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REGULAR ARTICLE

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Milk, money, and gender: Exploring the link between women's decision-making in dairy production and welfare investments in boys versus girls

Jessie Lin¹ / Meike Wollni²

¹United States Department of Agriculture, Economic Research Service, Washington, DC, USA

²Department of Agricultural Economics and Rural Development, University of Göttingen, Göttingen, Germany

Correspondence

Meike Wollni, Department of Agricultural Economics, and Rural Development, University of Göttingen, Göttingen, Germany. Email: mwollni1@gwdg.de

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Abstract

Greater women's bargaining power and decision-making within a household have been shown to increase investments in human capital. This study links women's participation in decision-making in dairy production with household investment in girls and boys in health, nutrition, and education. We survey households in the urbanizing region of Bangalore, India. We utilize a multinomial treatment effects model to analyze the individual and household factors that are associated with women's participation in sole or joint decision-making. We then assess how the type of decision-making influences a household's investments. The results first show that female decision-making households are more disadvantaged on average than other types of decision-making households. Second, we observe that female decision-makers for dairy production are more likely to have more children and earn a higher income than their husbands. Third, the main findings show that households in which women engage in joint decision-making have higher levels of investment across all categories for girls. Conversely, investments decrease in education and nutrition for both girls and boys when the wife is the sole decision-maker. Lastly, investments are enhanced further for girls when households can sell milk at a higher price.

KEYWORDS

children's investments, dairy production, decision-making, gender, India

Résumé

Une plus grande capacité de négociation et de prise de décision des femmes au sein d'un ménage a été démontrée comme augmentant les investissements dans le capital humain. Cette étude établit un lien entre la participation des femmes à la prise de décision dans la production laitière et l'investissement du ménage dans la santé, la nutrition et l'éducation des filles et des garçons. Nous enquêtons sur les ménages dans la région en urbanisation de Bangalore,

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en Inde. Nous utilisons un modèle d'effets de traitement multinomial pour analyser les facteurs individuels et familiaux associés à la participation des femmes à la prise de décision seule ou conjointe. Nous évaluons ensuite comment le type de prise de décision influence les investissements du ménage. Les résultats montrent d'abord que les ménages où les femmes prennent les décisions sont en moyenne plus défavorisés que les autres types de ménages décisionnels. Deuxièmement, nous observons que les femmes décisionnaires pour la production laitière ont plus de chances d'avoir plus d'enfants et de gagner un revenu plus élevé que leurs maris. Troisièmement, les principales conclusions montrent que les ménages où les femmes participent à la prise de décision conjointe ont des niveaux d'investissement plus élevés dans toutes les catégories pour les filles. À l'inverse, les investissements diminuent dans l'éducation et la nutrition pour les filles et les garçons lorsque la femme est la seule décisionnaire. Enfin, les investissements sont encore plus élevés pour les filles lorsque les ménages peuvent vendre le lait à un prix plus élevé.

1 | INTRODUCTION

The distribution of household decision-making affects how households allocate resources. Studies show that when women have more bargaining power and greater control over household finances, they tend to direct household resources toward higher investments in human capital, such as education, health, and nutrition (Mishra & Sam, 2016). Furthermore, concentrated resources with women lead to positive benefits for their children (Annan et al., 2021; Doss, 2006; Heckert et al., 2019; Quisumbing & Maluccio, 2003). Higher income, employment, and ownership and control over assets such as land and livestock are factors that bolster women's bargaining power (Doss, 2013; Mishra & Sam, 2016). Women with more control over income and greater bargaining power are expected to affect positively the developmental outcomes of children (Cunningham et al., 2015; Ewerling et al., 2020; World Bank, 2012).

Dairy production plays a prominent role in many small farming households in low-income countries. Livestock and dairy production have been shown to have positive benefits to food security for many low-income countries, since dairy products are an important protein source for children (Hoddinott et al., 2015) and sales of dairy products generate additional income (Ayenew et al., 2011; Godber & Wall, 2014). This paper explores the link between women's and joint decision-making in dairy production and the households' investment in girls versus boys, namely in health, education, and nutrition, in the urbanizing regions surrounding Bangalore, India. We investigate whether decision-making preferences differ between the wife and husband and when they jointly decide. Specifically, we aim to answer the following research questions (RQ):

RQ 1. What are the individual and household factors associated with women's individual or joint decision-making in dairy production?

RQ 2. How does the gender of the dairy decision-maker influence household investments in health, education, and nutrition for girls and boys?

The participation of women in decision-making has been widely studied in the areas of land ownership, land rights, agricultural management systems, production diversity, natural resource management, and women's empowerment (Bernard et al., 2020; Connors et al., 2023; Doss, 2013, 1996; Doss & Meinzen-Dick, 2015; Lambrechet et al., 2023; Sraboni et al., 2014). The literature has also addressed the various determinants of women's decision-making in smallholder farming households (Sell & Minot, 2018) and how their increased bargaining power and empowerment lead to increased benefits for children (Annan et al., 2021; Menon et al., 2014).

Malhotra and Schuler (2005) discuss how context is an important aspect when assessing the various aspects of women's empowerment at a household level. We are interested in decision-making in dairy production as dairy farming is an

important occupation and generates income sources for the population in the urbanizing region surrounding Bangalore. The Karnataka Cooperative Milk Producers' Federation Limited (KMF) is the second largest dairy cooperative in India and plays a role in providing employment in this region (KMF, n.d.). For smallholder farmers, dairy production provides a more consistent source of income than crop production (Njuki et al., 2016). For instance, in Tanzania, dairy income increased food expenditures in low-income households (Kidoido & Korir, 2015), which could translate into an increased ability to invest in children's education and health and hence improve their welfare status. In Bangladesh, household dairy production is associated with increases in the height for age *Z* scores of children (Choudhury & Headey, 2018). Peri-urban and urban dairy production in Ethiopia has been found to enhance the food security status of the population, increase the incomes of farm families, and create jobs for the unemployed (Ayenew et al., 2011). Similarly, in the State of Andhra Pradesh, India, incomes for milk-producing households were shown to be on average around 30% higher than the incomes of households that do not produce milk (Squicciarini et al., 2017).

We contribute to the literature by looking at the link between women's decision-making role and how it relates to the income-generation effects of dairy production. Female decision makers and household heads are more likely to come from poorer households (Chudgar, 2011) due to a higher child dependency ratio, lower income, and fewer years of education (Flato et al., 2017). At the same time, children may attain higher education outcomes as female-headed households tend to invest scarce resources in children (Buvinic & Gupta, 1997; Handa, 1996; Lloyd & Blanc, 1996).

We specifically address the difference between investments in boys versus girls, as past research documents the presence of a preference in India for sons over daughters (Clark, 2000; Mitra, 2015). Studies show that, in India, there are unequal investments between sons and daughters in terms of time and quality of child care and health care, vaccination rates, and vitamin and food supplements (Barcellos et al., 2014; Bose, 2011; Fikree & Pasha, 2004; Grabowski & Self, 2013). At the same time, Thomas (1994) shows that in the United States, Brazil, and Ghana, mothers tend to direct more resources to their daughters and fathers are more likely to allocate resources toward their sons.

India has one of the widest gaps in gender-specific mortality rates (Duflo, 2012); for example, girls are twice as likely to die from diarrhea as boys (Khanna et al., 2003). Beaman et al. (2012) find that in West Bengal, parents' desire for boys to graduate from secondary school or college is 14 percentage points higher than for girls. Another study finds that households are more cautious about using costly means to pay for inpatient health care expenses for girls than boys (Asfaw et al., 2010). This preference in favor of boys over girls is further exacerbated in households that face tighter budget constraints. Grabowski and Self (2013) find that increased levels of mothers' autonomy can reduce this type of bias.

Our study utilizes socioeconomic survey data collected from a sample of 421 households in the urbanizing surroundings of Bangalore, India. To answer our RQs, we employ multinomial endogenous treatment effect models to account for observable and unobservable characteristics and to allow for the distribution of the treatment (decision-making) and the outcomes (investments) to be determined by a latent factor form (Deb & Trivedi, 2006; Manda et al., 2016).

Our main findings first show that households in which wives are the sole decision-makers in dairy production are on average more disadvantaged than the other two types of decision-making households (households with husband as sole decision-maker and households with joint decision-making). Further results confirm this phenomenon, showing that joint decision-making in dairy production is associated with higher investments in girls and no clear effects on boys, suggesting that when couples decide jointly, the inequalities between sons' and daughters' investments are eased. These effects are enhanced when households sell milk at a higher price.

This paper is organized as follows. We provide background information on the dairy sector in India and in the State of Karnataka in Section 2. Section 3 describes the data and empirical specification. Results are presented in Section 4. Section 5 discusses the main findings and policy implications. Finally, Section 6 concludes.

2 | BACKGROUND

India is both the world's largest producer and consumer of milk (U.S. Department of Agriculture, Foreign Agricultural Service, 2021). The dairy sector accounts for an estimated 20% of the value of India's agricultural production, and around 70% of India's rural population takes part in some form of milk production (Cunningham, 2009). In addition, dairy production is an important source of employment and income for India's small-scale farmers and rural households (Cunningham, 2009; Squicciarini et al., 2017). Household expenditures on dairy products have been on the rise in both urban and rural parts of India (Ohlan, 2016). The State of Karnataka ranks sixth in the country for milk production and third in terms of production under the cooperative scheme (National Dairy Development Board of India, 2015). Karnataka's dairy production has been on an upward trend during most of the 21st century—from almost 4 million tons in 2004 to around 9 million tons by 2020 (Figure 1). Dairy ownership and production are prevalent in the urbanizing transects of Bangalore,



FIGURE 1 Milk Production in Karnataka. Source: National Dairy Development Board of India.

where cows are kept in both urban and rural areas. The demand for dairy products is high and is supplied mainly by small family farms in peri-urban and urban areas (Reichenbach et al., 2021). The proliferation of dairy production provides employment opportunities, especially for women (Ohlan, 2016).

The State Government of Karnataka started its dairy development program in 1974 through the "Operation Flood" model that was launched by the Indian Government in 1970 in order to link rural dairy producers to urban consumers through dairy cooperatives, processing plants, and distribution centers (FAO; GDP; IFCN, 2018). Through this initiative, the Karnataka Milk Federation (KMF) cooperative was established (Alderman, 1987). The KMF continues to have a prominent role as a provider of inputs and services and as the main marketing outlet for dairy producers in rural areas (Dohmwirth & Liu, 2020). The value-added dairy consumption is expected to further increase in the coming years due to factors such as increasing urbanization, rising household incomes, and demographic shifts (U.S. Department of Agriculture, Foreign Agricultural Service, 2021).

2.1 | Decision-making in dairy production and children's investment

The discourse and concept of women's empowerment has been a hotly contested topic and has evolved in the last several decades (Calvès, 2009). The degree of female participation in household decision-making is one aspect of empowerment (Alkire et al., 2013). In our study, rather than looking at decision-making power of women as a measure of empowerment, we focus on its effect on an outcome, the investments in children, which can inevitably lead to improvements in important developmental aspects (Anderson et al., 2017).

Decision-making often relates to a household's headship and structure. In India, female-headed households are rare. According to the World Bank's World Development Indicators, only 17.5% of India's households in 2021 were female-headed.¹ Women are usually household heads due to circumstances (death of spouse, divorced, separated, or never married) rather than by choice (Chudgar, 2011). Female-headed households tend to be more socioeconomically vulnerable than male-headed households, as women tend to earn less income than men, have higher child dependency ratios, and obtain fewer years of education (Flatø et al., 2017). Other cultural factors may limit the ability of women to participate in labor force (Kabeer, 1991). For instance, Gebre et al. (2021) find that in Ethiopia, households where decisions are made by females or jointly, the incident of food insecurity is higher than in male decision-making households; these differences can be attributed to the lower availability of resources in female and joint decision-making households.

At the same time, studies also show that, when women are in control of household income, they tend to spend more on children's investment, such as food, health, and education (Caiumi & Perali, 2015; Duflo & Udry, 2004). Similarly, children may attain higher education outcomes in female-headed households, since female heads tend to invest scarce resources in children (Bose-Duker et al., 2021; Buvinic & Gupta, 1997; Handa, 1996; Lloyd & Blanc, 1996).

¹ In our sample, 22.6% of households are female headed (Table A1).

In the literature, households are often treated as a single economic actor. However, the decisions are usually negotiated between household members and subject to intrahousehold dynamics (Agarwal, 1997). Any type of decision-making in agricultural production involves either individual and/or joint decision-making (Alkire et al., 2013). When women are engaged in decision-making, either solely or jointly, they are likely to have better access and control over household resources and increased bargaining power, potentially changing power relations and gender norms. Thus, women's engagement in household decision-making could influence the households' investments in human capital, notably health, nutrition, and education (Anderson & Eswaran, 2009; Doss, 2006; Menon et al., 2014; Wiig, 2013).

The household's decisions on how much to invest in children's human capital depend on several factors. Intrahousehold models often assess these decisions based on the assumption that household members seek to maximize the returns on their investments. Societies with male preference tend to make investment decisions based on the assumption that returns to boys will be higher than girls (Pasqua, 2005). Such gender preferences will especially affect investment decisions in resource scarce households. We investigate whether women's participation in decision-making will ease the supposed inequalities of investments between boys and girls and whether extra income from higher milk prices in female decision-making households could ease the gaps in children's investments.

Intrahousehold gender dynamics play an important role in how the household produce and consume dairy products (Njuki et al., 2016). Women are typically involved in the management and care of small-scale dairy production and are perceived to direct resources toward enhancing nutrition for the household (Hoddinott et al., 2015). Women's decision-making power in dairy production gives them access to income generated from dairy production. The type of decision-making is expected to influence dairy production, marketing, and sales. Participation in a dairy training program and in the household's pricing decisions for its milk output can further enhance the investments in children's welfare through increased capital accumulation and income generation (Kidoido & Korir, 2015; Leroy & Frongillo, 2007). Given that dairy production plays an important role for small-scale farmers and households in India, we expect female's participation in dairy related decision-making to influence investments in children.

3 | METHODOLOGY

3.1 | Data collection

The analysis in this paper is based on 421 dairy households, which are a subset of 1,275 households that were surveyed in the urbanizing surroundings of the Bangalore conglomerate from December 2016 to May 2017. The survey instrument was split into two sections. The first section elicited socioeconomic and demographic information and was administered to the household head. The second section included questions on investments in children and was asked to the main caretaker of the household.

The survey was carried out along two transects (Figure 2), reaching from rural villages to urban neighborhoods of Bangalore to cover places with different intensities of urbanization. The Northern transect has a span of 5 km in width and 50 km in length; the Southern transect has a total area of about 300 square km. To ensure that the sampled households are evenly distributed across the gradient of urbanization, their selection was based on a survey stratification index (SSI) as introduced by Hoffmann et al. (2017). The SSI went from a stratum of 1 = urban to 6 = rural depending on the density of the settlement and its distance to the center of Bangalore as a proxy for its level of urbanization (Hoffman et al., 2017). To this end, each transect was first divided into three strata. Strata 1 and 2 were classified as "urban", strata 3 and 4 as "peri-urban", and strata 5 and 6 as "rural". Ten villages² were then randomly selected within each of the six strata, resulting in a total of sixty villages. In the second step, around 21 households were randomly chosen in each village, leading to a total sample of 1275 households, some of which are agricultural. Agricultural management differs notably between the Northern and Southern transects. In the former, farm households engage in more agricultural intensification (i.e., modern input and machinery use [Steinhübel & von Cramon-Taubadel, 2021]), whereas in the Southern transect, off-farm employment is more widespread, in part facilitated by the main road that runs through the transect.

In this analysis, we focus only on households engaged in dairy production, which applies to 78% of the sample. Furthermore, as we are interested in the links between decision-making in dairy production and investments in children, our analysis includes only those households that have children. As a result, the sample size is reduced to 421 households. Survey questions on decision-making in dairy production refer to cattle management for milk production. Questions

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² The term village refers to either rural villages or urban neighborhoods. For simplification purposes, we utilize the term "village" throughout the paper.



FIGURE 2 Study area of Bangalore and its surrounding regions. *Note:* The two transects are marked with dotted black lines, and the circles represent the secondary towns.

were asked to the household head on who decides on how money is spent in the dairy business as a whole. The possible responses being (1) Wife, (2) Husband, and (3) Jointly. The outcome variables of our analysis are per capita expenditure in boys' and girls' education, nutrition, and health. Questions were asked to the main caregiver regarding the average investment by the wife, husband, or jointly in either the girls' and/or boys' education, nutrition, and health. The variables are then constructed by summing up the total investment of the household in each of the respective categories divided by the number of boys and girls separately in the household. Descriptive statistics for the key variables are presented in Table 1 in the results section.

3.2 | Empirical specification

We assess how the within-household allocation of decision-making in dairy production affects investments into boys and girls. Endogeneity may arise when unobservable aspects that determine a household's decision-making type are correlated with investment outcomes. To address these matters, we adopt a multinomial endogenous treatment effects model, following Deb and Trivedi (2006). We categorize households into three decision-making types (treatment) and compare the investment outcomes of *female* and *joint* decision-making with *male* decision-making. The model is specified such that the latent factor structures accounts for idiosyncratic effects of the treatment on outcomes, allowing us to reduce potential biases resulting from selection on unobservable characteristics (Deb & Trivedi, 2006).

TABLE 1 Summary statics of households by decision-making type.

	(1) Wife decisio 52)	on HHs (N =	(2) Husband de (N = 173)	cision HHs	(3) Joint decisio 122)	on HHs (N =
Variable	Mean	SD	Mean	SD	Mean	SD
Household size	4.37	2.02	4.81	1.68	5.22	2.44
Age of household head	37.79	12.33	34.7	9.84	35.08	9.53
Male household head	0.5	0.51	0.94	0.24	0.86	0.35
Number of children	3.62	1.82	3.19	1.83	3.34	1.93
Number of adults	3.58	1.43	3.8	1.34	4.23	1.88
Women education	5.09	4.25	6.14	4.38	5.95	4.25
Husband education	4.94	4.44	6.53	4.22	6.59	4.62
Sold crops	0.17	0.38	0.3	0.46	0.36	0.48
Number of owned plots	2.12	0.9	2.63	1.36	2.57	1.21
Off-farm occupation	0.13	0.2	0.13	0.17	0.14	0.19
Literacy rate	0.63	0.28	0.75	0.23	0.74	0.28
Time to dairy processor	8.59	6.62	9.96	11.62	12.51	31.03
Time to market (min)	37.96	30.38	84.65	273.14	50.6	163.49
Value of assets	225071.37	434102.28	265584.19	481995.13	287473.61	587198.35
Milk price (INR)	26.221	3.367	24.85	5.35	25.132	6.697
KMF member	0.731	0.448	0.66	0.48	0.631	0.484
Dairy training	0.173	0.382	0.19	0.39	0.262	0.442

Note: Male household head is the proportion of households that have a male household head; education refers to the highest number of years for women in the household; literacy rate is to the proportion of household members that are literate; time to markets refers to the nearest food market; off farm occupation is the proportion of households that engage in off farm employment in the respective decision categories.

We let EV_{ij}^* denote the indirect utility that households would attain by selecting the *j*th (*j* = 0, 1, 2) treatment such that:

$$EV_{ij}^* = \mathbf{z}_i' \alpha_j + \delta_j l_{ij} + \eta_{ij}, \tag{1}$$

where z_i is a set of exogenous variables with related parameters α_j . l_{ij} is the latent factor that embodies the unobservable characteristics of household *i*'s decision-making type and outcome, and η_{ij} is the error term that is uncorrelated with l_i .

Without losing generality, we let j = 0 to represent the control category and $EV_{ij}^* = 0$. As EV_{ij}^* is not observed, we let d_i represent a set of binary variables ($d_i = d_{i1}, d_{i2}, d_{i3}$) that is observed for each treatment choice. The probability of the treatment can be written as follows:

$$\Pr\left(d_{i}|\boldsymbol{z}_{i},l_{i}\right) = \boldsymbol{g}\left(\boldsymbol{z}'_{i}\alpha_{1} + \delta_{1}l_{i1}, \boldsymbol{z}'_{i}\alpha_{2} + \delta_{2}l_{i2}, \dots, \boldsymbol{z}'_{i}\alpha_{J} + \delta_{J}l_{iJ}\right)$$
(2)

Following Deb and Trivedi (2006), we assume that g has a mixed multinomial logit structure which can be estimated as:

$$\Pr\left(d_i | \boldsymbol{z}_i, l_{ij}\right) = \frac{\exp\left(\boldsymbol{z}_i' \alpha_j + \delta_j l_{ij}\right)}{1 + \sum_{k=1}^{J} \exp\left(\boldsymbol{z}_i' \alpha_k + \delta_k l_{ik}\right)}$$
(3)

In the second stage, the outcome equation for the three types of investment expenditures for household *i* is expressed as follows:

$$E(y_i|\boldsymbol{d}_i, \boldsymbol{x}_i, \boldsymbol{l}_i) = \boldsymbol{x}_i'\boldsymbol{\beta} + \sum_{j=1}^J \gamma_j \boldsymbol{d}_{ij} + \sum_{j=1}^J \lambda_j \boldsymbol{l}_{ij}, \qquad (4)$$

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TABLE 2 Average households	' investments by decision-making	g type.	
Per capita investments (INR)	Wife decision HHs ($N = 52$)	Husband decision HHs ($N = 172$)	Joint decision HHs ($N = 121$)
Boy education	2814.14	10371.77	12186.88
Girl education	2442.72	5991.21	8050.85
Boy nutrition	1254.76	1825.83	2121.67
Girl nutrition	1218.38	1349.6	1616.61
Boy health	3145.4	1519.72	1406.3
Girl health	1053.73	1149.51	1446.2

Note: The units for investments are in Indian rupees. The reference period for the investments is in the year prior to the questionnaire being asked.

where d_i is the observed decision-making type in household *i*, x_i stands for the exogenous covariates within parameters β and γ_i , denoting the effects of the treatment relative to the reference. $E(y_i)$ denotes the function of the latent variables l_{ii} when the outcome variables (investments) are associated with the unobservable influences that also affect the selection into the treatment. λ_i is the factor-loading parameter to be estimated on how the unobserved factors account for the observables. Instead of having our identification rely on a nonlinear functional form, we include variables that represent female individual characteristics in z_i that do not enter x_i as exclusion restrictions or instruments for a more robust identification (Deb & Trivedi, 2006; Kim et al., 2019). We assume that the continuous outcome variables are normally distributed. The model is estimated with a maximum simulated likelihood method approach.

RESULTS 4

4.1 Summary statistics by household decision-making type

We first present the summary statistics according to decision-making household types, shown in Table 1^3 . Column 1 shows the statistics for households with a female decision-maker in dairy production, followed by Columns 2 and 3 for male and joint decision-making, respectively. On average, households with a female decision-maker have lower levels of education, are less likely to sell crops, own fewer plots of land, are less literate, and have fewer assets in value terms. At the same time, these households have, on average, a lesser distance to the nearest market and a higher percentage of these households are members of the KMF. And their sales price of milk is on average around INR 1.50 higher per liter. Even though households with a female decision-maker are more likely to be members of the KMF, the other two types of households have higher participation rates in dairy training programs.

Table 2⁴ presents the per capita investments in the past year in the same respective types of households. The female decision-making households spent on average around INR 7500 less on boys' education, while their spending on health investments were on average INR 1625 more than households with a male decision-maker. Compared to households with a male decision-maker, households with joint decision-making in dairy spend on average more on all types of investments except for boys' health. Overall, each type of household on average invested more in boys than in girls.

4.2 **Results: Determinants of decision-making**

We next present the parameter estimates of the first stage multinomial logistic analysis in Table 3. Columns 1-6 show the determinants of having a female sole decision-maker with male decision-making as the base category, and Columns 7-12 show the determinants of a woman being involved in joint decision-making again with male decision-making as the base category. The results show some differences in the factors that are associated with female decision-making as opposed to joint decision-making. A woman is more likely to be the sole decision-maker in dairy production when there is a female household head, when she has more children, and when she earns more than her husband. Her chances decrease when her husband is more educated and when the household earns off-farm income. The factors associated with joint decision-making are when a household sells crops, when a household participates in a dairy training program,

³ Summary statistics for the full sample and household head splits are presented in Tables A1 and A2.

⁴ Summary statistics for investment types by dairy versus non-dairy households are presented in Table A3.

IABLE 3 MUUNOMIAL	ogistic estima	ales of the dete	rminants of 6	lecision-makii	ng (relauve io	o une male ca	ategory <i>)</i> .					
	(1) Girls	(2)	(3)	(4)	(5)	(9)	(7) Bovs	(8)	(6)	(10)	(11)	(12)
	Education		Nutrition		Health		Education		Nutrition		Health	
Variables	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint
Household covariates												
Gender of HH head	-3.561***	-2.470***	-2.881***	-2.947***	-3.270***	-2.214***	-1.988***	-1.152^{**}	-2.649***	-2.325***	-3.080^{***}	-1.365^{***}
	(0.834)	(0.596)	(0.617)	(0.652)	(0.555)	(0.518)	(0.626)	(0.465)	(0.859)	(0.667)	(0.596)	(0.494)
Age of HH head	0.009	0.002	0.012	0.004	0.003	-0.001	0.011	-0.009	-0.005	-0.008	-0.003	-0.010
	(0.010)	(600.0)	(0.010)	(600.0)	(0.010)	(0.007)	(0.012)	(0.007)	(0.013)	(0.007)	(0.012)	(0.007)
KMF	0.442	-0.618	0.555	-0.385	1.158^{**}	-0.474	0.700	-0.496^{*}	2.177^{***}	-0.254	1.153^{**}	-0.415
	(0.514)	(0.386)	(0.518)	(0.400)	(0.561)	(0.325)	(0.548)	(0.299)	(0.826)	(0.301)	(0.565)	(0.327)
Off farm income	1.778^{*}	1.095	1.422	-1.774	1.634^{**}	-0.019	-0.183	-0.028	-2.469***	-0.501	-1.555^{**}	-0.159
	(0.987)	(0.830)	(006.0)	(1.425)	(0.740)	(0.749)	(0.535)	(0.334)	(0.846)	(0.371)	(0.754)	(0.338)
Sold crops	-0.062	2.162***	1.443**	2.638***	0.213	1.771^{***}	-0.227	1.127^{***}	0.197	0.484	-0.130	0.833***
	(0.574)	(0.380)	(0.705)	(0.511)	(0.543)	(0.352)	(0.563)	(0.316)	(0.581)	(0.306)	(0.538)	(0.319)
Dairy training program	-0.126	1.349^{***}	-2.180^{**}	0.465	-1.199^{**}	1.009^{***}	0.869^{*}	0.765**	0.364	0.907***	0.959**	0.882***
	(0.594)	(0.406)	(0.950)	(0.434)	(0.581)	(0.348)	(0.480)	(0.322)	(0.495)	(0.320)	(0.460)	(0.317)
# of Children	0.279***	0.018	0.208**	0.152*	0.218***	0.054	0.303***	0.094	0.664***	0.208***	0.344^{***}	0.049
	(0.095)	(0.094)	(660.0)	(0.081)	(0.077)	(0.075)	(0.111)	(0.083)	(0.169)	(0.080)	(0.120)	(0.088)
Household assets in value	-0.002	-0.241^{*}	-0.244	0.009	-0.012	-0.215^{*}	-0.333^{*}	-0.102	-0.846^{***}	0.167	-0.334^{*}	0.084
	(0.249)	(0.140)	(0.200)	(0.143)	(0.166)	(0.116)	(0.199)	(0.117)	(0.283)	(0.151)	(0.194)	(0.132)
Southern transect	-0.592	-0.370	-0.276	-1.605^{***}	-0.993**	-1.205***	-0.047	-0.559*	-0.401	-0.850***	-0.803	-0.640^{**}
	(0.425)	(0.349)	(0.425)	(0.420)	(0.394)	(0.310)	(0.496)	(0.291)	(0.546)	(0.309)	(0.588)	(0.304)
Individual covariates												
Age of husband	-0.039*	0.029*	-0.059	0.008	-0.020	0.015	-0.006	0.012	-0.027	-0.008	-0.007	0.002
	(0.021)	(0.017)	(0.038)	(0.025)	(0.017)	(0.014)	(0.024)	(0.015)	(0.039)	(0.023)	(0.025)	(0.016)
Women's education	-0.005	-0.077	-0.103	-0.112	0.052	-0.049	0.004	0.001	0.042	-0.119^{**}	-0.004	-0.038
	(0.057)	(0.050)	(0.065)	(0.074)	(0.052)	(0.046)	(0.072)	(0.048)	(0.088)	(0.050)	(0.078)	(0.044)
Husband's education	-0.214***	0.127**	-0.118**	0.222^{***}	-0.154^{***}	0.183^{***}	-0.218^{***}	0.047	-0.146^{**}	0.019	-0.166^{**}	-0.045
	(0.056)	(0.054)	(0.054)	(0.050)	(0.054)	(0.044)	(0.064)	(0.042)	(0.066)	(0.046)	(0.071)	(0.046)
Age at marriage	0.095	0.351^{***}	0.190	0.244	-0.148	-0.069	0.271	0.157	0.627	0.262^{**}	0.163	0.064
	(0.172)	(0.129)	(0.228)	(0.200)	(0.186)	(0.147)	(0.217)	(0.107)	(0.389)	(0.121)	(0.193)	(0.120)
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	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)	(10)	(11)	(12)
	Girls						Boys					
	Education		Nutrition		Health		Education		Nutrition		Health	
Variables	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint	Wife	Joint
Age first child	0.141	-0.275**	-0.233	-0.267	0.332^{*}	0.047	-0.206	-0.119	-0.635	-0.175	0.021	0.004
	(0.168)	(0.124)	(0.237)	(0.200)	(0.191)	(0.143)	(0.229)	(0.106)	(0.438)	(0.128)	(0.198)	(0.124)
If wife earns more	1.339**	-0.091	1.865***	1.437**	1.904^{***}	0.656	0.346	-0.545	1.708^{***}	0.092	0.492	-0.125
	(0.521)	(0.665)	(0.503)	(0.650)	(0.551)	(0.446)	(0.506)	(0.364)	(0.651)	(0.416)	(0.584)	(0.324)
Time to market	-0.004	-0.003	-0.001	-0.011^{*}	-0.008	-0.004	-0.002^{**}	-0.005	-0.001	-0.005	-0.002	-0.010^{**}
	(0.003)	(0.003)	(0.001)	(0.006)	(0.008)	(0.004)	(0.001)	(0.003)	(0.001)	(0.003)	(0.002)	(0.004)
Constant	-1.611	1.554	7.141***	1.474	-2.851	2.541	2.372	0.962	9.162**	-0.329	0.754	-0.233
	(2.578)	(2.172)	(2.615)	(2.432)	(2.403)	(1.742)	(2.496)	(1.909)	(4.372)	(2.168)	(2.355)	(1.875)
Observations	333	333	300	300	355	355	374	374	340	340	373	373
Vote: Reference category is	"male decision-	-making". Robus	t standard errors	in parentheses.								

Abbreviation: KMF, The Karnataka Cooperative Milk Producers' Federation Limited. *** p < .05, * p < .01, ** p < .05, * p < .1.

TABLE 4 Multinomial endogenous treatment effect estimates of decision-making on girls' and boys' investments.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Boys' Edu	Boys' nutrition	Boys' health	Girls' Edu	Girls' nutrition	Girls' health
Wife decision making	-1.521***	-0.497***	0.041	-0.649**	-0.597***	0.898***
	(0.080)	(0.062)	(0.328)	(0.264)	(0.046)	(0.027)
Joint decision making	-0.879***	0.903***	-0.960***	0.779**	0.890***	1.228***
	(0.045)	(0.033)	(0.209)	(0.362)	(0.017)	(0.022)
Male headed household	-0.438***	0.608***	0.160	-0.226	0.618***	0.659***
	(0.042)	(0.053)	(0.277)	(0.178)	(0.023)	(0.013)
Dairy training program	0.568***	-0.043	0.213	0.291*	-0.147***	0.652***
	(0.017)	(0.052)	(0.152)	(0.171)	(0.019)	(0.016)
Avg. milk price in 2016	0.007***	0.027***	0.006	0.037***	0.028***	0.040***
	(0.001)	(0.002)	(0.011)	(0.010)	(0.002)	(0.001)
Education	0.167***	0.011**	-0.025	0.106***	0.057***	0.007***
	(0.004)	(0.005)	(0.019)	(0.027)	(0.007)	(0.002)
# of Boys or Girls	-0.341***	-0.363***	-0.329***	-0.212***	-0.133***	-0.084***
	(0.009)	(0.011)	(0.044)	(0.035)	(0.009)	(0.006)
Assets in value	0.071***	-0.333*	0.150*	0.090	0.147***	0.041***
	(0.012)	(0.199)	(0.084)	(0.055)	(0.017)	(0.005)
Sold crops	0.247***	-0.382***	0.175	-0.197	-0.769***	-0.651***
	(0.036)	(0.086)	(0.180)	(0.208)	(0.040)	(0.019)
Off farm income	0.247***	0.199	0.175	0.419	-0.415***	-0.098***
	(0.036)	(0.124)	(0.180)	(0.393)	(0.048)	(0.021)
KMF	0.215***	-0.623***	-0.242*	0.033	-0.356***	-0.415***
	(0.020)	(0.022)	(0.137)	(0.162)	(0.050)	(0.020)
Southern transect	0.405***	-0.589***	-0.319**	-0.379**	-1.132***	-0.209***
	(0.029)	(0.049)	(0.153)	(0.152)	(0.029)	(0.013)
Constant	7.775***	7.179***	6.839***	6.513***	4.958***	5.131***
	(0.142)	(0.112)	(1.319)	(0.680)	(0.077)	(0.081)
Observations	340	374	373	300	333	355

Note: Reference category is "male decision-making". The dependent variables are reported investments in girls and boys per household per year in INR. Household assets are reported in logs. Robust standard errors in parentheses.

Abbreviation: KMF, The Karnataka Cooperative Milk Producers' Federation Limited.

***p < .01, ** p < .05, * p < .1.

and when the husband is more educated. Notably, a woman's education does not appear to play a role in her participation in decision-making.

4.3 | Results: Decision-making on children's investments

Table 4 presents the results from the second stage endogenous treatment effects model for female decision-making and joint decision-making in comparison to male decision-making, respectively. Columns 1–3 report results for boys' education, nutrition, and health investments. Columns 4–6 present results for the three investment categories for girls. The findings show that female decision-making is associated with lower investments in both boys' and girls' education and nutrition, with the largest effect on boys' education. In contrast, when the decisions in dairy production are made jointly, investments in all three categories for girls increase. The association between joint decision-making and investment in boys is mixed: we find a negative association with investments in boys' education and health and a positive association for boys' nutrition.

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The variables associated with household dairy production also yield mixed results. First, all three types of investments increase for girls when households sell milk at a higher price. Second, there is no clear relationship between participation in a dairy training program and investments in children. Lastly, when a household is a member of the cooperative KMF, the relationship with investments is mostly negative for both boys and girls.

Regarding socioeconomic variables, we find education, the number of children, other income-generating activities, and regional effects to be significant. Education, as defined by the maximum years of education obtained by a household member, is associated with an increase in almost all categories of investments, with the largest effect sizes in boys' and girls' education. The number of children within a household decreases expenditure per capita. This is plausible since more children are competing for the same amount of household resources. Here, the magnitudes are larger for boys in all three categories compared to girls. Families that sell crops or have off-farm income are associated with a decrease in nutrition and health investments in boys and girls. We additionally observe that households in the Southern transect appear to invest less in children on average than their Northern counterparts, apart from boys' education.

5 | DISCUSSION

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The findings of this study give insights into the interrelations of decision-making and dairy production and how they influence education, nutrition, and health investments in daughters and sons. We first assess which factors influence women's participation in decision-making, and whether investments increase or decrease when women take part in sole or joint decision making.

We show that female decision-making households are often characterized by structural disadvantages such as lower years of educational attainment for both the wife and husband, fewer owned plots, and fewer assets in value terms. In line with this, we find lower investments in female decision-making households compared to the other two decision-making types of households. This finding is consistent with research by Gebre et al. (2021), where female decision-making households tend to be more food insecure compared to male and joint decision-making households. Girls, on average, receive lower investments in almost all categories regardless of the household's decision-making type. This result hints at similarities to the findings of Dercon and Singh (2013) that there is an "institutionalized" gender bias in favor of boys in education in India.

Second, our findings show that different attributes determine whether women engage in sole or joint decision-making. A woman is more likely to be the sole decision-maker when she earns more income than her husband, and when there are more children in the household. Factors that are positively associated with women's involvement in joint decision-making are more likely to be household factors, that is, when households sell crops and participate in dairy training programs. Interestingly, the more educated the husband, the more likely a female participates in joint decision-making. The opposite is true for sole decision-making. Contrary to the findings of Dohmwirth and Liu (2020), we do not find any statistically significant relationship between being a member of the cooperative and the type of decision-making.

One aspect to keep in mind is that in our survey, decision-making is reported by the household head, which is most cases, male. Many studies find that there are discrepancies in the reporting and perceptions of decision-making (Acosta et al., 2020; Alwang et al., 2017; Ambler et al., 2017; Twyman et al., 2015). For instance, men were more likely to report themselves as the sole decision-maker, while women reported being in joint decision-making more often (Acosta et al., 2020; Ambler et al., 2017).

The parameters in our outcome variables show that there are notable differences in investments between women as the sole decision-maker and when she makes decisions jointly with her husband. Female decision-making is associated with mostly decreasing investments in both boys and girls; the exception being girls' health. When decisions are made jointly, investments across all categories for girls increase. These differences could be partly explained by the higher levels of education, higher asset values, and literacy rates of joint decision-making households than those with the wife as the individual decision-maker, as observed in Table 1. We can further speculate that making decisions jointly may enhance women's confidence in communicating and bargaining with their male counterparts (Humphries et al., 2012). We further find evidence that investments in girls under joint decision-making schemes and in response to higher milk price sales experience larger increases than those in boys.

Households with a female decision-maker are more likely to be a member of the KMF cooperative. However, being a KMF member does not show any positive influences on children's investments except for boys' education. A possible explanation is that women are often disadvantaged in terms of access to assets and are less likely to receive extension services, which could limit their ability to influence investment outcomes (IFPRI, 2013).

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Our findings exhibit similarities with past studies that show that dairy production and milk sales have a positive influence on welfare outcomes through the channel of additional income (Ayenew et al., 2011; Godber & Wall, 2014).

Although the survey data used in our analysis does not include information on the extent of own milk consumption, we can speculate that own consumption of milk products can enable households to make other types of investments. The summary statistics in Table 1 illustrate that households on average spend more on education per boy than per girl. Our results show that in female-headed households, girls' education more than doubles in joint-decision making. This finding hints at some parallels with past studies that find that increasing women's bargaining power improves gender equality in education between daughters and sons (Ringdal & Sjursen, 2021; Saleemi & Kofol, 2022).

6 | CONCLUSION

Dairy farming and production play an integral role in the welfare and food security of children in many low-income countries. Similarly, increased decision-making power for women has been shown in past studies to increase the welfare outcomes of children. This study surveyed households from Northern and Southern transects in the urbanizing region of Bangalore, India and uses a multinomial endogenous treatment effects model to explore how decision-making in dairy production affects education, nutrition, and health investments in children.

Even though other demand-side factors are associated with investments in girls, such as the perceived lower capital returns on investments in girls (Aslam & Kingdon, 2012; Foster & Rosenzweig, 2009), our paper explores the influence of a specific factor—household decision-making combined with dairy production—that plays a crucial role in these investments.

Our main findings suggest that girls' investments benefit the most under joint decision-making schemes, especially when combined with a higher sales price of milk and household education. When couples make decisions jointly, it appears to offset the investment inequalities between boys and girls.

This study has several limitations. First, the true interpersonal dynamics behind the veil of joint decision-making are not captured by the survey data, as it is difficult to infer the share of responsibilities, decisions, and level of consultation between husbands and wives. Past research shows that the perspectives regarding agricultural household decision-making differ according to the gender of the respondent (Acosta et al., 2020; Alwang et al., 2017; Ambler et al., 2017; Twyman et al., 2015). This is particularly the case when wife and husband are interviewed separately (Anderson et al., 2017).

Oftentimes, daughters and sons do not receive equal levels of nutrition and education, as the undisclosed bargaining power between men and women within the households influences these investments (Doss & Meinzen-Dick, 2015). As our data contains an aggregate of reported investments made for all boys and all girls separately on a household level, it is difficult to assess whether these investments are distributed equally among girls and boys. It is also possible that parents spend more on their eldest offspring than on the second, third, or later-born child, regardless of the children's gender.

Lastly, because of the limitations in our data, we are not able to capture other aspects of women's empowerment as measured in the Women's Empowerment in Agriculture Index (Alkire et al., 2013). We instead assess one critical aspect of empowerment according to the context, decision-making and how it relates to household allocation of resources toward girls versus boys.

Despite these limitations, our findings yield many important discussion points. Looking to the future, the demand for and production of dairy products in India are expected to increase, leading to potential further growth in employment and incomes in this sector. These factors may translate to improvements in children's health and nutritional status. Survey questions regarding how households make decisions, as argued by Doss (2013), captures partly women's bargaining power and how involved she is in the decision-making process. In our analysis, it appears that joint decision-making has a bigger impact on investment in girls, suggesting that the participation of women in intrahousehold decision-making can lead to better developmental outcomes in girls. Female decision-making households appear to be more structurally disadvantaged. However, this does not imply that sole female decision-making is less desirable, nor does it lead to worse outcomes. The implication, rather, is that these households could be directing resources to more immediate needs and children's investments may be secondary to those needs. Thus, training and participation in the local dairy cooperative could provide a means for surmounting these structural barriers and implementing complementary measures to increase investments in children. Finally, we show that milk sales prices can induce higher investments in girls; if the already economically disadvantaged female decision-making households are enabled to produce higher value-added products beyond milk that bring the household more income, this could lead to increased investments in girls and further ease gender inequalities in spending and investment.

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ORCID

Jessie Lin b https://orcid.org/0000-0002-5309-2637

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Additional supporting information can be found online in the Supporting Information section at the end of this article.

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