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Farmers' prioritization of dairy development strategies in Vavuniya district, Sri Lanka

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ABSTRACT

This study examines dairy farmers' willingness to pay (WTP) for dairy development strategies in the Vavuniya district of Sri Lanka. Yeo hundred dairy farmers from Vavuniya district were randomly selected for this study. The choice research approach was applied, and conditional logit models were developed. The results of the study show that farmers are willing to pay for all the selected development strategies. Farmers prioritize the development strategies as follows: training in silage making, morning and evening milk collection, the establishment of milk collection centres within 2 km of dairy farms, and doubling the success rate of artificial insemination. Farmers' WTP for training in silage making is higher than their WTP for other dairy development strategies. Female farmers' WTP for training in silage making is greater than male farmers' WTP for the same training. Farmers' income and education level each have a positive effect on their WTP for training in silage making, and their education level positively influences their WTP for morning and evening milk collection. The results of this study will assist policymakers in developing appropriate dairy development strategies and charges for the services offered.

Contribution/Originality: This paper investigates dairy farmers' willingness to pay for dairy development strategies, their prioritization of strategies and the influence of their socioeconomic demographic characteristics on their willingness to pay. To develop effective dairy development projects, government authorities should know how farmers prioritize the various dairy development strategies.

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1. INTRODUCTION

Livestock significantly contributes to rural livelihoods in Sri Lanka. Livestock provides income, employment, and a safety net for producers, as well as nutrition for consumers in urban and rural areas. For many rural small farmers, livestock is a "living bank". In Sri Lanka, of the 2 million hectares of agricultural land, almost 75% consists of smallholding land area, and 90% of farmers have less than 2 ha of land. One-third of smallholder farmers have a mix of crops and livestock, mainly cattle or buffalo (Perera & Jayasuriya, 2008). The contribution of the agriculture sector to the country's gross domestic product (GDP) is around 6.8%. Of this, livestock contributes about 0.75% of the GDP. Of the 8.2 million-strong labour force, nearly 26% is employed in the agriculture sector (Economics and Social Statistics of Sri Lanka, 2017). Rural employment depends mainly on agriculture and livestock. Female participation in the livestock sector is higher in rural areas than in urban areas. Total annual milk production is 494.85 million litres per year. Cow milk production is 354 million litres per year and buffalo milk production was 67 million litres per year in 2019. In Vavuniya district, 10 million litres of cow milk were collected in 2017 (DAPH Department of Animal Production and Health Sri Lanka, 2019). In Sri Lanka, the total cow milk production was 354 million litres per year in 2019. Almost 56% of the total milk produced is collected by processors and then sent to the formal milk market and sold alongside imported milk products. The rest of the domestic milk production, about 44%, is kept by the dairy farmers for their own consumption needs and sold to their neighbours (Pathumsha, 2016). The number of milk chilling centres was around 236 in 2018. Fourteen main milk processors in the country collected 269.26 million litres through the formal milk market in 2018. Compared to other Asian countries, the per-capita consumption of milk and milk products is low in Sri Lanka. In 2018, the per-capita consumption of milk and milk products was 159.20 ml/day (DAPH Department of Animal Production and Health Sri Lanka, 2019). Imports of dairy products amounted to 104,861.87 metric tons (MT) in 2018 (DAPH Department of Animal Production and Health Sri Lanka, 2019). Powdered milk accounted for 83.18% of imported dairy products in 2018. Full cream milk powder and non-fat milk powder imports were around 87,228.39 MT and 11,799.32 MT, respectively. The total import expenditure on dairy products was nearly Rs 54.00 billion in 2018. The total availability of milk and milk products, including imported milk products, was 1,263.9 million litres of liquid milk equivalent. The per-capita availability of milk was 54 l/year. The average farm-gate price of milk was around Rs 70.59 per litre in 2018. The average cost of production per litre of milk under intensive systems was Rs 47.67 in 2018 (DAPH Department of Animal Production and Health Sri Lanka, 2019).

Before introducing the open economic policy in 1977, Sri Lanka was self-sufficient in milk consumption. After the open economic policy, milk products were imported due to the low price compared to the price of domestic milk products. Therefore, the interest in domestic dairy production decreased, and the dairy farmers were dismayed. From that point, the dairy industry in Sri Lanka was reliant on imported dairy products, which had a negative impact on the economy (Pathumsha, 2016). After dicyandiamide (DCD) was found in imported milk powder in 2013, consumers became more careful about buying imported milk powder for consumption. Data on consumers' behaviour and preferences could be important factors for the development of the dairy sector. Precise estimates of consumers' buying behaviour of dairy products could be useful for the dairy sector development in Sri Lanka. Dairy production in the country has shown positive growth in the past two decades. Efforts to upgrade the chilling facilities of milk collectors, provide financial assistance, stabilize profitable farm-gate prices, provide suitable high-bred cattle, and promote the consumption of fresh liquid milk have contributed to the positive growth in the dairy sector. Formal milk collection has shown an increasing trend; however, milk collection has not increased in line with the growth in milk production. According to surveys of household expenditure, the expenditure on dairy products is about 9.4%.

Reproductive efficiency is the most important factor in the economic success of dairy farming. Artificial insemination (AI) was first introduced in commercial production in the 1950s (Valergakis, Arsenos, & Banos, 2007). In the past, one of the reasons for the rapid adoption of AI was its lower cost for smallholders. In many districts, smallholder dairy farmers do not have adequate land to grow grass or access to available grassland (Perera & Jayasuriya, 2008). Silage making is a primary fodder preservation strategy in Sri Lanka. Silage making using commonly available grasses has become a suitable practice for commercial dairy farming, but there is little scope for smallholder use. Silage making in plastic barrels is a feasible technique. Fodder is cut using a machine and then pressed into a barrel and covered with a plastic top (Weerasinghe, 2019). A number of large feed mill operators control the feed business in Sri Lanka. Milking frequency in early lactation can expand milk yield persistency (Wall & McFadden, 2008). The normal milk yield of dairy animals drained 3 times/day is 2.9 kg/d greater than that of dairy animals drained 2 times/day (Hart, McBride, Duffield, & DeVries, 2013). Due to the lack of milk collection centres and the restriction of milk collection to mornings only, most dairy farmers only collect milk in the morning (Perera & Jayasuriya, 2008). Dairy farming in developing countries is considered relatively inefficient in its use of scarce resources. There is a high potential to increase milk yield in developing countries through sustainable intensification. Research and development can contribute to providing more sustainable solutions.

Vavuniya district is endowed with substantial natural and human resources that can be utilized for cattle farming. Figure 1 shows that Vavuniya district is located in the north of Sri Lanka. Vavuniya district is divided into four divisional secretaries. These are Vavuniya, Vavuniya North, Vavuniya South and Vengala Cheddikulam. It has an area of 1,967 square kilometres. The total population of the district is around 187,310. Paddy cultivation and livestock are the main livelihoods of most people in this district. The livelihood of one-third of the population mainly depends on livestock.

Livestock farming is the second most widespread economic activity in Vavuniya district, after crop farming, and it provides a livelihood for the majority of the rural population in Vavuniya district. There are around 13,530 farm households in the district. Cattle and buffalo farming produce about 30,328 litres of fresh milk daily. Many small-scale value-added production centres, nine milk collection centres, and two milk chilling centres operate in the district. Most of the cattle farms have small herds of less than ten heads that they rear on less than two acres. The livestock are mostly fed by free grazing, not by improved pastures. Livestock activities are not properly integrated with crop cultivation in the district, resulting in limited income and conflict in land use. Cattle farming provides jobs for rural people and a continuous flow of income in the district. The two chilling plants that operate in the district have a capacity of 8,500 litres per day. In 2014, these two chilling plants collected 2,772,409 litres of milk out of a total production of 7,430,780 litres. The buffalo milk production was 523,928 litres in 2014. There is a high potential for improving livestock in the district as a large number of families are involved in cattle farming, and about 20% of the total land is natural grassland that could be used for the production of improved pasture. If appropriate knowledge and high-bred cattle were provided to the farmers, the high potential of cattle farming in the district could be realized to a greater extent.

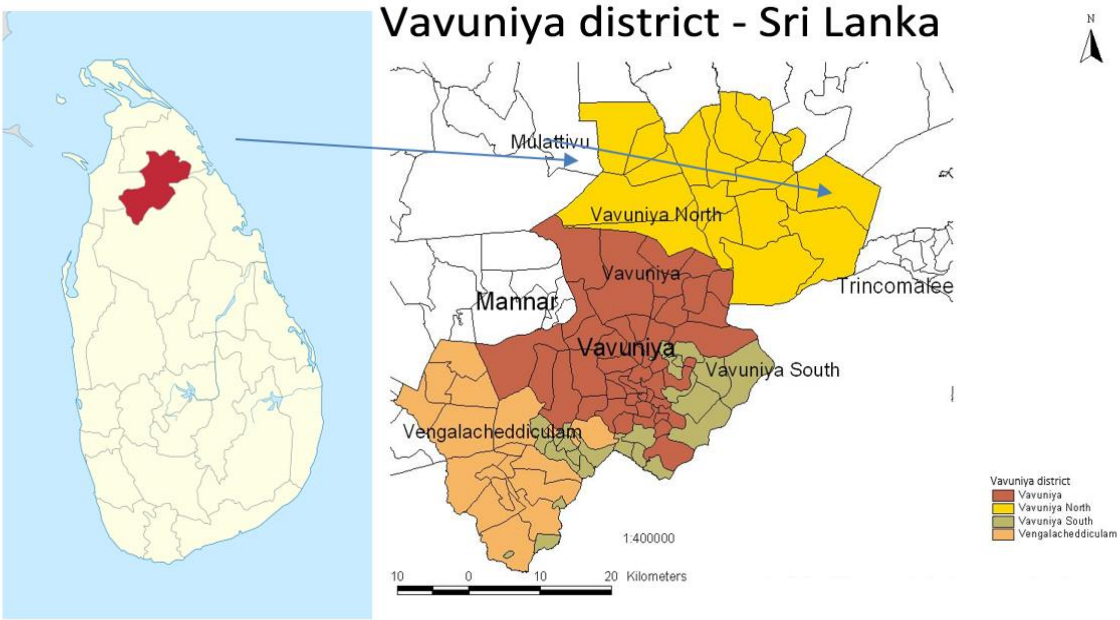

Figure 1. Map of Vavuniya district, Sri Lanka.

Vavuniya district is also one of the main agricultural land areas in Sri Lanka with a mix of crop and cattle farming on land areas of less than 2 ha. The total population of Vavuniya district is 181,539, of which the rural population is 140,741, and the urban population is 41,798. The rural population is thus higher than the urban population in Vavuniya district (Department of Census Statistics, 2012). The livelihoods of most people in Vavuniya district mainly depend on agriculture and animal husbandry, particularly cattle farming. The total cattle population in Sri Lanka was around 1.46 million in 2018. Vavuniya district had around 14% of the national cattle population in 2018 (DAPH Department of Animal Production and Health Sri Lanka, 2019). Vavuniya is the second major milk collection area in the northern region (DAPH Department of Animal Production and Health Sri Lanka, 2019). Local milk production has only been able to meet 42% of the demand in Sri Lanka, and the deficit is met by imports. Dairy development helps to improve food security and import substitution and prevents poverty and the migration of rural poor to urban areas (Perera & Jayasuriya, 2008). Small dairy farmers in Vavuniya district face many difficulties: lack of grazing land, low AI success rates, lack of knowledge of silage making, lack of milk collection centres, and price fluctuations of concentrated feeds. The Department of Animal Production and Health (DAPH) is the main provider of services to dairy farmers in Sri Lanka. It offers AI, training, and extension services to dairy farmers and sporadically assists with constructing animal sheds, enhancing calves and other assistance. The DAPH is also accountable for controlling widespread diseases and provides veterinary services through its offices. The National Livestock Development Board and the Milk Industries of Lanka Company MILCO (Private) Limited also provide some assistance with obtaining animals through brokers. However, farmers frequently do not receive services on time to the desired standards (Ranawana, 2008). Compared to India and Pakistan, dairy development in Sri Lanka, Nepal and Bangladesh is not developed to allow these countries to be self-sufficient, partly due to the lack of government assistance for the sector (FAO, 2009). The government should consider the development of the dairy sector as a main pathway for the social and economic development of the rural poor, but the government has limited resources to support dairy development programmes and seeks funds from foreign governments and agencies to develop the dairy industry in Sri Lanka. Resources allocated to dairy development projects or programmes should be effectively utilized to achieve maximum benefit from the scarce resources. To develop effective dairy development projects or programmes, government authorities should know how the farmers prioritize the various dairy development strategies. In Vavuniya district, dairy farmers face many difficulties in rearing cattle. Therefore, the objective of this study is to estimate the dairy farmer's willingness to pay (WTP) for dairy development strategies in Vavuniya district, as well as the influence of socioeconomic demographic characteristics on the farmers' WTP, and to make suggestions and recommendations to develop effective dairy development projects or programmes in this district.

2. METHODOLOGY

Vavuniya district was selected for this study because the livelihood of most farm families in Vavuniya district depends mainly on agriculture and animal husbandry, particularly cattle farming. There are 13,530 farm families in Vavuniya district. As a preliminary study, 20 households were randomly selected and interviewed about the strategies to develop the dairy industry in Vavuniya district. Based on data collected in the preliminary study, attributes of dairy development strategies were identified, and a questionnaire was prepared for this study. This study used a stratified random sampling method to select respondents from Divisional Secretariates (DS) in Vavuniya district. The respondents were randomly selected proportionate to the number of residents living in each DS division. A total of 200 cattle farmers were thus randomly selected from different areas using random stratified sampling. Data was collected through in-person interviews with the cattle farmers using a structured questionnaire. The questionnaire included the farmer's demographic and socioeconomic characteristics, such as age, income, education, number of people and children in the household, cattle farming practices, artificial insemination, distance from milk collection centres, milk collection time (morning and/or evening), silage making, feeding, and grazing land. Random utility choice modelling was used to estimate the farmers' WTP for the various factors contributing to improved milk production, such as artificial insemination, distance from milk collection centres, milk collection time (morning and/or evening), and training in silage making.

WTP is the perceived economic value of a selected good or service to an individual based on a particular set of conditions (Minh, Nguyen-Viet, Thanh, & Yang, 2013). Empirical techniques used to estimate WTP are categorized into two methods: stated preference (SP) and revealed preference (RP) methods. In the revealed preference method, the actual choices made by consumers in markets are used to estimate their WTP. RP methods can only be used if there is a market for a good or service. Since there is no market for factors contributing to improved milk production, such as artificial insemination, distance from milk collection centres, milk collection time (morning and/or evening), and training in silage making, the RP method cannot be used to estimate households' WTP for factors contributing to improved milk production. Within the stated preferences method, two economic approaches are used to estimate WTP: the contingent valuation method (CVM) and the choice modelling (CM) approach. CVM is a direct method that estimates the economic value of non-market commodities by asking a respondent's WTP for a non-market commodity. On the other hand, CM is an indirect method that estimates the economic value of non-market commodities by asking a respondent to choose between alternatives. The CM approach has been applied in many fields to study the determinants of choices of non-market commodities (Quaife, Terris-Prestholt, Di Tanna, & Vickerman, 2018). In choice experiments, respondents are asked to select their preferred choice from a set of hypothetical alternative goods or services. Choice experiments may avoid some of the potential biases of direct SP methods. In direct SP methods, hypothetical bias occurs when answers differ between hypothetical and real-life situations when respondents make payments (Hausman, 2012). Hypothetical bias has been extensively recognized in research using CVM (List & Gallet, 2001; Little & Berrens, 2004). However, there is very little evidence of hypothetical bias in research using the CM method (Johansson-Stenman & Svedsäter, 2003). CM often predicts actual health behaviours, for instance, and is less subject to social desirability bias compared to other SP methods (De Bekker-Grob, Donkers, Bliemer, Veldwijk, & Swait, 2020; Horiuchi, Markovich, & Yamamoto, 2022). Therefore, this study employed the CM approach to estimate farmers' WTP for the various attributes of dairy development strategies.

The CM approach was framed in a random utility framework that allowed us to measure the value of environmental goods and services. The utility function (U) has two components: the indirect utility function (observable component) and the error term (unobservable component):

$$U = V + \varepsilon \quad (1)$$

Where V is the indirect utility function, and ε is the stochastic error term. The indirect utility function is assumed to be a linear function:

$$V_i = \beta_i X_{ki} + \alpha m = \beta_1 + \beta_2 x_{2i} + \beta_3 x_{3i} + \ldots + \beta_k x_{ki} + \alpha_i m_i \quad (2)$$

Where ($X_{ki} = \{x_{1,2}, \ldots, x_k\}$) is a vector of k attributes of alternative i, β is a vector of coefficient of k attributes, m_i is the income of the individual choosing the alternative i, and α is the coefficient vector of income. If the error term is logistically Gumbel distributed, the probability of alternative i being chosen is given by

$$\Pr(i) = \frac{\exp(\rho V_i)}{\sum_{j \in C}^{J} \exp(\rho V_i)} \quad (3)$$

Where C is the choice set, and ρ is a positive scale parameter. ρ is assumed to be 1. The following formula is used to estimate WTP for a change from the status quo to the chosen state:

$$V_i(X_i, y) + \varepsilon_i = V_j(X_j, m - CV) + \varepsilon_j \quad (4)$$

Where Vi and Vj denote utility gained from the status quo state and the chosen state, respectively. Compensating variation (CV) is the quantity of money that brings the individual utility gained from the status quo state, and the chosen state is equal. To estimate the welfare changes (CV) in Equation 4, a conditional logit model is developed, and Equation 4 is restated as:

$$\beta_i X_{ki} + \alpha_i m + \varepsilon_i = \beta_j X_{kj} + \alpha_j (m - CV) + \varepsilon_j \quad (5)$$

As the marginal utility of income is assumed to be constant for an individual, αi and αj become equal in Equation 5. Therefore, Equation 6 presents the welfare change (CV).

$$CV = -\frac{1}{\alpha}\left[\left(\beta_i (X_{ki} - X_{kj}\right) + (\varepsilon_i - \varepsilon_j)\right] \quad (6)$$

In the conditional logit model, the coefficient of each attribute is the same across all alternatives (βi = βj), while only the attribute levels differ across the alternatives. Therefore, the welfare change can be estimated by the following equation:

$$CV = -\frac{1}{\alpha}\left[\left(\beta (X_{ki} - X_{kj}\right) + (\varepsilon_i - \varepsilon_j)\right] \quad (7)$$

Equation 7 is thus used to estimate a farmer's WTP for the various attributes of dairy development strategies.

The attributes of dairy development strategies were milk collection time (morning and/or evening), distance from a milk collection centre, artificial insemination, and training in silage making. Each attribute has several discrete levels. For artificial insemination, two levels were presented to respondents: double the success rate or no change from the current success rate. The attribute of training in silage making for cattle farmers was limited to two levels: training in silage making for all farmers or no change. The third attribute, the milk collection centre, was limited to two levels: establishment of a milk collection centre within 2 km or no change. The fourth attribute, milk collection from dairy farmers, was limited to two levels: milk collection in both morning and evening or no change. The four levels of the cost attribute were Rs 0, Rs 200, Rs 400, and Rs 800. Table 1 provides the definitions of the attributes of selected dairy development strategies along with the cost levels.

The choice experiment surveys comprised multiple choice sets of four development strategies for improving milk production in cattle farming. In the survey, respondents were briefed on the attributes of four development strategies and the cost associated with each alternative. Respondents were asked to choose their preferred option from the three options given to them. Each option was a combination of various levels of the four attributes and the cost. The costs presented to the respondent as Option A and Option B were set differently across the choice sets, and Option C was set at Rs 0 as the status quo for all choice sets. As there were two levels each for milk collection time, distance between milk collection centre and household, artificial insemination, and training in silage making, as well as four cost levels, there were 2x2x2x4 factorial designs. Therefore, 32 orthogonal choice combinations could be formed; however, it is difficult to ask a respondent to select among that many choice sets. For an efficient choice design, a D-efficient design was developed. We limited the number of choices to half of the orthogonal combinations. We selected 16 choice combinations from the 32 orthogonal combinations. Interaction effects between the attributes were assumed to be insignificant. Among the 16 choices, one unrealistic option was excluded. Therefore, 8 choice sets of Options A and B were developed. "No change", the current attribute of each development strategy was added to each choice set as Option C. Except for Option C, the levels of the attributes changed from one option to the next. The attribute levels, costs, and benefits for cattle farming were explained to the respondents. Each option in the choice set had different levels of the attributes of the dairy development strategies. Respondents were asked to choose an option from 8 choice sets. A conditional logit model was estimated for the farmer's choice.

Table 1. Definitions of selected attributes affecting milk production in cattle farming.

Attributes	Levels	Definitions
Artificial insemination (AI)	Double the success rate	Double the success rate compared to the current level
	No change	Maintain the current success rate
Training in silage making (TSM)	Training in silage making	Training in silage making for all farmers
	No change	No training in silage making for all farmers
Milk collection centre (MCC)	Establishing one within 2 km	Reduce the distance between the household and the milk collection point
	No change	Maintain the same distance
Milk collection time (MCT)	Morning & evening	Availability of milk collection in the evening as well as the morning
	No change	Morning only
Cost	Rs 0, 200, 400, 800	Annual payment to the Department of Animal Production and Health

Variable definitions and the effect codes for the attributes are presented in Table 2.

3. RESULTS AND DISCUSSION

The descriptive statistics of the socioeconomic demographic characteristics of the dairy farmers are shown in Table 3. The descriptive statistics show that the average, minimum, and maximum income of dairy farmers are Rs 23,000, Rs 1500, and Rs 80,000, respectively. This indicates a large variation in farmers' average income. The average educational level, minimum, and maximum educational levels of farmers are 10th grade, 5th grade, and graduate, respectively. Around 90% of dairy farmers in Vavuniya district are male.

Table 1. Effect codes: choice modelling.

Attribute	Variable	Effective code
Artificial insemination	AI	1 if double the success rate; -1 if no change
Training in silage making	TSM	1 if training all farmers; -1 if no training
Milk collection centres	MCC	1 if establishing within 2 km; -1 if no change
Milk collection time	MCT	1 if morning & evening; -1 if only morning
Income	Incom	1 if income < 20,000; 0 if income ≥ 20,000
Education	Edu	1 if edu ≥ G.C.E.(A/L); 0 if edu < G.C.E.(A/L)
Gender	Gen	1 if male; 0 if female

Table 3. Descriptive statistics.

Variable	Mean	Std. dev.	Min.	Max.
Income	23043.13	10050.53	1500	80000
Education	10.398	2.202	5	17
Gender	0.905	0.293	0	1

Four conditional logit models were developed using effective codes for attributes. The coefficients of the four conditional logit models are presented in Table 4. Model 1 consists of the attributes of milk production development strategies alone. Model 2 includes the attributes of dairy development strategies and the interaction of the attributes of dairy development strategies with farmers' income levels. Model 3 consists of the attributes of dairy development strategies and the interactions of the attributes of dairy development strategies with farmers' income levels and education levels. Model 4 consists of the attributes of dairy development strategies and the interactions of the attributes of dairy development strategies with farmers' income levels, education levels, and gender.

Table 4. Coefficients of the four conditional logit model.

Attributes	Model 1	Model 2	Model 3	Model 4
AI	0.474**	0.457**	0.481**	0.343**
TSM	0.748**	0.819**	0.739**	1.11**
MCC	0.447**	0.429**	0.433**	0.455**
MCT	0.577**	0.557**	0.522**	0.657**
Cost	-0.005**	-0.005**	-0.005**	-0.005**
AI × incom		0.062	0.051**	0.058
TSM × incom		-0.212**	-0.152**	-0.170**
MCC × incom		0.062	0.063	0.063
MCT × incom		0.07	0.102	0.096
AI × edu			-0.055	-0.075
TSM × edu			0.556**	0.605**
MCC × edu			0.08	0.078
MCT × edu			0.243**	0.264**
AI × gen				0.159
TSM × gen				-0.419**
MCC × gen				-0.017
MCT × gen				-0.148

Note: ** and * indicate significance at the 1% and 5% level, respectively.

All four conditional logit models show that the variables of artificial insemination, training in silage making, milk collection centre, milk collection time, and cost are significant at the 1% level. Farmers are willing to pay for artificial insemination, training in silage making, a nearby milk collection centre, and multiple milk collection times. The negative sign of the coefficient of cost shows that farmers are most likely to accept an option with lower costs. Among these attributes, farmers are willing to pay more for training in silage making than for other attributes. The interaction effect of training in silage making with income in Models 2, 3, and 4 is negative and significant at the 1% level. This implies that farmers with a monthly income below or equal to Rs 20,000 are willing to pay more for training in silage making than farmers with a monthly income of more than Rs 20,000.

The interaction effects of training in silage making with a farmer's education level in Models 3 and 4 are positive and significant at the 1% level. This indicates that farmers with an education level above General Certificate of Education Advanced Level, G.C.E.(A/L) are willing to pay more for training in silage making than farmers with an education level below or equal to G.C.E.(A/L) The interaction effect of milk collection time with a farmer's education level in Models 3 and 4 is positive and significant at the 1% level. This implies that farmers with an education level above A/L are willing to pay more for morning and evening milk collection than farmers with an education level below or equal to G.C.E.(A/L) The interaction effect of training in silage making with gender is negative and significant at the 1% level. This implies that female farmers' WTP for training in silage making is higher than male farmers' WTP for training in silage making.

Mean WTP for attributes of dairy development strategies were estimated using Equation 7, and the estimated welfare values for each attribute are presented in Table 5. It shows how dairy farmers prioritize the various attributes of dairy development strategies. Among the selected attributes, dairy farmers' WTP for training in silage making is higher than their WTP for other attributes. This shows that dairy farmers prioritize silage making over other attributes because they are facing persistent difficulties obtaining grass and fodder, especially during the dry season in Vavuniya district. Households give lower priority to artificial insemination than other attributes. The low success rate of artificial information in Vavuniya district could be the reason for the dairy farmers assigning a low priority to artificial insemination development strategies. Dairy farmers assign the second-highest priority to morning and evening milk collection. Most milk collection centres in Vavuniya district only collect milk in the morning. Therefore, dairy farmers do not milk in the evening and allow calves to consume all the milk instead. There is a high potential to increase dairy farmers' income if milk collection centres were to collect milk in the evening.

Table 5. Mean and total willingness to pay (WTP) per farming family per year (LKR).

Attributes	Mean WTP/household/year (LKR)	Total WTP/household/year (LKR)
AI	137	
TSM	444	
MCC	182	
MCT	263	
Total WTP (Household with income ≥ LKR 20,000)		1026
(WTP)TSM * Incom (Household with income < LKR 20,000)	376	958
TSM*EDU > G.C.E.(A/L)	686	1268
MCT*EDU > G.C.E.(A/L)	368	1132
TSM*GEN = Male	276	858

Note: Willingness to pay (WTP) was calculated from the significant coefficients in Table 4.

Dairy farmers are willing to pay Rs 137 per year for artificial insemination and Rs 182 per year for milk collection centres. A dairy farmer's willingness to pay for training in silage making is influenced by the farmer's income, education, and gender. Farmers with a household income greater than or equal to Rs 20,000 are willing to pay a total of Rs 1026 per year for all attributes of improved milk production strategies, with Rs 444 for the attribute of training in silage making. Farmers with a household income of less than Rs 20,000 are willing to pay a total of Rs 958 for all attributes of improved milk production strategies, with Rs 376 for the attribute of training in silage making. Farmers who were educated above G.C.E.(A/L) are willing to pay a total of Rs 1268 for all attributes of improved milk production strategies, with Rs 686 for the attribute of training in silage making. Farmers who were educated below G.C.E.(A/L) are willing to pay a total of Rs 1132 for all attributes of improved milk production strategies, with Rs 368 for morning and evening milk collection. Male farmers are willing to pay a total of Rs 858 for all attributes of improved milk production strategies, with Rs 276 for training in silage making.

4. CONCLUSION AND RECOMMENDATION

This study concludes that farmers are willing to pay for all the selected development strategies. Farmers' priorities for development strategies are as follows: training in silage making, morning and evening milk collection, establishing milk collection centres within 2km, and doubling the success rate of artificial insemination. Farmers' willingness to pay for training in silage making is higher than their willingness to pay for other dairy development strategies. Female farmers' willingness to pay for training in silage making is greater than male farmers' willingness to pay. Farmers' income and education level have a positive impact on their willingness to pay for training in silage making, and a farmer's education level positively influences their willingness to pay for morning and evening milk collection. The findings of this study may assist policymakers in developing appropriate dairy development strategies and charges for the services offered by DAPH to improve milk production.

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Institutional Review Board Statement: The Ethical Committee of the Faculty Board of Agriculture, University of Jaffna, Sri Lanka has granted approval for this study.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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