



Linking Livestock Farmer Group Performance to Household Food Security: Evidence from West Sumatra, Indonesia

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HIGHLIGHTS

- Food-secure and food-vulnerable households accounted for 46.7% and 44.4% of respondents, respectively.
- Group performance had a weak but significant positive correlation with household food security.
- Ordinal logistic regression showed no significant group-performance effect at the five percent level.
- Livestock groups require stronger economic functions to support members' food security.

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ABSTRACT

Livestock groups are widely promoted for agricultural development, but empirical evidence linking their institutional performance to household food security remains scarce. This study described the food security status of livestock-farming households and examined the relationship between livestock group performance and household food security in West Sumatra, Indonesia. A descriptive quantitative design was used, involving 45 respondents from nine Madya-class livestock groups, surveyed from August to October 2025. Group performance was assessed using the Farmer/Livestock Group Capacity and Independence Assessment (PAKEM POKTAN) instrument, while household food security was classified by combining food expenditure share and energy adequacy level. Data were analyzed using descriptive statistics, Spearman's rank correlation, and ordinal logistic regression at a 5% significance level. Results showed that 46.7% of households were food secure, 44.4% food vulnerable, and 8.9% food insecure. Group performance was significantly but weakly correlated with food security status ($r_s = 0.312$; $p = 0.037$), yet had no significant effect in the ordinal logistic regression model ($p = 0.060$; Nagelkerke $R^2 = 0.094$). These findings indicate that current group capacity is associated with, but does not directly determine, household food security.

INTRODUCTION

Food security among farming households remains a development paradox because households that produce food can still be vulnerable to food insecurity. Food insecurity is shaped by interactions among production capacity, climate exposure, household income, market access, and local institutions (Raj et al., 2026). In Indonesia, food is legally recognized as a basic need and a citizen's right under Law No. 18 of 2012 on Food. The food security of

farming households, therefore, has implications not only for welfare but also for rural development policy.

Institutional strengthening through farmer and livestock groups is one strategy used to improve smallholder access to information, technology, production inputs, credit, and markets (Niranjan et al., 2023). Collective action can reduce coordination costs and improve bargaining capacity in smallholder agriculture (Markelova et al., 2009; Fischer & Qaim, 2012) and empirical studies show that farmer organizations improve member welfare when they perform as

effective economic and learning institutions (Wossen et al., 2017; Bachke, 2019). A similar pattern has been reported for farming institutions in developing regions (Rout et al., 2026) and institutional strengthening has likewise been linked to sustainable agriculture and food security support in local Indonesian settings (Listiana et al., 2021). In Indonesia, the Farmer/Livestock Group Capacity and Independence Assessment (PAKEM POKTAN) is used to assess formal group performance across organizational dimensions, including planning, organizing, implementation, control, reporting, and leadership development (BPPSDM of Agriculture, 2018). However, this contribution is not automatic: it depends on group capacity, household assets, access to credit, land tenure, gender relations, and market conditions (Wossen et al., 2017; Vijayan et al., 2023; Jabbar et al., 2025), since groups may have adequate administrative performance but limited capacity to influence household food access unless they strengthen income, capital formation, market linkages, or production resilience. This makes it necessary to test whether formal group performance is reflected in the food security status of member households.

In West Sumatra, livestock groups have been supported through government programs, yet previous studies have reported that many assisted groups did not progress to higher-capacity classes and often experienced declining livestock populations (Madarisa et al., 2024; Putra et al., 2023). A recent assessment of the same nine Madya-class livestock groups found an average performance score of only 52.9% of the maximum PAKEM POKTAN score, with leadership development as the weakest dimension (Madarisa et al., 2026). That assessment described organizational capacity but did not examine whether that capacity was associated with the food security of member households. This study addressed that gap by analyzing group performance and household food security in the same livestock-group setting. The objectives were to describe the food security status of livestock-farmer households in Madya-class groups and to analyze the relationship and effect of group performance on household food security status. The evidence is expected to inform extension policy for livestock-group development by clarifying how formal institutional performance relates to household-level welfare outcomes in similar smallholder settings.

METHODOLOGY

This descriptive quantitative study was conducted in West Sumatra Province, Indonesia, from August to October 2025. Study sites were selected from livestock groups recommended by the West Sumatra Provincial Livestock and Animal Health Service. Nine groups classified as Madya under PAKEM POKTAN, with scores ranging from 456 to 607, were selected as the units of analysis. These were the same groups previously assessed for organizational capability (Madarisa et al., 2026).

The study involved 45 respondents, purposively selected from the nine groups, with five respondents per group: two group administrators and three active members. This composition was intended to represent both the leadership and membership perspectives relevant to group performance, consistent with group dynamics theory emphasizing the complementary roles of administrators and members in group learning, cooperation, and

production functions (Hariadi, 2011). The independent variable was group performance score (GP), measured using the PAKEM POKTAN instrument with a maximum score of 1,000. The dependent variable was household food security status, classified by combining two indicators: the proportion of food expenditure to total household expenditure using a 60% threshold, and the energy adequacy level using a 2,100 kcal/capita/day reference from the national recommended dietary allowance and an 80% adequacy threshold (Ministry of Health of the Republic of Indonesia, 2019). The combination produced four categories: food secure, food vulnerable, food insecure, and food at risk (Maxwell et al., 2000; Widada et al., 2017).

Household food consumption was recorded using a 7-day food-consumption recall covering food type, quantity, and price. Energy and protein contents were converted using Indonesian food composition tables (Ministry of Health of the Republic of Indonesia, 2018) and compared with per capita adequacy levels to calculate energy and protein adequacy percentages. Household income was estimated using an expenditure-based proxy, summing monthly food and non-food expenditures. Analysis combined descriptive statistics with Spearman's rank correlation (to examine the association between group performance and food security status) and ordinal logistic regression (to test the effect of group performance on food security category), with group performance entered as the model's single predictor. No intervention or treatment was administered to respondents or their livestock; all tests used a five percent significance threshold and were conducted in SPSS.

RESULTS

The results are presented according to the research objectives. The section first describes respondent characteristics, group performance, and household food security, then reports the relationship and effect of group performance on household food security status.

Respondent profile and group performance

Respondents were, on average, 50.4 years old (range: 28–70 years), and the average household size was 4.7 persons. Educational attainment was dominated by elementary school (40.0%) and senior high school (37.8%), followed by junior high school (11.1%), no formal schooling (8.9%), and a bachelor's degree (2.2%). Most respondents (62.2%) did not work outside their household's livestock or farming activities, while 37.8% had additional income-generating activities.

The nine Madya-class livestock groups had performance scores ranging from 456 to 607 out of 1,000 (Table 1). The highest score was recorded by Sumber Rezeki (607), while the lowest was recorded by Durian Sabatang (456). The 151-point difference indicates that the groups were not homogeneous, even though all belonged to the same formal capacity class. None reached the Utama threshold of 701, confirming that the observed groups remained within a medium institutional-capacity range.

Food security status of livestock households

Household food security was classified using the proportion of food expenditure and the energy adequacy level. The largest share

Table 1. Group performance scores

Code	Groups	Score
A	Mama Ceria KWT	457
B	Pemuda Setia	562
C	Mulia	460
D	Pincuran Gadang	594
E	Milenial	552
F	Sumber Rezeki	607
G	Sawah Bangsa	584
H	Kawasan Sigajai	487
I	Durian Sabatang	456
Average		528.78

Source: Madarisa et al. (2026)

Table 2. Food security status of livestock households

Category	Food expenditure (%)	Energy adequacy (%)	Share (%)
Food secure	48.0	108.4	46.7
Food vulnerable	62.6	103.2	44.4
Food insecure	43.0	62.9	8.9
Food at risk	-	-	0.0
Total			100.0

Source: Primary data, processed (2026)

of respondents was categorized as food secure (46.7%), followed by food vulnerable (44.4%) and food insecure (8.9%), while no household was categorized as food at risk (Table 2). Food-vulnerable households had the highest proportion of food expenditure (62.6%), although their energy adequacy level remained high (103.2%). In contrast, food-insecure households had a lower food expenditure proportion (43.0%) but a low energy adequacy level (62.9%).

As a supplementary descriptive measure not used in the food security classification in Table 2, the average protein adequacy level across all respondents was 104.5%, alongside an average energy adequacy level of 105.7%. The average share of food expenditure in total household expenditure was 57.6%, close to the 60% threshold. This indicates that many households had adequate average energy and protein intake, yet limited economic flexibility.

Animal protein was the largest component of monthly food expenditure, accounting for 43.9% of total food expenditure,

Table 3. Average food expenditure composition

Component	Average (Rp/month)	Share (%)
Animal protein	1,549,943	43.9
Other foods	751,581	21.3
Grains	560,095	15.9
Vegetables	345,205	9.8
Oils and fats	122,048	3.5
Fruits	109,600	3.1
Root crops	50,943	1.4
Legumes	39,619	1.1
Total food expenditure	3,529,033	100.0

Source: Primary data, processed (2026)

followed by other foods (21.3%) and grains (15.9%) (Table 3). Legumes and root crops contributed only 1.1% and 1.4%, respectively, indicating limited diversification of plant-based food sources.

Food expenditure accounted for 57.6% of the average total household expenditure of Rp 6,122,645 per month, while non-food expenditure accounted for 42.4%. The average per capita income was Rp1,355,372 per month, with a range from Rp553,357 to Rp3,568,429. Most respondents were in the lower-middle class (75.6%), followed by vulnerable and stable-middle classes at 11.1% each, while 2.2% were in the poor class and none were in the upper class (Table 4). Overall, 97.8% of respondents were in lower-middle- to lower-income classes.

Table 4. Per capita income class distribution

Income class	Range/capita/month	Share (%)
Poor class	< Rp582,932	2.2
Vulnerable class	Rp582,932 to Rp874,398	11.1
Lower-middle class	Rp874,398 to Rp2,040,262	75.6
Stable middle class	> Rp2,040,262 to Rp9,909,844	11.1
Upper class	> Rp9,909,844	0.0
Total		100.0

Source: Primary data, processed (2026)

Correlation between group performance and food security

Spearman's rank correlation showed a positive and significant relationship between livestock group performance and household food security status ($r_s = 0.312$; $p = 0.037$; Table 5). The relationship was weak, meaning that better group performance was associated with better household food security, but it was not strong enough to explain food security differences on its own.

Table 5. Spearman correlation test results

Variable	r_s	p	N
Group performance on food security	0.312	0.037	45

Source: Primary data, processed (2026)

Effect of group performance on food security

Ordinal logistic regression produced a positive coefficient for group performance (0.010), but the effect was not significant at the five percent level ($p = 0.060$; Table 6). The model met goodness-of-fit requirements, with Pearson $p = 0.252$ and Deviance $p = 0.178$, and the parallel-lines assumption was satisfied ($p = 0.170$). The Nagelkerke R^2 value of 0.094 is a pseudo- R^2 statistic that reflects relatively low overall explanatory strength for the model; unlike R^2 in ordinary linear regression, it should not be interpreted as the literal proportion of variance explained. Taken together with the non-significant coefficient, this indicates that group performance

Table 6. Ordinal logistic regression results

Parameter	Estimate	Wald	df	p
Group performance	0.010	3.551	1	0.060

Source: Primary data, processed (2026)

alone has limited explanatory power for household food security status within this model.

DISCUSSION

The nine Madya-class groups scored an average of 528.78 out of 1,000 (52.9% of the maximum), a level consistent with a companion assessment of organizational capabilities in the same groups, which found leadership development to be the weakest dimension (27.8%) and organizational ability the strongest (63.5%) (Madarisa et al., 2026). This pattern suggests that the groups have established basic administrative and organizational routines but have not yet developed strong leadership capacity to convert group activities into consistent economic benefits for members, which may help explain why formal group performance shows only a weak association with household food security, as discussed below.

The findings show that calorie adequacy alone does not fully represent household food security. Although the average energy adequacy level exceeds the standard, 44.4% of households are food-vulnerable, and 8.9% are food-insecure. Food-vulnerable households have sufficient energy intake but allocate more than 60% of their total expenditure to food, consistent with reduced economic flexibility rather than a direct measure of purchasing power. Food-insecure households have lower expenditure pressure but fail to meet energy adequacy. This confirms that economic vulnerability and nutritional vulnerability may appear through different pathways. Similar studies on farming households in Indonesia identify income constraints, household expenditure structure, and livelihood capacity as important determinants of food security (Rahmi et al., 2013; Widada et al., 2017; Rahmadanih et al., 2018), with recent evidence from Indonesia's borderland farming communities further highlighting the role of extension access and farmer motivation in supporting household food security (Banunaek et al., 2026). In the present study, the dominance of animal protein expenditure and the low share of legumes and root crops also suggest limited diversification in dietary costs.

The weak but significant Spearman correlation ($r_s = 0.312$) indicates that livestock groups still matter for household food security, but their contribution is limited by the same organizational gap noted above: groups perform adequately in planning and administration but have not yet built the leadership and economic linkage functions needed to translate group performance into measurable household outcomes. This pattern is consistent with broader evidence that farmer organizations support welfare, productivity, and food security only when collective action is translated into economic services, market access, credit facilitation, and effective learning (Markelova et al., 2009; Fischer & Qaim, 2012; Wossen et al., 2017; Bachke, 2019). Therefore, formal group performance provides an institutional signal, but not yet a strong food-security mechanism.

The ordinal logistic regression result reinforces this interpretation: group performance was not a statistically significant predictor of food security status ($p = 0.060$), and its explanatory power was low. Unmeasured household-level factors — such as income, household size, education, and livelihood diversity — likely account for a larger share of the variation, consistent with findings from other Indonesian food security studies (Hakim et al., 2021;

Akbar et al., 2023) and studies of livestock-rearing household adaptive capacity in other regional contexts (Mishra et al., 2026). The practical implication is that livestock-group development should move beyond administrative compliance. Groups need stronger roles in member income generation, access to capital, collective marketing, production planning, and livestock business continuity. Strengthening these economic functions may convert institutional capacity into measurable gains in household welfare.

This study has three main limitations. First, all nine groups belonged to the Madya class; of the 17 groups recommended by the West Sumatra Provincial Livestock and Animal Health Service, none reached the Utama class, so Madya represented the highest performance tier available in this population rather than a selection choice by the researchers (Madarisa et al., 2026). Second, the cross-sectional design, single independent variable, and small sample ($n = 45$) limit causal inference and the precision of the correlation and regression estimates. Third, group membership size and respondent gender were not recorded, limiting the characterization of respondent representativeness.

CONCLUSION

The nine Madya-class livestock groups studied were the most consistently active groups recommended by the West Sumatra Provincial Livestock and Animal Health Service, representing the highest formal performance tier reached within this population. During the study period, member households were predominantly food-secure and food-vulnerable, with average energy and protein adequacy exceeding minimum standards. Group performance showed a weak but statistically significant correlation with household food security and did not significantly predict food security status in the regression model, indicating that formal group capacity alone is not yet a strong determinant of household outcomes. This pattern is consistent with the groups' organizational profile: solid administrative capacity but weak leadership development, which limits their ability to translate formal performance into economic benefits for members. Strengthening group performance for food security purposes should therefore prioritize economic functions — capital access, market linkages, and income-generating activities — alongside leadership development.

DECLARATIONS

Ethical approval and consent to participate: This study was conducted in accordance with the ethical standards for social research in vogue in Indonesia. Respondent participation was voluntary, provided after participants received information regarding the study's purpose, benefits, and assurance of data confidentiality. Participant identity data were kept confidential and were not disclosed for any purpose other than scientific use. Respondents' identities are reported in aggregate form.

Conflict of interest: The author declares that this research was carried out without any commercial or financial relationships that could be interpreted as a potential conflict of interest. The authors confirm that they carefully reviewed, revised, and edited the content of this work as necessary during its preparation, and they take full responsibility for the final published content.

Authors' contribution: RAP conceptualized the study, designed the methodology, analyzed the data, and drafted and finalized the manuscript. FM contributed to the conceptualization, provided critical review and revision of the manuscript, and supervised the overall research process. NN supported data collection, data organization, and manuscript revision. All authors read and approved the final manuscript.

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