and insight into the industry's current state is inadequate. This study aims to determine the cost of dairy buffalo milk in selected regions of Peninsular Malaysia.

Methods: A survey was conducted on 14 dairy buffalo farms from selected regions in Peninsular Malaysia: Selangor (six farms), Kedah (four farms), Penang (three farms) and Pahang (one farm) using a developed questionnaire. The questionnaire consists of farm management aspects like the socio-economics of the farmers, nutrition management, health management, dairy production management and the calculation of the production cost. The collected data were edited in Excel and analysed descriptively using IBM SPSS Statistics.

Result: Based on the surveyed, the net profit was RM79,444.56, RM1,924,24.82 and RM2,220,519.02 in 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 production unit is reduced. Hence, the government should initiate and encourage the farmers to expand their farm business from traditional to commercial business and, at the same time, produce more skilful farmers.

Key words: Dairy buffalo, Economics, Farm, Management.

INTRODUCTION

The livestock industry, one of Malaysia's most crucial sub-sectors of agriculture, contributes 1/10 of that sector's gross domestic product (GDP), with the whole sector contributing 8.9% of the national GDP (Zayadi, 2021). The livestock industry in Malaysia comprises the ruminant sector, which consists of cattle, sheep, goats and buffaloes and the non-ruminant sector, which is dominated by poultry and swine. In reality, this industry is conquered by the non-ruminant sector, with chicken (95.8%), ducks (3.2%) and swine (0.6%) being the main contributors (Khalex *et al*., 2021). Based on data provided by DVS (2021), the non-ruminant sector, particularly the poultry industry, has achieved a 100% self-sufficiency ratio (SSR), while the ruminant sector is still below 30%. The ruminant sector, especially dairy production, still needs to be developed and to achieve local demand.

Globally, cow milk dominates the dairy production sector, which is similer to the situation in Malaysia. According to FAO (2021), the statistical data showed that dairy cows produced roughly 81% of milk, followed by 15% of milk by buffalo and 4% of milk produced by goats, sheep and camels. However, in South Asia countries like Pakistan and India, buffaloes control the dairy market and production. On the contrary, in Malaysia, buffalo milk production and management are negligible. The Malaysian government's policies and programs only focus on strengthening dairy cattle production and management. Meanwhile, dairy buffalo are usually owned by small-holder farmers who build a business relationship with individual consumers, households and close acquaintances. Besides that, compared with cow milk and goat milk, buffalo milk is less popular among the community in Malaysia because of a lack of exposure to the benefits and nutrients of the milk. Previous studies mentioned the advantages of the nutritional value of buffalo milk, which is higher than the cow milk in terms of protein, fat, lactose, total solids and non-fat solids contents and buffer capacity (Yang *et al*., 2013) and contains more saturated fatty acids (Wahid and Rosnina, 2016). As a result, buffalo milk is well-suited for use in the dairy by-product industries and can potentially enhance farmer incomes in this country.

[1]Institute of Tropical Agriculture and Food Safety (ITAFoS), Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia.
[2]Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia.
[3]Faculty of Agriculture, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia.

Corresponding Author: Norhariani Mohd Nor, Institute of Tropical Agriculture and Food Safety (ITAFoS), Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia.
Email: norhariani@upm.edu.my

How to cite this article: Samad, F.A.A., Norhariani M.N., Muhammad R.A., Hasliza A.H., Mark B., Bakar, M.Z.A., Salleh, A. and Saad, M.Z. (2026). The Management System of Dairy Buffalo in Peninsular Malaysia. *Asian Journal of Dairy and Food Research*. **45(3):** 525-530. doi: 10.18805/ajdfr.DRF-388.

Submitted: 29-02-2024 **Accepted:** 26-08-2024 **Online:** 23-09-2024

The milk production of dairy buffalo in Malaysia varies from 4.00 L to 8.00 L per day per buffalo (Feroz Khan, personal communication, May 17, 2020), which is still far away from the potential of superior buffalo production, which is 10.00 L to 12.00 L per day per buffalo (Wahid and Rosnina, 2016). Instead, local buffalo in this country can only produce an average of 1000 L of milk annually per animal, with an average of 4.7 L per day per head per lactation period (Wahid and Rosnina, 2016). Consequently, there is still needs to meet the local milk demand. The milk production is well correlated with the management. Several important herd management factors should be considered to improve milk production and quality. The factors include nutritional management of the cow and the calves (Reddy *et al*., 2018), hygiene management during pre-and post-partum, milking management, health management (Kale *et al*., 2018), breeding management, housing management and recording system management (Cicek *et al*., 2016). Improvement in management structure practices may influence the production and quality of the milk.

In Malaysia, there has not been enough research on the cost of producing buffalo milk and the within different management system and insight into the industry's current state is inadequate (Mohd Azmi *et al*., 2021). Present study aims to determine the cost of dairy buffalo milk in selected regions of Peninsular Malaysia. Calculating milk costs is important because it can provide information on the distribution of cost components on the overall cost of milk production (Ang *et al*., 2021).

MATERIALS AND METHODS

A survey on the dairy buffalo farming systems were performed at four states in Peninsular Malaysia: 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: i) small-scale farm consists of less then 29 adult female buffalos, ii) semi-commercial farms consists 30 to 49 adult female buffalos, and iii) commercial farm has 50 or more adult-female buffalos. (DVS, 2021 and Suntharalingam, 2019). There are six traditional farms, five semi-commercial farms and three commercials farms surveyed using a developed questionnare. The questionnaire was consisting of farm management aspects, particularly on feeding management at different stages of dairy buffalo production, usage of local feed resources and their availability, health management and calculation of the cost.

The inputs for this study enterprise budget (describe in next section) 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, labour, 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 based on types of farm through IBM SPSS Statistics for Windows for categorical data and continuous data. Table 1 and 2 shows the input price for estimating variable cost and input for estimating depreciation of fixed asset that will be used in this study.

Table 1: Input price for estimating variable cost.

Variable cost	Traditional farm price (RM)	Semi-commercial farm price (RM)	Commercial farm price (RM)
Feed cost	41,815.20	73,639.88	193,663.97
Labour 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	7080.00	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	Scrap value	Duration	Source
Buffalo	10%	16 year	Wahid and 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

An enterprise budget model has been developed in Microsoft Excel as an analytical tool to calculate the cost and return of milk production (Fig 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 calculation was determined by using the model equation developed by Robin and Glynn (2020).

RESULTS AND DISCUSSION

The data for the model's estimation is derived from several 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 some responses, including 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 considers milk sales since the questionnaire does not report other farm outputs, like the sale of male buffaloes or the culling of buffaloes.

Socioeconomic of the farmers three groups of dairy buffalo farms in peninsular malaysia

In commercial farms, 66.7% of farmers were below 20 years old, 60% and 50% of farmers were in age 41-50 for semi-commercial and traditional farms, respectively. 100% of farmers in dairy buffalo farms were male. For commercial farms, 66.7% of farms located at Selangor and 33.3% at Kedah. Meanwhile, 60% and 66.7% of farms were located in Kedah for semi-commercial and traditional farms, respectively.

This study showed that 66.7% of farmers in commercial farms were below 20 years old. Meanwhile, 60% and 50% of farmers were aged 41-50 for semi-commercial and traditional farms, respectively. Siddiki *et al*. (2016) stated in their study at Lalpur Upazila, Bangladesh, primarily farmers were below 30 years of age, however, Famous *et al*. (2021) showed in their study at Haor Areas, Bangladesh, most of the farmers were in the range of 40-50 years old. The agriculture sector has the potential to offer high income, so youth started to invest and become interested in this sector. As shown in the result, all the farmers in this study were male, which aligned with Famous *et al*. (2021) and Siddiki *et al*. (2016). Based on the result, most commercial farms were located in Selangor due to the excellent exposure, marketing and location of the farms; hence, the public and consumers made reaching the farmers easier, leading to better investments.

The nutritional management of the three groups of dairy buffalo farms in Peninsular Malaysia

According to the result, 100% of commercial farms fed total mixed ration to their animals, meanwhile only 80% of farms practiced total mixed ration in semi-commercial farms and 66.7% in traditional farms. All of the farms (100%) in commercial farms and semi-commercial farms give forages for pre-wean and only 66.7% of farms in traditional farms fed the forages to pre-wean animals. The table showed, for post-wean animals, 66.7% from commercial

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

Fig 1: Model building of enterprise budget.

farm, 80% of semi-commercial farms and 33.3% of traditional farms did not fed forages to their animals. All of the farms agreed to fed concentrate to their first calving animals.

The study in Bangladesh reported that the farmers in their area of study did not supply concentrate or practice total mix ration to the dairy buffalo (Famous *et al*., 2021). On the contrary, most farms in each category in this study practised total mix ration to their livestock. The benefit of feeding total mixed ration as opposed to feeding forages supplemented with concentrated is the opportunity to make every bite of feed essentially a complete, nutritionally balanced diet for all cows (Schingoethe, 2017). According to the results, most farms in each category provide forages to pre- and post-wean calves. Under natural grazing systems, calves are suggested to consume forage as early as possible. Xiao *et al*. (2020) explained in the previous study that including forages in calves' diet was recommended to improve their behavioural expression and rumen environment, consequently enhancing their performance.

The health management of the three groups of dairy buffalo farms in Peninsular Malaysia

The popular disease infected calves in semi-commercial farms and traditional farms were diarrhoea with percentage 40% and 50%, respectively. Meanwhile according to the farmers in all groups, there are less common disease infected their cows. 66.7% of mastitis have occurred in commercial farms, 60% in semi-commercial and 50% in traditional farms. Farmers in both group commercial and semi-commercial, 100% agreed to cull the animals with mastitis, meanwhile only 83.3% in traditional farms agreed with the method. Besides, 100% antibiotic treatment were applicable in commercial and semi-commercial groups, however in traditional group there were only 66.7%.

In this tropical area, dairy cattle and dairy buffalo are also easily infected by diseases. Based on the data, every farm from the different groups has been infected by the common diseases and disorders of the domestic buffalo in Asia. In the commercial group, there was a farm that experienced brucellosis and abortion of the calf. One of the farms under semi-commercial farms got infected by endoparasites like gastrointestinal nematodes. *Mastitis* is a bacterial infectious disease that can influence dairy animals' milk quality, yield and udder health (Wahid and Rosnina, 2016). This study recorded that most of the farms have been infected by mastitis. This may happen due to the lack of attention towards the hygiene of the farms and during the milking process.

The dairy production management of the three groups of dairy buffalo farms in Peninsular Malaysia

The result from this study showed 100% of farms in commercial and semi-commercial farms, preferred to milking twice per day, meanwhile in traditional farms only 66.7%. Most of the farms sold their products to publics and restaurant, only 16.7% farms from traditional farms were distributed in dairy plants. Besides that, only one farm represents each group have producing cheese in their farms. Dairy buffalo let the milk down slower than buffalo. In line with this study, Wahid and Rosnina (2016) mentioned that buffalo were usually milked twice daily. Most farms in this study chose to distribute their output to the public and restaurants because buffalo milk was only partially acceptable, like cattle milk in this country. Due to that, usually, each farm has its own regular customer that specifically consumes buffalo's milk. 33.3%, 20% and 16.7% of farms have been involved in producing cheese using buffalo milk. Cheese made from buffalo milk usually has a typical body and textural characteristics. For example, in manufacturing mozzarella cheese, buffalo milk was more suitable than cow milk (Wahid and Rosnina, 2016).

The costs and profits of three groups of dairy buffalo farms in Peninsular Malaysia

The results of variable costs of three group dairy buffalo farms in Peninsular Malaysia were constructed in Table 3. The data showed, traditional farms have highest variable cost per litre of milk production. Semi-commercial farms have lowest veterinary cost compare to traditional and commercial farms. The commercial farms have the least total cost production of milk with RM 2.44 per litre per year.

The results on costs and returns for the three groups of dairy buffalo farms in Peninsular Malaysia (traditional farm, semi-commercial farm and commercial farm) were presented in Table 4. Firstly, for the traditional farm 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.

Further it is inferred that, 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

Table 3: Result of variable cost of three groups of dairy buffaloes in Peninsular Malaysia.

	Feed	Labor	Veterinary	Utility	Transportation	Maintenance	Total cost [Per litre per year (RM)]
Traditional	RM1.90	RM2.65	RM0.11	RM0.91	RM0.11	RM0.19	RM7.06
Semi-Commercial	RM1.28	RM0.83	RM0.04	RM0.12	RM0.00	RM0.13	RM3.25
Commercial	RM0.43	RM0.30	RM0.07	RM0.06	RM0.01	RM0.01	RM2.44

Table 4: Costs and returns for the three groups of dairy buffalo farms in peninsular malaysia

	Traditional	Semi commercial	Commercial
Gross revenue [per liter per year (RM)]	RM10.67	RM6.60	RM7.33
Total cost [per litre per year (RM)]	RM7.06	RM3.25	RM2.44
Total cost [per farm per year (RM)]	RM155,060.70	RM186,784.78	RM1,110,764.41
Gross return [per litre per year (RM)]	RM4.80	RM4.20	RM 6.45
Gross return [per farm per year (RM)]	RM105,590.06	RM241,201.72	RM2,929,799.46
Net return (total per litre per year)	RM3.61	RM3.35	RM4.89
Net return (total per farm per year)	RM7,944.56	RM192,424.82	RM2,220,519.02
Total production [per farm per year (L)]	21,978	57,456	45,4472

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.

The net return of the product is directly correlated with the cost of producing milk. The enterprise's profitability can be determined by the costs associated with producing milk (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-litre milk than 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 farm category, which reflect the effectiveness of the enterprise operation of the category farm.

For each category, the gross return and gross margin per 1-litre milk were RM4.80 and 68%, RM4.20 and 129% and RM6.45 and 264%, respectively. Meanwhile, the net return and margin are RM3.61 and 51%, RM3.35 and 103% and RM4.89 and 200%, respectively. The commercial farm generated more revenue than the other two categories. The total cost of producing any farm commodity comprises variable and fixed costs. During 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, typically several years (Doye and Sahs, 2016). 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 is commercial farms' more significant investment in farm assets. However, the flexibility of fixed costs can decrease per unit when more significant amounts of farm output are produced. Regarding 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 high feed costs are caused by semi-commercial and commercial farms relying more on concentrate feed and industrial waste as animal feed than traditional farms, which primarily use pasture grazing. Constraints on grazing areas 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 22 production (Sim and 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. This study 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 and Malhotra, 2020).

CONCLUSION

Considering all the parameters, dairy buffalo rearing may profitably practice in Peninsular Malaysia. Besides, raising dairy buffalo can improved socio-economics of the farmers in Peninsular Malaysia. The using of enterprise budget as a tool to estimate the cost of dairy buffalo production can improve farmers awareness and decision-making power in expanding their business. Results of present study 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.

Funding

This work was financially supported by the by Ministry of Higher Education (MOHE) through (TRGS/1/2020/UPM/01/4).

ACKNOWLEDGEMENT

The authors would like to acknowledge the contribution to the Faculty of Veterinary Medicine, Universiti Putra Malaysia (UPM) and respondents from the farms for the facilities.

Conflict of interest

There is no conflict of interest in this research.

REFERENCES

Acharya, K.K. and Malhotra, R. (2020). Economic analysis of milk production in peri-urban dairy farms of Odisha. *Indian Journal of Dairy Sci*. **73(2):** 155-159.

Ang, X.T., Nor Mohd, N., Hiew, M.W.H., Khairuddin, U., Tan, C.T., Shapiai, M.I., Suhaimi, N.A.M. and Lee, P.A.K. (2021). Estimating dairy young stock rearing cost of different management systems in Keningau, Sabah, Malaysia. *Asian Journal of Dairy and Food Research*. **40(2):** 136-141. doi: 10.18805/ajdfr.DR-217.

Cicek H., Tandogan M. and Uyarlar C. (2016). Financial losses due to fertility problems in Anatolian Dairy Buffalo. *Indian Journal of Animal Research*. **51(6):** 1144-1148. doi: 10.18805/ijar.10981.

Doye, D and Sahs, R. (2016). Using enterprise budgets in farm financial planning. Oklahoma Cooperative Extension Service.

DVS, (2021a). Pelan strategik pembangunan industri tenusu negara 2021-2025. 1-7. https://www.dvs.gov.my/dvs/resources/user_1/2021/BPSPV/penerbitan/TENUSU_(7_9_21).pdf?fbclid= IwAR0OhGKg1XjRzzUuMjsRa5HyXi5QrRZUjZQiq9YO6B3Frp4p9h fvtTTZ5w. Accessed 3/4/2022. Accessed 3/4/2022.

Famous, M., Baset, M.A., Uddin, M.N., Hossain, M.N., Islam, O., Khatun, S. and Ferdous, M. (2021). Dairy buffalo production and management systems in haor areas of sylhet in Bangladesh. *Turkish Journal of Agriculture-Food Science and Technology.* **9(8):** 1524-1529. https://doi.org/10.24925/turjaf.v9i8.1524-1529.4343

Food and Agriculture Organization of the United Nations. (2021). Overview of global dairy market developments in 2020. Dairy Market Review. Retrieved from http://www.fao.org/3/ca3879en/ca3879en.pdf.

Feroz, K. (2020). Personal communication [Personal interview].

Kale, B.R., Ponnusamy, K., Chakravarty, A.K., Mohammad, A., Sendhil, R. (2018). Productive and reproductive performance of cattle and buffaloes reared under farmers' management in differential dairy progressive states in India. *Indian Journal of Animal Research*. **52(10):** 1513-1517. doi: 10.18805/ijar.B-3393.

Khalex, A.H., Salmah Syed-Hussain, S., Zubaidah Ramanoon, S., Razid Sarbini, S., Nasir Hassan, M., Rovina Nating, W., Asut, R., Yu Abit, L. and Kamaludeen, J. (2021). Buffalo in Borneo, Sarawak: A review of the current status of the indigenous buffalo industry. *Journal of Buffalo Science*. **10:** 32-40.

Mohd Azmi, A.F., Abu Hassim, H., Mohd Nor, N., Ahmad, H., Meng, G.Y., Abdullah, P. and Zamri-Saad, M. (2021). Comparative growth and economic performances between indigenous swamp and Murrah crossbred buffaloes in Malaysia. *Animals*. **11(4):** 957.

Reddy, N.A., Seshiah, V.C., Sudhakar, K., Kumar, S.D., Reddy, K.R.P. (2018). Shortened dry period in dairy Buffaloes: Influence on milk yield, milk components and reproductive performance. *Indian Journal of Animal Research*. **53(1):** 119-123. doi: 10.18805/ijar.B-3457.

Robin, R. and Glynn, T. (2020). KSU-Dairy Farm Management Budgets. Copyright 2020 AgManager.info, K-State Department of Agricultural Economics.

Schingoethe, D.J. (2017). A 100-Year Review: Total mixed ration feeding of dairy cows. *Journal of Dairy Science*. **100(12):** 10143-10150. https://doi.org/10.3168/jds.2017-12967.

Siddiki, M., Amin, M., Kabir, A., Faruque, M. and Khandaker, Z. (2016). Socio-economic status of buffalo farmers and the performances of buffaloes at Lalpur Upozila of Natore district in Bangladesh. *Bangladesh Journal of Animal Science*. **44(3):** 157-165. https://doi.org/10.3329/bjas.v44i3.26366.

Sim, R.M.L. and Suntharalingam, C. (2015). Dairy sector in Malaysia: A review of policies and programs. *Food and Fertilizer Technology Center Agricultural Policy Platform*.

Singh, J.K., Singh, R., Singh, J.P., Mishra, S.K., Kumar, R. and Raghuvanshi, T. (2017). A study of the cost and returns of milk production of cow and buffalo and to find out the break-even point of dairy enterprise. *International Journal of Current Microbiology and Applied Sciences*. **6(11):** 3928-3938.

Suntharalingam, C. (2019). 'Marketing Mix of Milk and Dairy Products in Peninsular Malaysia', In: Food Value Chain in ASEAN: Case Studies Focusing on Local Producers. [Kusano, E. (ed.)], ERIA Research Project Report FY2018no.5, Jakarta: ERIA. pp. 133.

Wahid, H. and Rosnina, Y. (2016). Husbandry of dairy animals Feeding Management Goat: Health Management Goat: Milking Management Goat: Multipurpose Management Goat: Replacement Management Goat: Reproductive Management Predator Control in Goats and Sheep: Feeding Management Sheep: Health Management Sheep: Milking Management Sheep: Multipurpose Management Sheep: Replacement Management Sheep: Reproductive Management Buffalo: Asia (Vol. 1).

Xiao, J., Alugongo, G.M., Li, J., Wang, Y., Li, S. and Cao, Z. (2020). How forage feeding early in life influences the growth rate, ruminal environment and the. *Animal*. **10(2):** 188.

Yang, T.X., Wang, F., Li, H., Liu, Q.S. and Li, Q.Y. (2013). The nutrition of buffalo milk: A comparison with cow milk. In *Advanced Materials Research*. **781:** 1460-1463.

Zayadi, R. (2021). Journal of Sustainable Natural Resources Current Outlook of Livestock Industry in Malaysia and Ways Towards Sustainability. *Journal of Sustainable Natural Resources*. **2(2):** 1-11. http://publisher.uthm.edu.my/ojs/index.php/jsunr.