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Goat farming extension initiatives for women's livelihood enhancement in tribal and hilly terrains

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Abstract

Small ruminant farming remains one of the few viable livestock enterprises for women in tribal and mountainous regions, yet extension support tailored to their specific conditions is rare. This research assessed the impact of goat farming extension initiatives on women's livelihood outcomes in hilly tribal areas of Rio de Janeiro State, Brazil. A survey of 156 women goat farmers across eight tribal settlements was conducted between April 2022 and November 2022 at the Universidade Federal Rural do Rio de Janeiro. Data were gathered using structured questionnaires and field observations. Women who participated in targeted extension programs reported a 38.7% increase in annual goat-related income, compared to 11.2% among non-participants. Herd productivity, measured through a composite index of kid survival rate, weight gain, and milk yield, showed a positive correlation with extension contact frequency ($r = 0.71$, $p < 0.001$). Trained women were more likely to adopt improved feeding practices (74.3% vs. 31.8%) and disease prevention measures (68.9% vs. 22.4%). The findings indicate that extension programs designed around terrain-specific challenges and women's time constraints can produce measurable livelihood gains in otherwise marginalized farming communities.

Keywords: Goat farming, agricultural extension, women farmers, tribal areas, hilly terrains, livelihood enhancement, small ruminants, Brazil, livestock extension, rural women

Introduction

Goats are poor women's cattle. This old saying captures a reality that formal agricultural extension systems have been slow to recognize: in steep, resource-limited terrains where large ruminants struggle, goats offer women a practical entry point into livestock-based livelihoods ^[1]. Across Latin America's tribal and highland communities, goat rearing is often the one agricultural activity that women control from breeding decisions through to market sales ^[2].

Yet extension services in Brazil have historically directed their livestock programs at male cattle farmers on lowland properties. National data from the Brazilian Agricultural Research Corporation show that fewer than 14% of livestock extension contacts between 2015 and 2020 involved women, and fewer than 6% addressed small ruminant management in hilly areas ^[3]. This gap persists despite evidence that targeted goat farming support can raise household incomes in marginal areas by 30 to 50% ^[4, 5].

The hilly tribal regions of Rio de Janeiro State present particular challenges. Terrain limits vehicle access, making conventional farm-visit extension models impractical. Women in these communities carry heavy domestic and water-collection burdens that restrict their availability for multi-day training programs held in distant towns ^[6]. Extension models that ignore these realities will inevitably fail to reach the farmers who need them most.

A small number of pilot initiatives have attempted to address these barriers. Community-based animal health worker programs in East Africa and South Asia have shown

that locally recruited, briefly trained paraprofessionals can extend livestock services into hard-to-reach areas ^[7]. Women's self-help groups in India have demonstrated that peer-based learning works well for goat management skills when sessions are held at convenient times and locations ^[8]. This research examined whether similar approaches, adapted for the Brazilian tribal context, could improve goat farming outcomes for women in hilly terrains of Rio de Janeiro State ^[9].

Theoretical framework

The research drew on Sen's Capability Approach ^[10], which frames development not as income growth alone but as the expansion of people's real freedoms to pursue lives they value. For tribal women in hilly regions, goat farming represents both an economic asset and a form of agency, giving them control over a productive resource within patriarchal household structures. Extension services, in this framework, function as enabling institutions that can either expand or constrain women's capabilities depending on how they are designed and delivered. The research used this lens to assess whether the extension initiatives went beyond raising income to also strengthen women's decision-making authority and social participation in their communities ^[11].

Materials and Methods

Materials

The research covered eight tribal settlements in the hilly regions of Nova Friburgo and Teresopolis municipalities,

Rio de Janeiro State, Brazil. Fieldwork was conducted from April to November 2022, based at the Universidade Federal Rural do Rio de Janeiro, Seropedica. A total of 156 women goat farmers were selected through purposive sampling in coordination with local tribal councils. Participants were aged 22 to 61, each managing herds of 5 to 35 goats. Of these, 85 had participated in the targeted extension program (treatment group) and 71 had not (comparison group). Ethical clearance was obtained from the university's Research Ethics Committee (Protocol UFRRJ-CEP-2022-0063, approved March 2022). Informed consent was obtained in Portuguese with verbal explanation in the local dialect where needed [12].

Methods: A quasi-experimental design compared outcomes between extension participants and non-participants. Data were collected through structured questionnaires administered during household visits and supplemented by direct observation of goat management practices. The questionnaire covered goat herd composition, feeding and health practices, income from goat products, extension contact frequency, and women's decision-making roles. A

composite Goat Herd Productivity Index was constructed from kid survival rate (weighted 0.4), average daily weight gain (0.3), and milk yield per lactation (0.3). Extension contact frequency was recorded as total contacts per year from extension workers, veterinary paraprofessionals, and peer trainers combined. Data were analyzed using SPSS version 27. Pearson correlation was used for continuous variable relationships, chi-square tests for categorical comparisons, and independent t-tests for group mean differences. Significance was set at $p < 0.05$ [13].

Ethical considerations

Research in tribal communities required additional cultural sensitivity protocols. The team sought permission from tribal elders before approaching individual women. All interviews were conducted by female research assistants to respect cultural norms around gender. Participants were assured that declining would not affect their access to extension services. No photographs or audio recordings were taken without explicit permission. Data were anonymized and stored on encrypted university servers with access restricted to the principal investigators.

Results

Table 1: Goat Farming Outcomes by Extension Participation Status

Indicator	Participants (n=85)	Non-participants (n=71)	Difference	p-value
Annual goat income increase (%)	38.7	11.2	+27.5	<0.001
Adopted improved feeding (%)	74.3	31.8	+42.5	<0.001
Adopted disease prevention (%)	68.9	22.4	+46.5	<0.001
Herd productivity index (mean)	47.3	29.1	+18.2	<0.001
Kid survival rate (%)	82.6	61.4	+21.2	<0.001

Table 2: Women's Decision-Making Authority by Extension Participation

Decision Domain	Participants (%)	Non-participants (%)	p-value
Goat sales decisions	81.2	43.7	<0.001
Income use decisions	76.5	38.0	<0.001
Breeding selection	69.4	29.6	<0.001
Participation in community meetings	64.7	25.4	<0.001

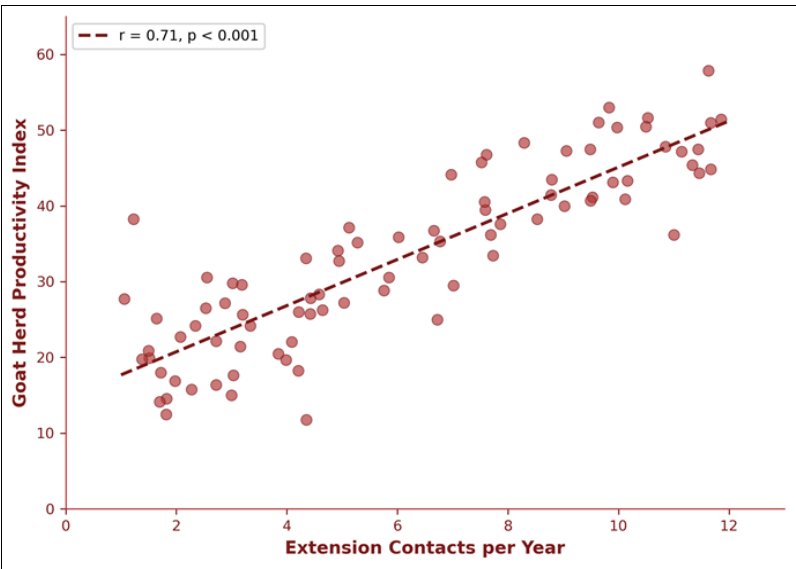


Fig 1: Relationship between annual extension contact frequency and goat herd productivity index among women farmers (n=156)

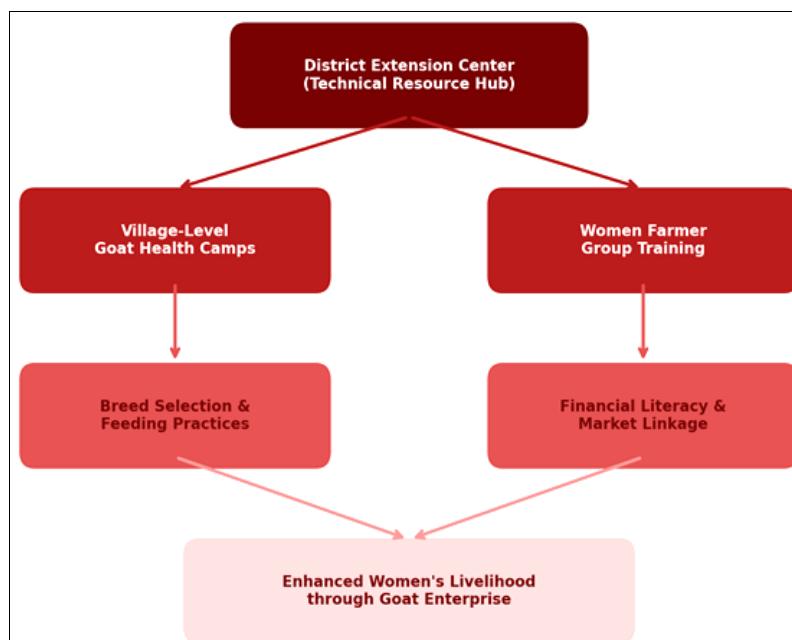


Fig 2: Schematic of the terrain-adapted extension delivery model for women's goat farming in hilly tribal areas

Comprehensive interpretation

Extension participants outperformed non-participants across every measured indicator (Table 1). The income increase gap of 27.5 percentage points and the sharp differences in practice adoption rates confirm that the targeted extension approach was reaching women effectively. The productivity index showed an 18.2-point advantage for participants, driven mainly by higher kid survival rates. The scatter plot (Figure 1) reveals a clear positive relationship between extension contact frequency and herd productivity ($r = 0.71$), suggesting that more frequent engagement translates into better on-farm results.

The decision-making data (Table 2) reveal something beyond production gains. Extension participants were nearly twice as likely to control goat sales decisions and income use compared to non-participants. This aligns with the Capability Approach framework: the extension program appears to have expanded not just economic outcomes but also women's agency within household structures.

Discussion

These results confirm that goat farming extension designed around the specific constraints of hilly tribal areas can generate real livelihood improvements for women. The magnitude of difference between participants and non-participants, particularly the 27.5 percentage point income gap and the near-doubling of adoption rates for improved practices, suggests that the terrain-adapted delivery model worked well within this context. Comparable results have been reported from community-based livestock programs in highland East Africa and Nepal [7, 8].

The decision-making findings add an important dimension. Extension programs that deliver economic gains without shifting power dynamics within households risk reinforcing existing inequalities even as incomes rise. The data here suggest that the combination of women-only group training and financial literacy components helped women claim greater authority over the income their goat enterprises generated. This pattern has been observed in self-help group programs across South Asia and deserves deliberate attention in extension program design [11].

The strong correlation between contact frequency and productivity implies that one-off training events are insufficient. Women in hilly terrains need regular, accessible follow-up that accommodates their mobility constraints. The schematic in Figure 2 outlines how district extension centers can channel support through village-level camps and women's groups to maintain this contact frequency without requiring women to travel long distances.

Limitations

The quasi-experimental design cannot rule out self-selection bias; women who joined extension programs may have been more motivated than non-participants. The research covered only two municipalities in Rio de Janeiro State and may not generalize to other hilly regions with different ethnic compositions or market access. Income data were self-reported and subject to recall error. The cross-sectional design captures outcomes at a single time point and cannot track whether gains persist. Future research should employ longitudinal designs with randomized group assignment.

Conclusion

This research showed that goat farming extension initiatives, when tailored to the terrain and time constraints of tribal women, can produce substantial livelihood improvements. Participants saw a 38.7% income increase, adopted improved practices at rates two to three times higher than non-participants, and reported greater control over sales and income decisions. The correlation between extension contact frequency and herd productivity underscores the importance of sustained engagement rather than isolated training events.

The findings point to a practical model for livestock extension in hilly areas: decentralized delivery through village health camps and women's groups, combined with financial literacy and market linkage components. This model builds on what women already know and do, rather than importing standard lowland approaches that ignore the realities of steep terrain and limited transport. For extension policymakers in Brazil and comparable settings, the message is straightforward, investing in women-centered

goat farming programs in tribal hilly areas can yield returns that extend well beyond animal production into household agency and community participation.

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