Dairy agripreneurs' preference for production and animal health support services in Kenya—a choice experiment

D. Okello[1] · P. Okello[2]

Abstract

Utilization of production and animal health services among smallholder dairy agripreneurs is crucial in enhancing their productivity and income levels. However, studies have documented low uptake of these services among smallholder dairy agripreneurs in Kenya. This study utilizes a choice experiment (CE) to determine dairy agripreneurs' preferences and willingness to pay (WTP) for five attributes of production and animal health support services. Multistage sampling procedure was used to collect data from 682 dairy farmers in Murang'a County. Data were analysed using Random Parameter Logit (RPL)/Mixed Logit model. The results of CE reveal significant heterogeneity in preference among dairy agripreneurs. Dairy agripreneurs prefer to have group marketing services offered rather than selling on individual basis. They also prefer curative services rather than preventive services. In addition, dairy agripreneurs prefer use of artificial insemination in improving productivity of cows rather than using improved feeds such as hay and silage. The results further indicate that dairy agripreneurs have less preference for business plan training service. In relation to willingness to pay (WTP), dairy agripreneurs were more willing to pay for group marketing (KES 8797.91/month), artificial insemination (KES 2816.01/month) and curative services (KES 2577.62/month). Lastly, dairy agripreneurs were not willing to forgo KES 2411.29 per month for business plan training service. Service providers should consider the differences in preferences among dairy agripreneurs to increase the uptake of production and animal health services in dairy agrienterprises.

Keywords Artificial insemination · Business plan training · Curative · Group marketing · Preventive · Vaccination

Introduction

Dairy farming constitutes the backbone of Kenya's economy. Small-scale agripreneurs dominate the sector (80%) with about 1.8 million farmers involved in production of milk, meat and other dairy products (Mwambi et al., 2018). These agripreneurs have a farm size of about 3–5 acres, keeping 2–5 cows which produce about 5 kg of milk per day (Oloo, 2016). This sector contributed 30% of the gross domestic product (GDP) in 2018. In addition, the sector produced 4 billion litres of milk in 2018 which makes it among the highest producer and consumer of milk in Africa (FAOSTAT, 2018). According to Bosire et al. (2017), the annual per capita milk consumption in Kenya ranges from 19 kg in rural areas to 125 kg in urban ones. Moreover, Schneider (2018) reported that the demand for milk and milk products in Kenya is among the highest in developing countries.

Despite the crucial role these smallholder dairy agripreneurs play in the sector, they are characterized by low productivity. They are constrained by inadequate quantity and quality of feeds, poor access to breeding technologies, diseases, poor access to credit facilities and poor access to output markets (Richards et al., 2015). A sustainable dairy business intensification is necessary to improve the productivity and income levels of smallholder dairy agripreneurs (Van der Lee et al., 2018; Lukuyu et al., 2019). Such a goal cannot be attained without the greater uptake and utilization of production, animal health and marketing dairy support services that may improve yield and income of smallholder dairy agripreneurs (Wane et al., 2019).

✉ D. Okello
dckokello@gmail.com

P. Okello
patrickowino48@gmail.com

1   Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536, Njoro, Kenya

2   STIHL Marketing E.A. Ltd, P.O. Box, Nairobi 2087-00606, Kenya

Mutenje et al. (2020) emphasized that one of the pathways to increase productivity of smallholder dairy farmers is through access to dairy breeding support, animal health services and improved feed requirements. This includes artificial insemination, usage of high quality forage and hay which could improve the nutritional status of cows and hence improve milk production. Services related to animal health are divided into curative and preventive services. Curative services deal with clinical care for the animals, while preventive services encompass vaccination, disease control and vector control (Bardhan et al., 2015). Mwambi et al. (2018) and Ngeno (2018) also emphasize the need for group marketing support services as a pathway to improve market access and milk prices for smallholder dairy farmers in Kenya.

Chawala et al. (2019) also reported that utilization of production and animal health programmes such as AI, improved feeds and animal health services such as vaccination and deworming programmes could potentially aid dairy agripreneurs increase their productivity. In appreciation of this, efforts have gone towards improving dairy production by increasing provision of these services especially through dairy hubs and cooperatives (Rao et al., 2018). Despite this availability of different production and animal health support services, access and use of these support services remain a problem for dairy agripreneurs in developing countries (Ngeno, 2018; Omondi et al., 2017 and Oloo, 2016).

Most of the existing literature on use of production and animal health services has focused on the following: (1) examining the factors that influence the use and delivery of breeding services and (2) farmers' perceptions towards the use of artificial insemination as a breeding services (Mugisha et al., 2014; Kebebe et al., 2017; Omondi et al., 2017; Mazimpaka et al., 2018; Mwanga et al., 2019; Mutenje et al., 2020). However, the missing component in these studies is dairy agripreneurs' preferences and willingness to pay (WTP) for different attributes of production and animal health support services.

The contribution of this study to the literature is twofold. First, our focus on the WTP for the aforementioned attributes of production and animal health support services expands on the work of Omondi et al. (2017); Rao et al. (2018); Chawala et al., (2019) and Mutenje et al., (2020). The elicitation of WTP for these attributes provides in-depth analysis of dairy agripreneurs' reactions towards utilization of dairy technologies and support services. This is an important topic considering the low uptake of these services among dairy farmers (Omondi et al., 2017). In addition, dairy cooperatives and input providers are taking a major role in strengthening the uptake of dairy technologies among smallholder dairy farmers. Thus, understanding preferences of dairy agripreneurs for bundle of dairy support services

will facilitate effective delivery of these services. Second, by using DCE, this study sheds light on preferences heterogeneity among dairy agripreneurs. Through this experimental design, we quantitatively determined the extent to which dairy agripreneurs value different attributes of production and animal heath support services.

The remainder of the paper is structured as follows. The second section describes the DCE methodology and how it was applied in the study. The third section describes the results and discussions. The fourth section provides a final conclusion and policy implications.

Materials and methods

Study area and data collection procedure

Data were collected in Murang'a County, Kenya, in four sub-counties: Gatanga, Maragwa, Kiharu and Kangema. The study areas were purposively selected since they are the main milk producing sub-counties in the county, while Murang'a County is among the highest milk producing counties in Kenya (Murang'a CIDP, 2018). Hence, the study areas were selected to maximize the number of dairy agripreneurs and presence of production and animal health support services. Figure 1 shows the study sites in the four surveyed sub-counties. Data were collected through cross sectional survey design from 4 January to 14 February 2020. A semi-structured questionnaire was prepared and administered by 12 trained enumerators, who collected data through personal interviews. The interview took an average of 90 min. Information on household demographics, institutional characteristics and choice experiment on agripreneurs' preferences of production and animal health were collected. A total of 682 dairy agripreneurs were interviewed based on proportionate to size of the sub-counties as follows: Gatanga, 278; Maragwa, 195; Kiharu, 143; and Kangema, 66. The collected data was cleaned, edited and coded for data analysis.

Choice of production and animal health attributes and levels

The selection of the attributes used in the choice experiment was based on the domain knowledge and empirical literature (Wongtschowski et al., 2013; Bardhan et al., 2015; Omondi et al., 2017; Rao et al., 2018; Chawala et al., 2019 and Mutenje et al., 2020). In addition, we carried out in-depth interviews with dairy agripreneurs and focus group discussions with key informants who included input providers, consultants in dairy sector, managers of farmer cooperatives and government extension agents, to ensure that production, animal health and

Fig. 1 Map of the study areas: Gatanga, Maragwa, Kiharu and Kangema
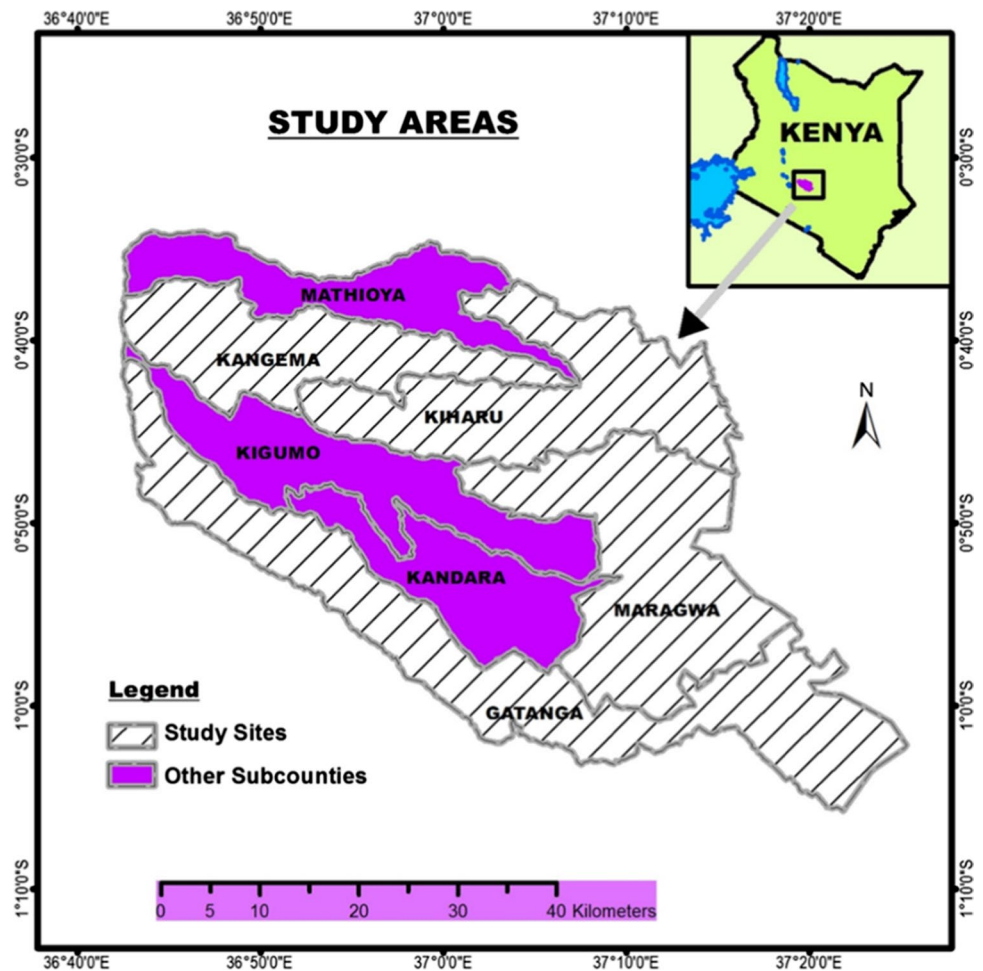
marketing attributes selected were amenable to policy changes in dairy sector. The five attributes considered in this study were group marketing, animal health, business plan training, production support and monthly fee (KES). The dairy support services attributes and their levels are defined in Table 1.

Experimental design

The choice sets for the discrete choice experiment (DCE) were generated using NLOGIT statistical program. This programme aided in generation of D-optimal design that maximized D-efficiency. Through this method, we were able to take

Table 1 Production and animal health attributes and levels

Attributes	Definition	Levels
Group marketing	Dairy agripreneurs engaging in collective marketing of milk	1. Yes 2. No
Animal health	Access to preventive services (vaccination and deworming) and curative (drugs to cure diseases)	1. Preventive 2. Curative
Business plan training	Training in management of resources in agrienterprises	1. Yes 2. No
Production support	Access to services that improve productivity of cows such as improved breeds through AI or improved feeds such as silage and hay	1. AI 2. Improved feeds
Monthly fee (KES)	Amount of money paid in Kenya shillings for utilizing the bundle of ASS	1. 500 2. 1000 3. 1500 4. 2000

into account the orthogonality (attribute levels are independent of each other), level balance (attribute levels appear with the same frequency) and minimal overlap (attributes do not take the same level within a choice set). Twenty-four choice cards were generated and allocated to four profiles so that each dairy agripreneur was assigned one profile of six cards. Each card had different attributes of production and animal health services options and one opt out option.

The choice experiment involved presenting hypothetical choice cards which described attributes of production and animal health services. Each smallholder dairy agripreneurs was asked to evaluate choice alternatives based on the attribute levels and finally select the alternative with the highest utility. Figure 2 presents a sample of choice card used in the discrete choice experiment.

Model specification and data analysis

In order to estimate dairy agripreneurs' general preferences for production and animal health support services, the study used Random Parameter Logit (RPL)/Mixed Logit model. This model has several merits which make its suitable for this study. First, compared to multinomial or conditional logit models, mixed logit is very flexible and it relaxes the restrictive independence of irrelevant alternatives assumption (IIA). Hence, the unobserved variables were allowed to correlate over choice options. Moreover, RPL accounted for unobserved preferences heterogeneity across the dairy agripreneurs so that it was possible to get multiple choice sets from the same respondents with unrestricted substitution patterns. The Mixed Logit model is usually expressed as

$$P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta \tag{1}$$

where $L_{ni}(\beta)$ is the logit probability evaluated at parameters β:

$$L_{ni}(\beta) = \frac{e^{V_{ni}(\beta)}}{\sum_{j=1}^{J} e^{V_{nj}(\beta)}} \tag{2}$$

and $f(\beta)$ is a density function and $V_{ni}(\beta)$ is the observed portion of the utility, which depends on the parameters β. If utility is linear in β, then

$$V_{ni}(\beta) = \beta' x_{ni} \tag{3}$$

In this case, the mixed logit probability takes its usual form:

$$P_{ni} = \int \left(\frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} \right) f(\beta) d\beta \tag{4}$$

The mixed logit probability is a weighted average of the logit formula evaluated at different values of β, with the weights given by the density $f(\beta)$. The weighted average of several functions is called a mixed function, and the density that provides the weights is called the mixing distribution. Mixed logit is a mixture of the logit function evaluated at different β's with $f(\beta)$ as the mixing distribution. Standard logit is a special case where the mixing distribution $f(\beta)$ is degenerated at fixed parameters b: $f(\beta) = 1$ for $\beta = b$ and 0 for $\beta K b$. The choice probability then becomes the simple logit formula:

$$P_{ni} = \frac{e^{b' x_{ni}}}{\sum_j e^{b' x_{ni}}} \tag{5}$$

The mixing distribution $f(\beta)$ can be discrete, with β taking a finite set of distinct values. Suppose β takes M possible values labelled $b_1,...b_M$, with probability S_m that $\beta = b_m$. In this case, the choice probability is

$$P_{ni} = \sum_{m=1}^{M} S_m \left(\frac{e^{b_m x_{ni}}}{\sum_j e^{b_m' x_{nj}}} \right) \tag{6}$$

The above can be interpreted as there are M segments in the population; the share of the population in segment m is s_m, in which the researcher can estimate within the model along with the b's for each segment. Using this model, the price coefficient was assumed fixed using the Wald test of

Fig. 2 An example of a choice card used in the experiment with dairy agripreneurs

Attributes	Option 1	Option 2	Option 3
Group marketing	Group marketing	No group marketing	
Animal health	Preventive	Curative	
Business plan training	Business plan training	No business plan training	I would not purchase any of these plans
Production support	AI services	Improved feeds	
Monthly fee (KES)	2000	1500	
Which option would you choose?	**Plan 1**	**Plan 2**	**None**

Suppose you have a bundle of agribusiness support services provided to you to run your dairy business. Below are three options, each with different attributes. If you were given a choice, which option would you choose?

linearity restrictions. This assumption helped to avoid price dispersion around zero, which implied excessive willingness to pay for production and animal health support services (Train and Weeks 2005; Meijer and Rouwendal 2006).

Results and discussion

Descriptive statistics

Table 2 presents the socio-economic and institutional characteristics of our sample (n = 682). Result on household sex shows that about 70% of the respondents were male, implying that few females are involved in dairy farming. A plausible explanation could be because investment in dairy farming needs productive resources which are mostly owned by male-headed households. Machina and Lubungu (2019) found that male-headed households have higher access to productive resources and information that increases chances of engaging in dairy farming.

The mean age and experience of the respondents were 56 years and 19 years respectively. This finding indicates that most of these farmers were elderly and they had practiced dairy farming for long duration. Households with an older age have control over more resources and more experienced, and this could influence their decision to invest in dairy farming which requires high initial capital outlay (Ngeno, 2018). Youth with the age bracket of 18 to 35 years lack capital to start dairy enterprises which justifies the

reason why majority of dairy farmers were in the middle age (40–60 years). Similar findings of age distributions and experience were revealed by Gitau (2013) whereby majority of the farmers involved in milk production were above the youthful stage (over 35 years of age) and had over 10 years of experience in milk production.

In this study, household size is used both as a proxy for labour endowment, representing a key factor of production, and as a push factor for participating in milk production activities (Kiwanuka and Machethe (2016)). The average household size was 4 persons. Availability of family labour in dairy farming households plays a key role in rural agricultural systems, as noted by Grima and Marco (2013). Most of the household heads completed primary school education. These results indicate low levels of literacy among the respondents despite the fact that access to education could increase the likelihood of dairy farmers utilizing agribusiness support services (Anang et al. (2015)). In relation to land size and tenure system, the mean land size under dairy farming was 1.29 acres, and 61% of the respondents had title deeds. Ownership of land as a production asset plays an important role in household head decision to invest on the agribusiness. This could also influence the decision to access agribusiness support services (Maonga et al., 2017).

In relation to dairy production parameters, 95% of the cattle domesticated by the dairy farmers were improved/exotic. The plausible reason could be the need to improve milk production and commercial nature of the farmers, though they have limited land space; hence, they would consider high

Table 2 Respondents' socio-economic and institutional characteristics

Variables	Description of variables	Mean	Std. dev
Sex	Dummy = 1 if HH head male and 0 if female	0.70	13.7
Age	Age of HH head in years	55.6	1.01
Education level*	Highest education level of household head	3.60	1.33
Household labour	Number of adult household members	3.43	12.9
Experience	Experience in dairy farming in years	18.8	0.49
Land tenure	Dummy = 1 if HH owned land with title deed, 0 otherwise	0.61	1.21
Land size	Size of land under dairy farming in acres	1.29	0.21
Livestock type	Dummy = 1 if HH had improved/exotic, 0 = otherwise	0.95	1.81
Number of cows	Number of cows owned in the household	2.50	15.6
Milk yield	Average milk production per day in litres	14.3	0.47
Access to contracts (yes = 1)	Dummy = 1 if HH had written contracts, 0 otherwise	0.66	6.54
Milk price (KES)	Milk price per litre in KES	33.2	7.92
Distance veterinary clinic (km)	Distance to a veterinary clinic in km	2.79	19.4
Distance output market (km)	Distance to the output market in km	2.12	0.48
Type of road	Dummy = 1 if Tarmac, 0 otherwise	0.36	0.48
Trust buyers of milk	Dummy = 1 if HH had high trust, 0 otherwise	0.65	0.49
Remittance (yes = 1)	Dummy = 1 if HH had access to remittance, 0 otherwise	0.40	0.22

*1 no formal, 2 adult, 3 primary, 4 secondary, 5 college, 6 university

productive cattle to optimally run their agrienterprises. The mean number of cows owned by the household was about 3 cows with per animal average milk production per day that was 14.3 L. This shows that most of these farmers were smallholder and were practicing intensive farming due to limited land. But their milk yield was higher compared to majority of dairy farmers in other parts of Kenya who produce about 5 L of milk per day (Oloo, 2016). The average milk price was KES 33.2 per litre. The price the dairy farmers receive is considerably very low compared to the high cost of production and the price paid for pasteurized milk by consumers of KES 120 per litre.

The mean distance to veterinary clinic and output market was 2.8 km and 2.1 km, while only 36% of the respondents had access to tarmac road. Majority of the dairy farmers (65%) had high trust for their milk buyers, which also corresponds to 66% of the respondents who had access to contracts with buyers. This is plausible because of the high number of cooperatives and milk processing companies in the county (Murang'a County Integrated Development Plan, 2018). Finally, 40% of the respondents received remittance from family members and relatives. This shows that majority

of the respondents had low social network in relation to financial support in running the agrienterprise.

Dairy agripreneurs' preferences for production and animal health attributes

The coefficient estimates of mixed logit are presented in Table 3. All the attributes were significant (at 1% confidence level). Dairy agripreneurs positively value group marketing, curative services and artificial insemination services, while they negatively value business plan training services.

The willingness to pay (WTP) for various production and animal health attributes is reported in Table 4. Willingness to pay is the amount of money dairy agripreneurs are willing to forgo each month in order to utilize a particular attribute of production and animal health services. This is the monetary value that dairy agripreneurs place on the different attributes of dairy support services, and it was derived from the coefficient estimates in Table 3. For group marketing attribute x_j, for example, it is simply the value β_j / β_1 where β_1 is the coefficient on monthly fee for service. Overall, group marketing service had the highest willingness to pay (KES

Table 3 Mixed logit model regression results estimating preferences for production, animal health and marketing attributes

Attributes	Mean effects		Standard deviation	
	Coefficient	SE	Coefficient	SE
Monthly fee for service	0.0018***	(0.0005)	0.0018***	(0.0005)
Group marketing service[a]	15.9133***	(3.2267)	9.9212***	(2.0568)
Business plan training service[b]	-4.3614***	(1.0221)	5.5883***	(1.1765)
Curative service[c]	4.6623***	(1.0178)	3.4416***	(0.8114)
Artificial insemination (AI)[d]	5.0935***	(1.1756)	-3.0470***	(0.7195)
Model fit				
Log Likelihood	-757.602			
Number of dairy agripreneurs	682			
Number of observations	6138			
Wald χ^2	280.40***			

SE standard errors in (parentheses); [a]reference is selling individually; [b]reference is no business plan trainings; [c]reference is preventive service; [d]reference is improved feeds. ***coefficients are significant at 1% level

Table 4 Estimated willingness to pay for various production and animal health attributes

Attributes	Mean (KES)	Std. dev	(95% Conf. interval)
Group marketing service	8797.91***	1465.45	11,670.14 to 5925.69
Business plan training service	-2411.29***	441.33	-1546.31 to -3276.28
Curative service	2577.62***	456.65	3472.63 to 1682.62
Artificial insemination (AI)	2816.01***	480.53	3757.83 to 1874.19
Number of dairy agripreneurs	682		
Number of observations	6138		

(i) Calculations based on coefficient estimates in Table 4.3. (ii) We used the nlcom command in Stata to calculate WTP and 95% confidence intervals; ***Significant at 1% level; *KES* Kenyan Shilling (KES 100 = 1 US$)

8797.91/month) and business plan training service had the least (KES 2411/month) among the respondents. Moreover, dairy agripreneurs were willing to pay KES 2816.01 and KES 2577.62 per month for artificial insemination and curative services respectively.

Discussion

The payment price coefficient was positive and statistically significant (P < 0.01) indicating that smallholder dairy agripreneurs prefer to pay more for production and animal health services, ceteris paribus (Table 3). This is contrary to expectation that a higher fee would reduce the probability of using production and animal health services among smallholder dairy agripreneurs. This finding indicates that cost of service is not a limiting factor in utilization of production, animal health and marketing services. Therefore, dairy agripreneurs were willing to pay any reasonable cost in order to get dairy support services. This underscores the need for service providers to provide quality dairy services which are efficient and effective. These findings are consistent with Mwanga et al. (2019) who reported that farmers were more willing to pay higher cost for AI service. However, it is contrary with those by Omondi et al. (2017), who reported that dairy agripreneurs had higher preference for AI profile that offered lower prices.

With regard to marketing of milk attribute, farmers were asked if they preferred selling their milk in groups such dairy cooperatives or selling individually by finding their own markets such as middlemen, retailers and consumers. Group marketing had the highest positive significant coefficient, indicating that smallholder farmers had higher preferences in selling their milk in groups. The plausible explanation could be because group marketing allows smallholder farmers to manage marketing challenges such as brokers who offer low prices, transportation limitations and managing milk quality. Through a marketing group, the farmers could easily consolidate produce in joint transportation mechanism, avoid brokers and ensure every member of the group adheres to produce standards as reported in previous studies (Mwambi et al., 2018; Kumar et al., 2019).

Dairy agripreneurs preference for group marketing could also be associated with increase in bargaining or negotiation power when it comes to inputs and milk market prices. Through membership to a group, dairy agripreneurs are able to negotiate with buyers for better milk prices (Ngeno, 2018). In addition, through joint marketing, dairy agripreneurs may access and procure farm inputs such as fertilizer, seeds and herbicides in bulk, hence attracting quantity discounts and reducing chances of buying fake inputs (Kumar et al., 2018). It is prudent to note that majority of micro-finance firms mostly target well-organized groups which also easily access

market with assurance of returns (Wossen et al., 2017). Hence, with group marketing, members of such groups can easily access affordable credit facilities which help them to improve their farm enterprises. A similar higher preference for group marketing support services was previously reported in smallholder dairy agripreneurs in India (Kumar et al., 2018) and Kenya (Ngeno, 2018).

The results further reveal that dairy agripreneurs were not willing to acquire business plan training support services. Negative preference towards business plan training support services can be related to lack of entrepreneurial mindset of dairy agripreneurs which makes them not to see the value of this support service. Business plan training is designed to help dairy agripreneurs create a written plan to start, manage or expand their farm business (Makropoulos et al., 2020). The training may make them to view their business on a long-term perspective and embrace innovative farming approaches. Smallholder farmers need to be innovative and forward-looking in managing their businesses as long-term ventures with a view to establishing sustainable agrienterprises (Dias et al., 2018).

Despite the benefits associated with business plan training, we witness farmers not interested in such trainings. Main reason being, for decades, extension service providers have focused on capacity building farmers on only the technical aspects of dairy production with limited attention paid to enhancing the business skills of farmers to facilitate the commercialization of their dairy enterprises. According to Caldwell et al. (2019), the government and NGOs frequently provide agricultural advice to maximize yields, but farmers need advice to maximize profit. This, over emphasis on technical extension services, makes farmers resistant to change, hence making them reluctant to use business plan training. This brings the issue of attitude and mindset which has been a major stumbling block in improving the entrepreneurial behaviour of farmers (Korsgaard et al., 2015).

Another important production and animal health attribute that could influence productive and profitability of dairy agripreneurs is access and uptake of curative and preventive animal health support services. The positive and significant estimate for 'curative service' suggested that dairy agripreneurs preferred curative animal health services over preventive animal health support services. The plausible reason could be due to the higher prevalence of animal diseases in Kenya dairy sector which increases the interest of dairy agripreneurs for curative services over preventive. Some of these diseases include contagious bovine pleuropneumonia, trypanosomosis, brucellosis, mastitis, foot-and-mouth and bovine tuberculosis (Oloo, 2016).

In addition, high cost of vaccination and deworming programmes limits smallholder agripreneurs to utilize preventive support services (Chawala et al., 2019). Majority of farmers are resource constrained, hence they will see no

need of employing preventive measures like vaccination or deworming since they consider that a cost related item and will only act once the animal falls sick. They rather invite the veterinary officer when they realize that the animal situation is beyond their intervention. Some farmers might prefer preventive measures, but the challenge existing is the few numbers of veterinary officers. This makes such farmers to practice wait approach and act once an animal is sick. These results are similar to findings of Wane et al. (2019) who found high cost of vaccination services and low number of veterinary officers that hindered dairy farmers to utilize preventive support services in Tanzania.

In relation to preference to production support services, the coefficient for artificial insemination was positive and highly significant, indicating that dairy agripreneurs preferred 'utilization of AI services' over utilization of improved feeds. Preference for AI service is seen as more suitable option to improve the productivity of smallholder dairy agripreneurs due to genetic improvement of their cows (Mazimpaka et al., 2018). This result is consistent with Omondi et al. (2017) who found that artificial insemination together with progeny testing programmes and the contract mating scheme (bull-dam recruitment schemes) were the main breeding programmes used to improve the dairy herd in Kenya. Further, Lukuyu et al. (2019) assert that farmers have higher preference for AI services due to its ability to increase dairy productivity, reduced calving intervals and improved herd fertility. These results indicate that before smallholder farmers consider utilizing improved feeds such as hay, silage and concentrates, they are more interested in improving the genes of their animals.

Conclusion and policy implications

This paper contributes to the literature on Kenyan dairy agripreneurs' willingness to use production and animal health support services and the price premiums they demand for different attributes of these services for improved dairy farming systems. This research adds to the literature analysing preferences through the utilization of a discrete choice experiment (DCE). The central result of this investigation is that dairy agripreneurs prefer a bundle of agribusiness support services that offers group marketing, curative services and artificial insemination. However, dairy agripreneurs prefer non-utilization of business plan training services in their dairy business.

To motivate dairy agripreneurs to continue using production and animal health services, it is imperative to put in place appropriate strategies that will enhance easier and quicker access to these services. Policy-makers in both government and non-governmental organizations need to develop training programs that suits smallholder dairy

agripreneurs' preference and help them change their attitude and mindset without advocating for forceful need to adopt a certain practice. Farmers need to be empowered and encouraged to be more enterprising which will enhance the uptake of business plan training for sustainable dairy farming intensification. They also will need to work with farmers as colleagues (team approach) on two-way approach but not traditional extension approach which was like compelling farmers to uptake a certain approach in their farmlands. This will encourage farmers to take up technologies such as vaccination services.

The policy-makers should also advocate for practices and programs which gel with the farmer's need and status. Since majority of dairy agripreneurs are smallholders, there should be appropriate policy strategies targeting how to upgrade these farmers through increasing their chain governance and control of activities such as producer cooperatives. Dairy cooperatives have proved to be effective business models that enhance market access and input delivery among smallholder agripreneurs. Thus, there is a need to improve the structure and business model for dairy cooperatives. By strengthening their linkage with private service providers, this will enhance timely and affordable access to production, animal health and marketing services among smallholder dairy agripreneurs.

Declarations

Ethics approval All the procedures that were performed in this study were in accordance with the ethical standards of Egerton University and National Commission For Science, Technology & Innovation.

Conflict of interest The authors declare no competing interests.

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