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**Gender Inequality in Livestock Ownership, Decision-Making, and  
Productivity**

**Evidence from Nigeria**

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## Abstract

Livestock systems in sub-Saharan Africa are characterized by persistent gender disparities: women contribute substantial labor but have limited ownership and control of productive assets. Using individual-level data from the 2022/23 Nigeria Agricultural Sample Survey, this study examines gender gaps in livestock ownership, income control, and productivity by using the individual livestock manager rather than the household as the unit of analysis. The results reveal that women are 7.1 percentage points less likely to own large ruminants, 5.8 percentage points less likely to own small ruminants, and 1.4 percentage points less likely to own monogastrics, while having a 9.7 percentage-point advantage in poultry ownership. Women are also 19.2 percentage points less likely to control livestock income, even when actively engaged in production, with this gap moderated by household headship rather than education or agricultural training. Enterprises managed by women produce approximately 3.2 fewer liters of milk and 1.8 to 3.2 fewer eggs per week than those managed by men, conditional on herd size and geographical zone. Ownership disparities in large ruminants in Nigeria are more pronounced in the livestock-dense North but narrow or reverse in the South. The persistence of income-control gaps despite differences in human capital suggests that gender inequality in livestock systems is rooted in structural constraints, including inheritance norms and intrahousehold bargaining dynamics. These findings highlight the need for gender-responsive interventions that combine asset transfers and market access with measures to strengthen women's decision-making authority and monitor economic agency using individual-level indicators.

**Keywords:** Gender inequality, livestock ownership, decision-making, livestock productivity, Nigeria

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## 1. Background

Livestock systems are among the most gender-differentiated dimensions of smallholder agriculture in sub-Saharan Africa. Yet specific patterns of women's labor contribution and asset exclusion vary considerably by country, livestock species, and social structure, for instance, whether inheritance systems are patrilineal or differently organized (Kristjanson et al., 2014; Njuki and Sanginga, 2013). Women contribute substantially to daily livestock management through feeding, watering, milking, and disease monitoring, among others, across most of these contexts. However, their ownership of productive animals, especially high-value species, is systematically constrained by cultural norms, limited access to capital, and intrahousehold power dynamics. This disjuncture between labor contribution and asset control is not merely a matter of equity; it has measurable consequences for productivity, household welfare, and national agricultural output.

Nigeria, sub-Saharan Africa's largest economy and one of its largest livestock populations, provides an especially important test case, both in terms of its economic and demographic weight and its internal heterogeneity. Nigeria's agricultural sector employs roughly 35 percent of the labor force, with the livestock sub-sector contributing approximately 6 percent of GDP and a substantially larger share of rural household income (World Bank, 2022). Nigeria's six geopolitical zones differ sharply in agroecology, dominant livestock systems, religious and customary norms, and market access. Each of these dimensions plausibly shapes gender gaps in ownership, control, and productivity in different ways and different regions. In Nigeria's crop sector, a parallel and more extensively documented literature has found that gender productivity gaps vary sharply by geopolitical zone. Using the 2018/19 Nigeria Living Standards and Measurement Survey (LSMS), the World Bank (2022) finds an unconditional gender gap of 35 percent in the North and 25 percent in the South in agricultural output per hectare. A synthesis of this evidence notes that after controlling for individual-, household-, and plot-level characteristics, the regional difference in the conditional gap narrowed further, though the specific drivers continued to vary between regions even as the gap itself converged (Donald and Tafere, 2026). If crop-sector gender gaps in Nigeria vary this substantially by zone, there is good reason to expect, and to test, whether livestock-sector gaps follow a similar regional pattern. Yet the sector remains understudied from a gender perspective, particularly at the national level. Most existing evidence is qualitative or confined to single states, limiting its policy relevance for a country with extreme agroecological, cultural, and institutional heterogeneity across its six geopolitical zones.

This paper fills that gap by using individual-level microdata from the 2022/23 Nigeria Agricultural Sample Survey (NASS), a nationally representative, stratified multi-stage survey covering 316,286 livestock-keeping households. We provide a rigorous, nationally representative econometric analysis of gender disparities in livestock ownership, income control, and productivity in Nigeria. Our analysis is distinguished from prior work in three ways. First, we define the unit of analysis as the individual livestock manager rather than the household, enabling direct identification of intrahousehold gender dynamics that household-level surveys systematically obscure (Kilic et al., 2021; O'Sullivan, 2017). Second, we exploit the survey's nationally representative coverage to document spatial heterogeneity across all six geopolitical zones, revealing that the nature and magnitude of gender gaps differ markedly between northern and southern Nigeria, a pattern consistent with, though not identical to, the regional heterogeneity documented in Nigeria's crop sector (World Bank, 2022; Donald and Tafere, 2026). Third, we assess whether human capital variables such as education, literacy, and agricultural training moderate the gender gap in income control. Our findings show they

do not, suggesting that structural rather than informational constraints are the binding barrier to women's economic agency.

The remainder of the paper proceeds as follows. Section 2 provides the study context, reviews the empirical literature on gender and livestock in sub-Saharan Africa, and identifies key research gaps that this study addresses. Section 3 describes the data and empirical strategy. Section 4 presents descriptive statistics and regression results. Section 5 presents the discussion of findings. Section 6 concludes and provides policy recommendations.

## **2. Literature Review**

### **2.1 Study Context**

Nigeria exhibits substantial regional heterogeneity in agroecological conditions, livestock production systems, and gender relations, providing an important context for understanding regional differences in livestock ownership, decision-making, and productivity. The country's six geopolitical zones span a broad North–South agroecological gradient. The northern zones are generally drier and have a greater prominence of pastoral and agro-pastoral livestock systems, whereas the southern zones are more humid, with livestock production more commonly integrated into sedentary mixed crop–livestock systems. These differences shape the relative importance of livestock keeping, production resource requirements, and opportunities for crop–livestock integration. Gender relations and agricultural opportunities also vary across regions. Evidence from Nigeria shows that gender differences in agricultural productivity and their underlying determinants differ between the North and South (Oseni et al., 2015). Similarly, Das et al. (2023) document more restrictive gender norms in the northern Nigerian states covered in their study. Using evidence across Nigeria's major agroecological zones, Peterman et al. (2011) demonstrate that gender differences in agricultural outcomes vary across ecological settings, highlighting the importance of accounting for regional context. Further evidence from southwestern Nigeria illustrates how gendered household responsibilities and labor allocation shape women's participation in agricultural production (Pierotti et al., 2022).

These regional differences suggest that women's livestock ownership, decision-making authority, and productivity cannot be understood independently of the agroecological, production–system, and sociocultural contexts in which they operate. Accordingly, although the empirical analysis distinguishes Nigeria's six geopolitical zones, these are interpreted within broader regional differences in livestock production systems, resource access, and gender norms that may shape the observed patterns of gender inequality.

### **2.2 Gender Disparities in Livestock Systems: A Review of the Evidence**

#### **2.2.1 Asset Ownership and the Species Hierarchy**

Patterns in the stratification of livestock ownership by both gender and species value is widely documented across sub-Saharan Africa. Men disproportionately own high-value large ruminants, cattle in particular, while women's holdings are largely confined to small ruminants and poultry (Doss, 2014; Njuki and Mburu, 2013; Naz et al., 2023). The magnitude of this stratification, however, varies considerably by country and livestock system and should not be read as a single uniform gap. Data from Uganda show that women-headed households control only 60–70 percent of the tropical livestock units (TLUs) held by households headed by men (Ali et al., 2015), while evidence from Ghana, Ethiopia, Malawi, and Kenya documents gaps in the same direction but not necessarily the same size (Tufa et al., 2022; Takele et al., 2024).

Within Nigeria, studies from Nasarawa State confirm that women are primarily engaged in small livestock production despite performing most day-to-day management tasks (Ayoade et al., 2009; Okoh et al., 2010), though this evidence comes from a single state, and whether the pattern holds with similar magnitude nationally, or varies across Nigeria's six geopolitical zones, has not previously been established at national scale.

Evidence from a Fulani pastoralist community in northern Nigeria's Kaduna State concretely illustrates this species-based gender division: sheep are owned and managed by men, while goats and poultry are predominantly owned by women and are one of their few sources of independent cash income (Ducrotoy et al., 2017). This pattern closely parallels the crop-choice segregation documented in sub-Saharan Africa's crop-agriculture literature: women concentrate in lower-value food crops while men concentrate in cash and export crops, and this concentration is consistently the single largest driver of the gender productivity gap across the countries reviewed (Donald and Tafere, 2026). The consistency of this pattern across both crop and livestock sub-sectors within the same country suggests a common underlying logic of gendered asset and product specialization that may be worth investigating directly in the livestock context.

This species hierarchy is not random. It reflects the intersection of patrilineal inheritance systems, which transfer cattle from father to son; land and collateral constraints that restrict women's access to credit for high-value asset acquisition; and social norms that frame large ruminant ownership as a man's domain (Mulugeta and Amsalu, 2014; Djurfeldt, 2018). Inheritance evidence from the same Kaduna State community illustrates how formal rights and actual control can diverge along gender lines: upon a household head's death, cattle are formally divided in a 2:1 ratio between sons and daughters, so women are not excluded from inheritance outright, but prevailing norms typically lead women to transfer their share of cattle wealth to sons or husbands rather than retain it themselves, meaning formal inheritance rights do not reliably translate into sustained asset control (Ducrotoy et al., 2017). The mechanisms underlying the species hierarchy, inheritance systems, credit access, and norms differ across Nigeria's ethnically and religiously diverse zones, providing further reason to expect that the ownership gap will not be nationally uniform. As a result, women generally enter livestock systems at the low-value end of the species spectrum and face structural barriers to upward mobility in the asset hierarchy, though the height of those barriers is context-specific.

### **2.2.2 Decision-Making, Income Control, and Household Bargaining**

The ownership gap is compounded, in many contexts, by a decision-making gap. Even in households with ostensible joint ownership, women frequently require men's consent for livestock sales, breeding decisions, and input purchases (Bonis-Profumo et al., 2022; Carnegie et al., 2020). Evidence from across sub-Saharan Africa consistently shows that men tend to dominate strategic decisions about livestock marketing and revenue use, even where women supply the bulk of labor, though the degree of that dominance is not identical across the settings studied (Njuki et al., 2011; Assan, 2014). Control over income is particularly consequential: women allocate 70–90 percent of resources under their control to household food, health, and education, whereas men typically allocate only 30–40 percent (Malapit and Quisumbing, 2015), making their financial agency a powerful lever for welfare outcomes beyond agriculture. One study in rural Malawi, for example, found that women's empowerment in livestock decision-making was significantly associated with improved household dietary diversity and food security (Mataka et al., 2023).

Household headship status emerges as a critical moderator of women's decision-making power and is one clear example of how gender interacts with other social identities and household structures rather than operating alone. Women household heads or spouses of heads tend to have greater bargaining power and income control than other women or girls in the family, consistent with collective household models in which resource rights are conditioned on relational status (Doss, 2013; Lubungu and Birner, 2021). Household structure matters in a further, more direct sense too. For instance, in the Kaduna State pastoralist community studied by Ducrotoy et al. (2017), each additional marriage of the household head was associated with a 15.7-unit increase in household TLUs, holding household size constant, which concretely illustrates how gendered household structure, in this case polygamy, can directly predict the distribution of livestock wealth within a community. This finding underscores the importance of intrahousehold heterogeneity, conditioned by factors such as headship status, marital structure, and, as we examine below, geographic zone, a dimension that household-level analyses cannot capture.

### **2.2.3 Productivity Gaps and Their Structural Determinants**

Gender productivity gaps in livestock are well documented across multiple contexts but vary in magnitude and are primarily attributed to differential access to inputs rather than differences in capacity or effort. Women-managed enterprises in sub-Saharan Africa produce 11 to 44 percent less output per unit of productive asset than those managed by men (Palacios-López and López, 2015; UN Women, 2019; Takele et al., 2024). A structurally similar pattern of widespread cross-country variation has been documented in sub-Saharan Africa's crop sector: there, unconditional gender productivity gaps range from 7 percent in Guinea to 77 percent in Chad, and the largest single driver—women's concentration in lower-value crops—parallels the species-hierarchy dynamic described above for livestock, suggesting a common underlying logic of gendered asset and product specialization across agricultural sub-sectors (Donald and Tafere, 2026). The mechanisms behind the livestock productivity gap include restricted access to extension services, veterinary care, improved breeds, quality feed, and market information, all of which are more readily available to men (Kariuki et al., 2022; Elias et al., 2024). Women's triple workload and mobility constraints further limit their ability to invest in productivity-enhancing practices and attend training (FAO et al., 2023; Silvert et al., 2024), a constraint that echoes findings in the crop literature, where women's lower use of labor and lower returns to the labor they do use are, alongside crop choice, the most consistent drivers of the gender productivity gap across sub-Saharan African countries (Donald and Tafere, 2026).

The policy significance of closing these gaps is substantial. The FAO (2011) estimated that equalizing women's access to productive resources in agriculture could raise output in low- and middle-income countries by 20–30 percent and contribute up between 2.5 and 4 percent of additional national output. More recent evidence from Kenya and Ethiopia shows that interventions combining asset transfers with improved forage technologies increased milk production and enhanced women's income decision-making roles (ILRI, 2022; Baltenweck et al., 2024).

Despite this growing literature, four important gaps remain. First, most nationally representative analyses of gender and agriculture in Nigeria focus on crop production (Oseni et al., 2015; World Bank, 2022), and livestock-specific evidence remains largely confined to sub-national qualitative studies. Second, few studies jointly examine ownership, income control, and productivity within a single analytical framework, making it difficult to trace the pathways through which ownership constraints translate into productivity and welfare outcomes. Third, there is limited use of individual-level, gender-disaggregated survey

instruments in West Africa. Most household surveys record livestock ownership at the household level, masking intrahousehold inequalities (O’Sullivan, 2017; Galiè et al., 2019; Kilic et al., 2021). Fourth, the spatial heterogeneity of gender gaps across Nigeria’s diverse agroecological and cultural landscape has not been systematically documented. This study addresses all four gaps.

### **3. Conceptual Framework**

This study draws on the Gender, Agriculture, and Assets Project (GAAP) conceptual framework (Meinzen-Dick et al., 2011, 2013) to examine gender inequality in livestock ownership, decision-making, and productivity in Nigeria. The framework links contextual conditions, asset endowments, and intrahousehold decision-making to agricultural outcomes and well-being. We adapt it to livestock by treating livestock as a productive asset, as a site of bargaining, and as a livelihood strategy. Assets are unevenly distributed within households, with welfare consequences beyond aggregate income (Deere and Doss, 2006; Quisumbing and Maluccio, 2003). Men and women hold different asset bundles, exercise different degrees of control, and pursue different strategies, so unitary household models risk masking how interventions affect welfare (Doss, 2013). We therefore adopt a collective bargaining perspective in which outcomes reflect negotiation among members whose influence depends on the assets, income, and outside options each control (Alderman et al., 1995; Doss, 2013). Livestock is a useful lens in Nigeria. Unlike land, often constrained by customary tenure, livestock ownership is nominally more accessible to women, especially small ruminants and poultry acquired through inheritance, marriage gifts, or informal exchange (Kristjanson et al., 2014; Njuki and Sanginga, 2013). Nominal ownership does not guarantee control over breeding, health care, sale, or income allocation. The distinction between ownership and effective control is therefore central.

We operationalize the pathway from context to well-being using GAAP’s causal logic and livestock-specific indicators from the Women’s Empowerment in Agriculture Index (WEAI) (Galiè et al., 2019). Using individual managers as the unit of analysis allows us to empirically identify this distinction. Contextual conditions include agroecological variation between northern pastoral and southern mixed systems, norms governing women’s mobility and market access, and coexisting statutory and customary property regimes. Livestock holdings are disaggregated by species following FAO (2023) conventions, reflecting a gendered hierarchy in which women more commonly own lower-value small ruminants and poultry while men predominate in cattle (Kristjanson et al., 2014).

Control is treated as distinct from ownership. Our analysis focuses on decision-making authority over livestock income, testing whether ownership, income control, or their interaction better predicts productivity. Gendered livelihood strategies mediate this link, so productivity outcomes include herd size, net stock change, milk yield, and egg production. Shocks such as disease, drought, and farmer–herder conflict act asymmetrically on men and women. Finally, income allocation is gendered: women’s control is more consistently linked to food, health, and education spending (Quisumbing and Maluccio, 2003). Savings and reinvestment feed back into future asset stocks, rendering the control–welfare relationship cyclical. This framework structures the analysis of how gendered livestock ownership and decision-making shape productivity differences in Nigeria.

## **4. Data and Methodology**

### **4.1 Data Source**

The analysis uses individual-level microdata from the 2022/23 NASS, conducted by the National Bureau of Statistics in collaboration with the Federal Ministry of Agriculture and Food Security. The NASS is a nationally representative, cross-sectional survey employing a stratified, multi-stage cluster design. It covers all 36 states and the Federal Capital Territory, with local government areas (LGAs) serving as primary sampling units and households as the final unit of selection. The livestock module collects information at the level of the individual livestock-managing household member, which allows multiple observations per household, a critical feature that enables identification of intrahousehold gender dynamics. The full livestock module yields 914,443 observations from 316,286 livestock-keeping households. The unit of analysis is the livestock-managing household member, identified by the intersection of household identifier and member identifier ( $hhid \times hhmember\_id$ ). This individual-level definition preserves intrahousehold gender variation that would be lost in household-level aggregation. All analyses account for the survey's complex design by applying probability weights, using design-based standard errors, and clustering at the household level.

### **4.2 Variable Construction**

The primary variable of interest is a binary indicator for the sex of the livestock manager (woman = 1). Livestock are classified into five groups following FAO (2023) conventions: large ruminants (cattle), small ruminants (goats and sheep), monogastrics (pigs), poultry, and equines/draught animals. Herd measures are aggregated to TLUs at the manager level to facilitate cross-species comparisons and avoid double-counting. Agroecological zone fixed effects are defined by Nigeria's six geopolitical zones: North–Central, North–East, North–West, South–East, South–South, South–West.

Human capital controls include literacy (binary: can read and write), educational attainment (binary: at least primary education), and receipt of formal agricultural training (binary). Household position is captured by an indicator measuring whether the manager is the household head or spouse of the head. Productivity outcomes include log-transformed total and group-specific herd size, net 12-month stock change (levels), average daily milk yield per cow (liters), and egg production per hen per month. Table 1 provides full variable definitions.

**Table 1: Variable Definitions**

| <b>Variable</b>           | <b>Description</b>                                                     |
|---------------------------|------------------------------------------------------------------------|
| <i>women_member</i>       | Binary: 1 = woman managing member, 0 = man                             |
| <i>age_group</i>          | Binary: 1 = youth (15–35), 2 = mature (36+)                            |
| <i>mgr_literate</i>       | Binary: 1 = can read and write                                         |
| <i>mgr_educated</i>       | Binary: 1 = at least primary education                                 |
| <i>mgr_agtraining</i>     | Binary: 1 = received formal agricultural training                      |
| <i>own_largerum</i>       | Binary: keeps large ruminants (cattle)                                 |
| <i>own_smallrum</i>       | Binary: keeps small ruminants (goat/sheep)                             |
| <i>own_mono</i>           | Binary: keeps monogastrics (pigs)                                      |
| <i>own_poultry</i>        | Binary: keeps poultry (all types)                                      |
| <i>mgr_decides_income</i> | Binary: 1 = member is primary decision-maker over livestock income use |
| <i>ln_total_livestock</i> | Log (total herd size + 1), all groups combined                         |
| <i>ln_n_largerum</i>      | Log (large ruminant herd + 1)                                          |
| <i>ln_n_smallrum</i>      | Log (small ruminant herd + 1)                                          |
| <i>ln_n_poultry</i>       | Log (poultry flock + 1)                                                |
| <i>stock_net</i>          | Net 12-month stock change (levels)                                     |
| <i>Avg daily milk qty</i> | Average daily milk quantity per animal (liters)                        |
| <i>Peak month eggs</i>    | Peak month eggs per bird                                               |
| <i>final_weight</i>       | Household probability weight                                           |
| <i>lga</i>                | Primary sampling unit (LGA identifier)                                 |
| <i>state_id</i>           | Stratification variable (state identifier)                             |
| <i>zone_id</i>            | Geopolitical zone (6 zones)                                            |

Source: Authors' construction from NASS 2022/23.

### 4.3 Analytical Framework

The empirical strategy addresses three research questions in sequence, corresponding to the ownership, decision-making, and productivity dimensions of the WEAI framework as operationalized for livestock systems (Galiè et al., 2019).

For livestock ownership, we estimate linear probability models (LPMs) separately for each species group, regressing a binary ownership indicator on the women manager dummy, individual-level human capital controls, and agroecological zone fixed effects. To examine spatial heterogeneity, we augment these models with women-by-zone interaction terms and assess their joint significance. Probit models with average partial effects (APEs) serve as robustness checks. The women coefficient captures the conditional gender ownership gap—that is, the difference in the probability of owning a given species between women and men managers with identical observable characteristics.

For income control, we estimate probit models with APEs for a binary outcome indicating whether the managing member is the primary decision-maker over the use of livestock income. Zone fixed effects and livestock portfolio controls are included. The decision-making variable (*mgr\_decides\_income*) captures income-use decisions specifically; results are interpreted narrowly as evidence on income control rather than broader management autonomy.

For productivity, we estimate survey-weighted ordinary least squares regressions for herd size outcomes (log-transformed using  $\ln(Y+1)$  to address right-skewness and zero counts), net stock change (in levels), milk yield, and egg production. Two specifications are reported for each outcome: Model 1 (M1) includes individual-level controls only, and Model 2 (M2) adds agroecological zone fixed effects. Productivity analyses are restricted to relevant sub-populations, for example, milk yields estimated to cattle owners only. All estimates are interpreted as conditional gender gaps rather than causal effects. The identifying assumption is conditional as-good-as-random assignment of manager sex given the control set; we make no

causal claims but note that the richness of the NASS microdata, including individual human capital and spatial controls, substantially reduces confounding relative to prior studies.

## 5. Results

### 5.1 Descriptive Statistics: Socioeconomic and Livestock Characteristics

Table 2 documents gender differences in demographic, human capital, and livestock ownership characteristics. Men managers constitute a slightly larger share of the sample (53.4 percent) and are, on average, significantly older (43.6 years as compared to 40.2 years for women managers  $p < 0.001$ ), consistent with older managers holding more assets on average. Men managers exhibit considerably higher literacy rates (73.4 compared to 61.6 percent for women) and are more than twice as likely to have received formal agricultural training (10.1 versus 4.3 percent). These human capital gaps are particularly notable because, as shown below, they do not explain the income control differential. Livestock asset endowments are markedly skewed toward men. Operations managed by men maintain significantly larger herds (33.1 TLUs compared to 23.0 TLUs;  $p < 0.001$ ) and higher net stock accumulation (2.70 versus 1.16 TLUs;  $p < 0.001$ ). Women managers are slightly more likely to be household heads or spouses (92.5 versus 90.6 percent), a small difference that may reflect the way women's livestock activities are embedded in household roles.

**Table 2. Socioeconomic characteristics of livestock-managing household members by sex**

| Characteristic                             | Men     | Women   | p-value |
|--------------------------------------------|---------|---------|---------|
| <b>Sample composition (unweighted N)</b>   |         |         |         |
| Observations                               | 379,091 | 330,488 |         |
| Share (%)                                  | 53.4    | 46.6    |         |
| <b>Demographics (weighted means)</b>       |         |         |         |
| Age (years)                                | 43.6    | 40.2    | <0.0001 |
| Youth (15–35) (%)                          | 59.6    | 40.4    | <0.0001 |
| <b>Human capital (weighted means)</b>      |         |         |         |
| Literate (%)                               | 73.4    | 61.6    | <0.0001 |
| At least primary education (%)             | 98.8    | 98.6    | 0.1651  |
| Formal agricultural training (%)           | 10.1    | 4.3     | <0.0001 |
| <b>Household position (weighted)</b>       |         |         |         |
| Head or spouse (%)                         | 90.6    | 92.5    | <0.0001 |
| Urban sector (%)                           | 60.3    | 39.7    | <0.0001 |
| <b>Livestock holdings (weighted means)</b> |         |         |         |
| Total herd size (TLU)                      | 33.1    | 23.0    | <0.0001 |
| Net stock change (TLU)                     | 2.70    | 1.16    | <0.0001 |

Source: Authors' construction from NASS 2022/23. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$

Table 3 reveals strong gender specialization across livestock species. Men are significantly more likely to own cattle (21.7 as against 12.9 percent for women;  $p < 0.001$ ), while women managers dominate ownership of small ruminants (69.3 percent), poultry (62.8 percent), and working animals (81.4 percent). There was no statistically significant gender difference observed for monogastrics (pigs), suggesting that pig production occupies a more gender-neutral niche in Nigeria's livestock economy. The strong presence of women in poultry is

consistent with the broader African literature associating women with small-stock management, though as the regression analysis reveals, women poultry owners manage significantly smaller flocks than their male counterparts.

**Table 3. Weighted prevalence of livestock ownership (% of managers) by species group, manager sex, and age group**

| Species group                | By manager sex |       |        | By age group |        |        | Sig. |
|------------------------------|----------------|-------|--------|--------------|--------|--------|------|
|                              | Men            | Women | p      | Youth        | Mature | p      |      |
| Cattle (large ruminants)     | 21.7           | 12.9* | <0.001 | 39.5         | 60.5   | <0.001 | ***  |
| Small ruminants (goat/sheep) | 30.7           | 69.3* | <0.001 | 34.9         | 65.1   | <0.001 | ***  |
| Monogastrics (pigs)          | 33.3           | 33.3  | 0.829  | 34.6         | 65.4   | 0.408  | ns   |
| Poultry                      | 37.2           | 62.8* | <0.001 | 33.9         | 66.1   | 0.072  | *    |
| Working/draught animals      | 18.6           | 81.4* | <0.001 | 31.5         | 68.5   | 0.308  | ns   |

Source: Authors' construction from NASS 2022/23. Notes: Values show the percentage of managers in each group that own the given species. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$

Table 4 presents mean herd sizes and net stock changes by species group. The largest absolute gender gaps are among cattle (10.94 versus 3.28 TLU;  $p < 0.001$ ) and small ruminants (22.35 versus 13.45 TLU;  $p < 0.001$ ). Mature managers (36 years and older) maintain larger herds than youth managers, a pattern consistent with the accumulation of livestock assets over time. Net stock change follows the same gendered pattern across all species, with men managers achieving significantly higher herd growth rates, consistent with the broader pattern of lower net accumulation among women-managed operations documented above.

**Table 4. Weighted mean herd size and net stock change by species group, manager sex, and age group**

| Livestock group                   | By sex |       |        | By age group |        |        |
|-----------------------------------|--------|-------|--------|--------------|--------|--------|
|                                   | Men    | Women | p      | Youth        | Mature | p      |
| Large ruminants (cattle)          | 10.94  | 3.28  | <0.001 | 9.33         | 8.66   | 0.505  |
| Small ruminants                   | 22.35  | 13.45 | <0.001 | 18.37        | 20.92  | 0.023  |
| Monogastrics (pigs)               | 2.91   | 1.54  | 0.001  | 1.87         | 2.96   | 0.003  |
| Poultry                           | 29.54  | 21.89 | <0.001 | 22.47        | 30.68  | <0.001 |
| Equines (working animals)         | 0.40   | 0.12  | <0.001 | 0.29         | 0.33   | 0.445  |
| Total herd (all species)          | 33.14  | 23.00 | <0.001 | 24.98        | 33.66  | <0.001 |
| Net stock change: large ruminants | 1.20   | 0.25  | <0.001 | -            | -      | -      |
| Net stock change: small ruminants | 2.60   | 1.12  | <0.001 | -            | -      | -      |
| Net stock change: poultry         | 1.76   | 0.81  | <0.001 | -            | -      | -      |
| Total net stock change            | 2.70   | 1.16  | <0.001 | 1.93         | 2.33   | <0.001 |

Source: Authors' construction from NASS 2022/23. Note: All means are survey weighted.  $p$ -values from adjusted Wald tests. '-' = not estimated separately by age for stock changes. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$

Table 5 disaggregates stock flow dynamics over the 12-month reference period. Men managers reported higher levels of all inflows (births, acquisitions, and purchases) and substantially greater net accumulation (2.70 TLUs compared to 1.16 for women;  $p < 0.001$ ). Although herds managed by men also experience higher absolute death and slaughter rates, this reflects their larger scale; the net accumulation gap remains large. This pattern is consistent with, though does not directly test, differences in access to capital or market participation between men and women managers.

**Table 5. Weighted mean stock flows over the 12-month reference period by manager sex**

| Stock flow variable      | Men  | Women | p-value | 95% CI (women) |
|--------------------------|------|-------|---------|----------------|
| Births / acquisitions    | 4.37 | 2.16  | <0.001  | [2.02, 2.29]   |
| Purchases                | 1.96 | 0.54  | <0.001  | [0.48, 0.60]   |
| Deaths / losses          | 2.18 | 0.94  | <0.001  | [0.86, 1.02]   |
| Slaughtered              | 0.37 | 0.20  | <0.001  | [0.17, 0.22]   |
| Sold alive               | 0.23 | 0.12  | <0.001  | [0.10, 0.13]   |
| Gifted out               | 0.62 | 0.24  | <0.001  | [0.22, 0.26]   |
| Net stock change (total) | 2.70 | 1.16  | <0.001  | [1.05, 1.26]   |

*Source: Authors' construction from NASS 2022/23.*

Table 6 reports gender differences in production outcomes for dairy and poultry sub-samples. Women managers are substantially more likely to be currently milking their cattle (24.4 percent compared to 10.5 percent for men), suggesting a strong functional specialization of women in dairy activities despite being less likely to own cattle in the first place. However, men managers achieve higher milk output per cow (6.48 liters compared to 5.11 liters per day for women;  $p < 0.001$ ) and are far more likely to sell milk commercially (95.6 percent compared to 90.3 percent for women). Similarly, men-managed flocks produce more eggs per hen per month (43.0 compared to 38.5 for women;  $p < 0.001$ ), and men are disproportionately engaged in egg marketing (64.3 versus 35.7 percent of sales). These descriptive patterns motivate the regression analysis below, which places conditions on herd and flock size to isolate the intensive-margin productivity gap.

**Table 6. Weighted means of milk and egg production indicators by manager sex**

| Variable                               | Men   | Women | p      | 95% CI (women) |
|----------------------------------------|-------|-------|--------|----------------|
| <b>Milk production</b>                 |       |       |        |                |
| Currently milking (% of cattle owners) | 10.5  | 24.4  | <0.001 | -              |
| Number of cows milked                  | 5.33  | 5.77  | 0.345  | [5.11, 6.43]   |
| Liters per cow per day                 | 6.48  | 5.11  | <0.001 | [4.01, 6.21]   |
| Total liters per day                   | 10.73 | 8.17  | <0.001 | [6.47, 9.87]   |
| Proportion selling milk (%)            | 95.6  | 90.3  | <0.001 | -              |
| <b>Egg production</b>                  |       |       |        |                |
| Currently laying (% of poultry owners) | 57.1  | 42.9  | 0.009  | -              |
| Laying hens (no.)                      | 5.61  | 5.36  | 0.010  | [4.97, 5.75]   |
| Eggs per hen per month                 | 43.0  | 38.5  | <0.001 | [34.7, 42.4]   |
| Total eggs per month (no.)             | 18.1  | 16.4  | <0.001 | [14.8, 17.9]   |
| Proportion selling eggs (%)            | 64.3  | 35.7  | 0.002  | -              |

Source: Authors' construction from NASS 2022/23. Notes: Milk sample restricted to cattle-owning households. Egg sample restricted to poultry-owning households. *p*-values from adjusted Wald tests. '-' = not applicable.

Table 7 reveals stark gender inequalities in decision-making authority. Men managers control livestock income in 72.9 percent of cases, compared to only 26.9 percent for women managers ( $p < 0.001$ ). Men managers also dominate responsibility for household farming operations (79.1 versus 20.9 percent), organization of daily farm work (78.8 versus 21.2 percent), and farm record-keeping (65.9 versus 34.1 percent). These patterns collectively indicate that women's labor contributions to livestock management are not matched by commensurate decision-making authority, a finding relevant to the design of interventions targeting women's empowerment.

**Table 7. Weighted proportions for decision-making and income control indicators by manager sex and age group**

| Variable                             | By sex |       |        | By age group |        |        |
|--------------------------------------|--------|-------|--------|--------------|--------|--------|
|                                      | Men    | Women | p      | Youth        | Mature | p      |
| Controls livestock income (% = 1)    | 72.9   | 26.9  | <0.001 | 31.6         | 68.4   | <0.001 |
| Responsible for household farm (= 1) | 79.1   | 20.9  | <0.001 | -            | -      | -      |
| Organizes daily farm work (= 1)      | 78.8   | 21.2  | <0.001 | -            | -      | -      |
| Keeps farm records (% yes)           | 65.9   | 34.1  | <0.001 | -            | -      | -      |

Source: Authors' construction from NASS 2022/23. Notes: Values are weighted proportions (%) from svy: tab with design-based Pearson *F*-tests.  $p < 0.001$  for all sex comparisons.

Table 8 presents average partial effects from the survey-weighted probit regression for livestock income control. Being a woman is associated with a 19.6 percentage-point lower probability of controlling livestock income ( $p < 0.001$ ), holding human capital, household position, and livestock portfolio constant. Notably, household headship or spouse status increases this probability by 21.0 percentage points, the largest positive coefficient in the model, consistent with household position being a stronger correlate of women's economic

agency than human capital in this sample. None of the human capital variables—literacy, education, training—approach statistical significance, a pattern consistent with informational deficits playing a limited role, though the data cannot identify what other factors account for the remaining gap. Ownership of small ruminants is positively associated with income control (+1.9 percentage points;  $p < 0.001$ ), while poultry ownership is negatively associated (−2.4 percentage points;  $p < 0.001$ ), possibly reflecting the informal, low-value nature of most poultry transactions.

**Table 8. Average marginal effects from survey-weighted probit: determinants of livestock income control**

| Variable                       | dy/dx  | Std. err. | t      | p      | 95% CI           |
|--------------------------------|--------|-----------|--------|--------|------------------|
| Women manager                  | -0.196 | 0.006     | -32.73 | <0.001 | [-0.208, -0.184] |
| Mature age group (36+)         | 0.003  | 0.004     | 0.69   | 0.491  | [-0.005, 0.011]  |
| Literate                       | -0.001 | 0.007     | -0.16  | 0.870  | [-0.016, 0.013]  |
| At least primary education     | -0.007 | 0.017     | -0.41  | 0.682  | [-0.041, 0.027]  |
| Received agricultural training | 0.002  | 0.006     | 0.30   | 0.761  | [-0.011, 0.015]  |
| Head / spouse of household     | 0.210  | 0.010     | 21.16  | <0.001 | [0.190, 0.229]   |
| Owens large ruminants (cattle) | 0.008  | 0.009     | 0.87   | 0.383  | [-0.010, 0.026]  |
| Owens small ruminants          | 0.019  | 0.004     | 4.29   | <0.001 | [0.010, 0.027]   |
| Owens monogastrics (pigs)      | 0.018  | 0.010     | 1.81   | 0.070  | [-0.002, 0.039]  |
| Owens poultry                  | -0.024 | 0.006     | -4.06  | <0.001 | [-0.035, -0.012] |

*Source: Authors' construction from NASS 2022/23. Notes: Dependent variable = 1 if manager controls livestock income. Reference categories: men, youth (15–35), illiterate, no education, no training, non-head/spouse, does not own the relevant species. Observations = 70,455;  $F(10, 719) = 182.32$ ,  $p < 0.001$ . \*\*\*  $p < 0.01$*

Table 9 presents summary statistics by agroecological zone. Average herd sizes vary considerably, ranging from 21.4 TLUs in the North–West to 48.7 TLUs in the South–South. Men managers maintain larger herds than women managers in every zone. Women's participation in livestock management ranges from 24.1 percent in the North–West, where cattle and pastoralism dominate, to 47.9 percent in the South–East, a pattern consistent with the more diversified, small-stock-based systems of the southern zones. Cattle ownership is heavily concentrated in the North–East and North–West, while poultry ownership is high and relatively uniform across all zones, exceeding 65 percent everywhere.

**Table 9. Weighted mean total herd size (TLU) and ownership prevalence by agroecological zone and manager sex**

| Zone          | All managers (TLU) | Men (TLU) | Women (TLU) | Women share (%) | Cattle owners (%) | Poultry owners (%) |
|---------------|--------------------|-----------|-------------|-----------------|-------------------|--------------------|
| North–Central | 27.1               | 34.1      | 21.9        | 35.2            | 19.8              | 80.3               |
| North–East    | 23.0               | 25.3      | 16.2        | 24.7            | 48.5              | 68.8               |
| North–West    | 21.4               | 25.1      | 19.4        | 24.1            | 43.3              | 65.2               |
| South–East    | 27.1               | 35.8      | 24.6        | 47.9            | 4.8               | 86.1               |
| South–South   | 48.7               | 68.1      | 37.7        | 42.4            | 0.7               | 83.9               |
| South–West    | 36.7               | 54.7      | 26.2        | 46.9            | 4.6               | 87.4               |

*Source: Authors' construction from NASS 2022/23. Notes: All estimates are survey weighted.*

Table 10 presents LPM estimates with women-by-zone interaction terms, revealing important spatial moderation of the gender ownership gap. The main effect of being a woman is negative and significant for large ruminants ( $-0.096$ ;  $p < 0.01$ ) and small ruminants ( $-0.076$ ;  $p < 0.01$ ), and positive for poultry ( $+0.105$ ;  $p < 0.01$ ), consistent with the descriptive patterns in Table 3. However, the interaction terms reveal a more nuanced picture. In the northern zones—where livestock endowments are higher—women managers face an additional reduction in the probability of large ruminant ownership relative to men managers (Women  $\times$  North–West:  $-0.029$ ;  $p < 0.01$ ). One possible explanation is that cattle-dense systems are associated with norms that further concentrate high-value asset ownership among men; we do not have data on norms to test this directly.

In contrast, in the South–East, South–South, and South–West, where overall large ruminant ownership is lower, the women interaction effects for large ruminants are positive and significant (e.g., Woman  $\times$  South–East:  $+0.076$ ; Woman  $\times$  South–South:  $+0.085$ ; both  $p < 0.01$ ), indicating that the gender gap in large ruminant ownership narrows, and in some cases reverses, in southern zones. For poultry, the women premium is amplified in the North–East (Woman  $\times$  North–East:  $+0.073$ ;  $p < 0.01$ ) but attenuated in the South–West (Woman  $\times$  South–West:  $-0.053$ ;  $p < 0.01$ ), a pattern that may reflect regional differences in poultry management systems and market orientation, though this is not directly tested here.

**Table 10. Gender-by-zone interaction effects on livestock ownership probability (LPM)**

| Variable                      | (1) Large Ruminants | (2) Small Ruminants | (3) Poultry         |
|-------------------------------|---------------------|---------------------|---------------------|
| Member is a woman             | -0.0960*** (0.0057) | -0.0760*** (0.0095) | 0.1051*** (0.0068)  |
| North–East                    | 0.2701*** (0.0075)  | 0.0946*** (0.0065)  | -0.1655*** (0.0077) |
| North–West                    | 0.2376*** (0.0063)  | 0.0936*** (0.0061)  | -0.1626*** (0.0067) |
| South–East                    | -0.0946*** (0.0059) | -0.0652*** (0.0096) | 0.0403*** (0.0083)  |
| South–South                   | -0.1368*** (0.0048) | -0.2095*** (0.0127) | 0.0227** (0.0097)   |
| South–West                    | -0.1069*** (0.0053) | -0.2147*** (0.0102) | 0.0613*** (0.0083)  |
| Woman × North–East            | -0.0228* (0.0131)   | -0.0069 (0.0141)    | 0.0732*** (0.0124)  |
| Woman × North–West            | -0.0290*** (0.0104) | 0.0222* (0.0127)    | 0.0076 (0.0113)     |
| Woman × South–East            | 0.0760*** (0.0069)  | 0.0085 (0.0153)     | -0.0355*** (0.0109) |
| Woman × South–South           | 0.0851*** (0.0060)  | -0.0524** (0.0222)  | -0.0402*** (0.0134) |
| Woman × South–West            | 0.0691*** (0.0064)  | 0.0886*** (0.0153)  | -0.0529*** (0.0105) |
| Age of managing HH member     | -0.0011*** (0.0001) | -0.0004** (0.0002)  | -0.0008*** (0.0001) |
| Manager literate              | -0.0451*** (0.0070) | -0.0602*** (0.0074) | 0.0027 (0.0073)     |
| Manager educated              | 0.0245 (0.0160)     | -0.0223 (0.0180)    | -0.0261* (0.0157)   |
| Manager agricultural training | 0.0227*** (0.0053)  | -0.0209*** (0.0068) | -0.0185*** (0.0063) |
| Constant                      | 0.2115*** (0.0173)  | 0.8714*** (0.0197)  | 0.8497*** (0.0173)  |
| N                             | 71,289              | 71,289              | 71,289              |
| R <sup>2</sup>                | 0.174               | 0.089               | 0.065               |

Source: Authors' construction from NASS 2022/23. Notes: Survey-weighted LPM. Dependent variable = 1 if household member owns the respective livestock type. Standard errors (in parentheses) clustered at the household level. Reference zone: North–Central. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

## 5.2 The Women Ownership Gap across Livestock Groups

Table 11 presents the unconditional gender ownership gap by livestock group, controlling for zone fixed effects. These estimates are abstracted from compositional differences across zones and provide the most reliable summary of the average within-zone gender ownership penalty. The results show lower rates of ownership among women in four of five species categories: –7.1 percentage points for large ruminants ( $p < 0.01$ ), –5.8 points for small ruminants ( $p < 0.01$ ), –1.4 points for monogastrics ( $p < 0.01$ ), and –0.4 points for equines ( $p < 0.01$ ). The women premium in poultry ownership (+9.7 percentage points;  $p < 0.01$ ) is large and robust across specifications.

These findings are consistent with the species-based asset hierarchy documented in the descriptive statistics and are consistent with gender-based livestock stratification being a persistent pattern across zones. Agricultural training is positively associated with large ruminant ownership (+2.2 percentage points;  $p < 0.01$ ) but negatively associated with small ruminant, monogastric, and poultry ownership. This positive association could reflect returns to training but could equally reflect that managers who already hold cattle are more likely to seek out or be offered training; the cross-sectional data cannot distinguish these explanations, which has implications for how any training-based intervention targeting women is designed and evaluated.

**Table 11. Linear probability model estimates of the women ownership gap by livestock type**

| Variable          | (1) Large<br>Rum.      | (2) Small<br>Rum.      | (3)<br>Mono.           | (4)<br>Poultry         | (5)<br>Equine          |
|-------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Member is a woman | -0.0711***<br>(0.0028) | -0.0579***<br>(0.0049) | -0.0138***<br>(0.0025) | 0.0966***<br>(0.0038)  | -0.0036***<br>(0.0006) |
| Member age group  | -0.0175***<br>(0.0050) | -0.0301***<br>(0.0067) | -0.0019<br>(0.0039)    | -0.0037<br>(0.0060)    | 0.0017<br>(0.0012)     |
| Age of manager    | -0.0004**<br>(0.0002)  | 0.0006**<br>(0.0002)   | -0.0001<br>(0.0001)    | -0.0006***<br>(0.0002) | 0.0000<br>(0.0000)     |
| Manager literate  | -0.0395***<br>(0.0071) | -0.0564***<br>(0.0075) | 0.0098**<br>(0.0049)   | 0.0039<br>(0.0074)     | 0.0014 (0.0018)        |
| Manager educated  | 0.0010<br>(0.0192)     | -0.0078<br>(0.0211)    | -0.0011<br>(0.0118)    | -0.0247<br>(0.0187)    | -0.0310***<br>(0.0102) |
| Agric. training   | 0.0218***<br>(0.0053)  | -0.0226***<br>(0.0068) | -0.0124***<br>(0.0036) | -0.0167***<br>(0.0063) | -0.0008 (0.0012)       |
| Zone FE           | Yes                    | Yes                    |                        | Yes                    | Yes                    |
| N                 | 70,455                 | 70,455                 | 70,455                 | 70,455                 | 70,455                 |
| R <sup>2</sup>    | 0.171                  | 0.086                  | 0.031                  | 0.064                  | 0.017                  |

Source: Authors' construction from NASS 2022/23. Notes: Survey-weighted LPM with zone fixed effects and household-clustered standard errors. Dependent variable is a binary indicator of species-group ownership. Selected controls shown; full results available on request. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

### 5.3 Gender Gap in Total Herd Size and Net Stock Value

Table 12 examines gender differentials in herd quantity and value outcomes. In the base specification (M1), being a woman is associated with a 9.9 percent smaller total herd size ( $p < 0.01$ ). This gap increases to 14.0 percent in M2 once zone fixed effects are included, indicating that women managers are systematically located in zones with larger average herd sizes, partially masking the within-zone gap. For net livestock stock value, the penalty is  $-1.37$  TLUs in M1 and  $-0.87$  TLUs in M2 (both  $p < 0.01$ ).

Agricultural training is positively and significantly associated with larger herd sizes (M1:  $+20.6$  percent; M2:  $+19.5$  percent; both  $p < 0.01$ ). This association is consistent with training improving management practices but could equally reflect that managers with larger herds are more likely to access or be selected into training programs; the cross-sectional design cannot distinguish between these explanations. Education, by contrast, is not significant for herd size but is positively associated with net stock value ( $+0.81$  TLUs;  $p < 0.01$ ), an association consistent with, though not proof of, educated managers holding higher-value livestock portfolios. In the net livestock stock value models, species portfolio controls confirm clear valuation gradients: households keeping monogastrics record the highest net stock premium ( $+2.34$ ;  $p < 0.01$ ), followed by small ruminants ( $+1.88$ ;  $p < 0.01$ ) and large ruminants ( $+0.92$ ;  $p < 0.01$ ). Poultry keepers show a negative net stock value coefficient ( $-0.51$ ;  $p < 0.01$ ), consistent with the low unit value of poultry.

**Table 12. OLS estimates of the gender gap in total herd size and net livestock stock value**

| Variable             | ln (Herd Size)         |                        | Net Livestock Stock Value |                        |
|----------------------|------------------------|------------------------|---------------------------|------------------------|
|                      | M1                     | M2                     | M1                        | M2                     |
| Member is a woman    | -0.0992***<br>(0.0110) | -0.1403***<br>(0.0118) | -1.3722***<br>(0.0695)    | -0.8723***<br>(0.0704) |
| Member age group     | 0.1486***<br>(0.0167)  | 0.1378***<br>(0.0166)  | -0.0790<br>(0.1399)       | 0.0343 (0.1395)        |
| Age of manager       | 0.0027***<br>(0.0006)  | 0.0022***<br>(0.0006)  | 0.0089*<br>(0.0049)       | 0.0158***<br>(0.0051)  |
| Manager literate     | 0.1057***<br>(0.0174)  | 0.1034***<br>(0.0175)  | -0.3390***<br>(0.1103)    | -0.0961<br>(0.1093)    |
| Manager educated     | 0.0669 (0.0432)        | 0.0432 (0.0434)        | 0.8118***<br>(0.2191)     | 0.8025***<br>(0.2212)  |
| Agric. training      | 0.2057***<br>(0.0193)  | 0.1953***<br>(0.0190)  | 0.0209 (0.1607)           | 0.1416 (0.1634)        |
| Zone FE              | No                     | Yes                    | No                        | Yes                    |
| Species portfolio FE | No                     | No                     | No                        | Yes                    |
| N                    | 70,455                 | 70,455                 | 70,455                    | 70,455                 |
| R <sup>2</sup>       | 0.017                  | 0.027                  | 0.005                     | 0.020                  |

Source: Authors' construction from NASS 2022/23. Notes: Survey-weighted OLS. M1 = individual and household controls only; M2 = M1 + zone fixed effects. For net stock value, M2 additionally includes species ownership dummies. Clustered standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

#### 5.4 Gender Gap in Control over Livestock Income

Table 13 examines intrahousehold bargaining over livestock income using both probit APEs and LPM estimates. The results are consistent across estimators. Being a woman is associated with a 19.2 percentage point lower probability of controlling livestock income (probit APE:  $-0.192$ ;  $p < 0.01$ ), with the LPM yielding a slightly larger estimate of  $-0.238$  ( $p < 0.01$ ) due to the linear approximation at non-mean probability values. Both estimators show a large, significant, and robust gap in income control associated with being a woman that persists after conditioning on livestock portfolio, household position, and agroecological zone.

The strongest positive predictor of income control is household headship or spouse status (+20.6 percentage points in probit; +30.9 percentage points in LPM; both  $p < 0.01$ ), consistent with relational position within the household being a stronger correlate of income control in this sample than education, literacy, or training, though the cross-sectional design cannot establish the direction of causality. This finding is theoretically consistent with collective household models in which bargaining power is determined by social and relational entitlements rather than individual productivity (Doss, 2013). The counterintuitive negative association between poultry ownership and income control ( $-2.2$  percentage points;  $p < 0.01$ ) is consistent with the informality of poultry markets in Nigeria, where transactions tend to be small-scale, irregular, and difficult to attribute to a single decision-maker.

**Table 13. Probit APE and LPM estimates of the women gap in control over livestock income**

| Variable              | (1) Probit APE      | (2) LPM             |
|-----------------------|---------------------|---------------------|
| Member is a woman     | -0.1924*** (0.0029) | -0.2380*** (0.0041) |
| Member age group      | -0.0116*** (0.0045) | -0.0119*** (0.0045) |
| Age of manager        | 0.0009*** (0.0002)  | 0.0007*** (0.0002)  |
| Manager literate      | 0.0016 (0.0053)     | -0.0020 (0.0063)    |
| Manager educated      | -0.0053 (0.0145)    | -0.0085 (0.0143)    |
| Agric. training       | 0.0035 (0.0046)     | 0.0032 (0.0038)     |
| Head or spouse        | 0.2058*** (0.0046)  | 0.3091*** (0.0086)  |
| Keeps large ruminants | 0.0063 (0.0042)     | 0.0055 (0.0035)     |
| Keeps small ruminants | 0.0179*** (0.0033)  | 0.0216*** (0.0038)  |
| Keeps monogastrics    | 0.0167*** (0.0057)  | 0.0168*** (0.0053)  |
| Keeps poultry         | -0.0224*** (0.0038) | -0.0173*** (0.0029) |
| Zone FE               | Yes                 | Yes                 |
| N                     | 70,455              | 70,455              |

Source: Authors' construction from NASS 2022/23. Notes: Column (1) reports average partial effects from a survey-weighted probit. Column (2) reports LPM estimates. Both specifications include zone fixed effects and household-clustered standard errors. Dependent variable = 1 if manager controls income from livestock sales. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

## 5.5 Gender Gaps in Group-Specific Herd Sizes

Table 14 decomposes the aggregate herd size gap by livestock group. Women managers hold significantly smaller herds across all four major categories. For large ruminants, the gap is 0.454 TLU in M1, narrowing to 0.231 TLU in M2 after zone controls the narrowing indicating that women managers are concentrated in high-cattle-density zones, partially masking the within-zone deficit. The pattern is similar for small ruminants (M1: -0.415 TLU; M2: -0.255 TLU).

For poultry, the results reveal a dual-margin gender gap: women are more likely to own poultry (Table 10), but female owners hold smaller flocks than male owners (M1: -0.240 TLU; M2: -0.099 TLU; both  $p < 0.01$ ). This is a substantively important finding: women's higher likelihood of poultry ownership does not translate into parity in the scale of holdings. However, ownership and flock-size data alone cannot establish the underlying reasons for this gap or determine whether it reflects constraints on women's ability to expand their poultry operations.

**Table 14. OLS estimates of the gender gap in group-specific herd sizes**

| Variable         | Large Ruminants      |                      | Small Ruminants      |                      | Monogastrics         |                      | Poultry             |                     |
|------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|
|                  | M1                   | M2                   | M1                   | M2                   | M1                   | M2                   | M1                  | M2                  |
| Member is woman  | -0.454***<br>(0.009) | -0.231***<br>(0.009) | -0.415***<br>(0.015) | -0.255***<br>(0.016) | -0.044***<br>(0.007) | -0.068***<br>(0.008) | 0.240***<br>(0.015) | 0.099***<br>(0.015) |
| Member age group | -0.054***<br>(0.017) | -0.025<br>(0.016)    | -0.039*<br>(0.023)   | -0.012<br>(0.022)    | 0.011<br>(0.012)     | 0.009<br>(0.012)     | 0.135***<br>(0.024) | 0.112***<br>(0.023) |
| Age of manager   | -0.005***<br>(0.001) | 0.000<br>(0.001)     | 0.000<br>(0.001)     | 0.005***<br>(0.001)  | -0.001<br>(0.001)    | 0.000<br>(0.001)     | 0.003***<br>(0.001) | 0.000<br>(0.001)    |
| Manager literate | -0.154***<br>(0.023) | -0.095***<br>(0.022) | -0.195***<br>(0.025) | -0.117***<br>(0.025) | 0.014<br>(0.014)     | 0.034**<br>(0.014)   | 0.133***<br>(0.026) | 0.107***<br>(0.026) |
| Agric. training  | 0.042**<br>(0.019)   | 0.077***<br>(0.018)  | -0.030<br>(0.025)    | 0.023<br>(0.024)     | -0.033***<br>(0.012) | -0.021*<br>(0.012)   | 0.161***<br>(0.027) | 0.140***<br>(0.027) |
| Zone FE          | No                   | Yes                  | No                   | Yes                  | No                   | Yes                  | No                  | Yes                 |
| N                | 70,455               | 70,455               | 70,455               | 70,455               | 70,455               | 70,455               | 70,455              | 70,455              |
| R <sup>2</sup>   | 0.034                | 0.138                | 0.018                | 0.058                | 0.001                | 0.026                | 0.009               | 0.039               |

Source: Authors' construction from NASS 2022/23. Notes: Survey-weighted OLS. M1 = base controls; M2 = M1 + zone fixed effects. Standard errors clustered at the household level. Selected controls shown. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

## 5.6 Gender Gap in Milk and Egg Productivity

Table 15 examines productivity outcomes conditional on ownership. Women cattle owners produce 3.41 fewer liters of milk per week in M1 and 3.23 fewer liters in M2 (both  $p < 0.01$ ), after conditioning on herd size. For eggs, the women deficit is 1.78 units per week in M1 and 3.16 units in M2 (both  $p < 0.01$ ). The widening of the egg productivity gap after spatial controls indicates that women's lower output is systematically understated when zone heterogeneity is unaccounted for—women poultry owners are concentrated in higher-productivity zones, partially masking the within-zone performance gap.

One counterintuitive finding is that agricultural training is negatively associated with milk output (M1:  $-2.57$  liters/week;  $p < 0.01$ ) but positively associated with egg production (M1:  $+7.29$  eggs/week;  $p < 0.01$ ). This divergence may reflect specialization effects: trained managers in cattle systems redirect large ruminants toward draught or market sales rather than dairy extraction, while trained poultry managers invest more intensively in productivity-enhancing practices, such as improved breeds or commercial feeds. However, this interpretation cannot be distinguished from selection into training, for example, whether managers who already prioritize non-dairy outputs are more likely to pursue or receive training. Manager literacy is not significant for milk but is positively associated with egg output ( $+2.5$  to  $+3.0$  eggs/week;  $p < 0.01$ ), consistent with the informational demands of poultry intensification. The positive herd size coefficients are consistent with expected scale effects: each additional large ruminant is associated with approximately 0.009 additional liters of milk per week, while each additional bird yields approximately 0.018 additional eggs per week.

**Table 15. OLS estimates of the gender gap in milk and egg productivity**

| Variable          | Milk Output (liters/week) |                   | Egg Output (units/week) |                   |
|-------------------|---------------------------|-------------------|-------------------------|-------------------|
|                   | M1                        | M2                | M1                      | M2                |
| Member is woman   | -3.411*** (1.004)         | -3.232*** (0.914) | -1.776*** (0.560)       | -3.159*** (0.660) |
| Member age group  | -0.050 (0.853)            | -0.104 (0.834)    | 1.561* (0.870)          | 1.347 (0.850)     |
| Age of manager    | -0.022 (0.032)            | -0.015 (0.032)    | 0.009 (0.030)           | -0.040 (0.031)    |
| Manager literate  | 0.168 (0.874)             | 0.506 (0.804)     | 3.031*** (0.637)        | 2.461*** (0.650)  |
| Agric. training   | -2.571*** (0.609)         | -2.584*** (0.601) | 7.287*** (1.208)        | 6.713*** (1.170)  |
| Herd size control | 0.009*** (0.003)          | 0.009*** (0.002)  | 0.018** (0.009)         | 0.018** (0.009)   |
| Zone FE           | No                        | Yes               | No                      | Yes               |
| N                 | 77,771                    | 77,771            | 47,533                  | 47,533            |
| R <sup>2</sup>    | 0.039                     | 0.064             | 0.087                   | 0.104             |

*Source: Authors' construction from NASS 2022/23. Notes: Sample restricted to livestock keepers. Survey-weighted OLS. M1 = base controls including herd/flock size; M2 = M1 + zone fixed effects. Milk estimated on large ruminant keepers ( $n = 77,771$ ); eggs on poultry keepers ( $n = 47,533$ ). Clustered standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .*

## 6. Discussion

### 6.1 The Structural Nature of Gender Stratification in Nigeria's Livestock Sector

Our results show gender stratification in Nigeria's livestock sector that is structural, persistent, and multidimensional. Women managers face ownership penalties across virtually all high-value species, control significantly less livestock income, and produce less output per unit of owned assets, even after conditioning on human capital endowments and agroecological zones. This is consistent with evidence that women are more likely to own small or less valuable livestock, and that even where many households report women owning livestock, women still own fewer animals than men (Njuki and Sanginga, 2013). Reviews of gender differences in non-land agricultural inputs also find that men generally have higher input measures than

women, although this is often sensitive to the controls and gender indicator used (Peterman et al., 2014). Recent nationally representative evidence from Nigeria points the same way. Livestock wealth is associated with a lower, not higher, share of household income accruing to women (Kirui et al., 2026). Evidence on crop productivity in Nigeria and elsewhere shows how context-dependent such gaps are. In Nigeria, women in the North produce 28 percent less than men even after controlling for observed factors of production, while the South shows no significant gender difference (Oseni et al., 2015). In Malawi, women-managed plots are 25 percent less productive on average, but most of that gap is explained by observable differences (Kilic et al., 2015). The finding that human capital variables, namely, education, literacy, and training, do not significantly predict income control suggests that the barriers women face are not primarily informational. This is notable because education, income, and assets are usually treated as core determinants of women's bargaining power (Doss, 2013). In Nigeria, these constraints are institutional. They are embedded in patrilineal inheritance systems, intrahousehold power asymmetries, and cultural norms that condition resource rights on social and relational status rather than individual capability or effort.

This finding has important implications for program design. Our null result for individual human capital does not mean that training, extension, and literacy programs are ineffective. A scoping review of livestock interventions found that credit, asset transfers and extension, and training and education had the strongest impacts on women's access to and control over livestock income and assets (Quisumbing et al., 2023). Our results suggest such programs are necessary but not sufficient for income control unless they also address intrahousehold relations. The primacy of household headship in determining income control suggests that interventions should also target intrahousehold bargaining dynamics, including norm-change programs and legal reforms supporting women's property rights.

## **6.2 The Dual Margin: Ownership and Scale**

An important nuance in the findings is the distinction between the extensive margin (probability of ownership) and the intensive margin (scale of ownership). Women managers have a significant ownership advantage in poultry, but this advantage does not translate into scale parity: women poultry owners manage smaller flocks than men within the same ownership category. This dual-margin structure implies that policies targeting only access to ownership, for example, asset transfer programs, may be insufficient if they do not also address capital, market, social, and intrahousehold constraints that limit women managers' ability to scale and retain control over their operations.

This is consistent with our own findings on income control, where household headship or spouse status was the strongest predictor of a manager's control over livestock income—considerably stronger than any human capital variable—a pattern consistent with collective household bargaining models in which resource control is conditioned on relational and social entitlements rather than on individual productivity or ownership alone (Doss, 2013). This suggests that even where asset transfer programs succeed in shifting formal ownership toward women, gains may not translate into control over the resulting income or production decisions if underlying household bargaining dynamics and social norms governing women's authority remain unaddressed. Evidence from asset- and rights-based interventions in Uganda illustrates that an ongoing land titling experiment found that formal ownership shifts toward women increased substantially only when the process explicitly required the wife's presence or was designed around joint titling, rather than when it targeted individual title transfer alone (Cherchi et al., 2019). More broadly, programs explicitly designed to shift intrahousehold norms, and men's participation directly, have shown success in shifting men's engagement in household

decision-making and resource allocation (Doyle et al., 2018; Vaillant et al., 2020). This evidence suggests that closing the gender gap in livestock ownership and productivity in Nigeria is unlikely to be achieved through asset- or capital-focused interventions alone, and that program design should also engage directly with household bargaining dynamics and the social norms that govern women's authority over the resources they manage.

### **6.3 Spatial Heterogeneity and Targeted Intervention**

The zone-level results reveal that the magnitude and direction of the gender gap vary substantially across Nigeria's geopolitical zones. In the livestock-dense northern zones, patrilineal norms appear to intensify women's disadvantage in cattle ownership; in the southern zones, where cattle holdings are generally lower, the gender gap narrows or reverses. This echoes Nigerian crop evidence, where the gender gap appears in the North but not the South, and where the authors conclude that in the South, access to resources explains most of the gap (Oseni et al., 2015). This heterogeneity has critical implications for policy design: nationally uniform interventions risk misallocating resources and may fail to address the specific institutional constraints that bind women in each region. Gender-responsive livestock programs should be zone-differentiated: in the northern zones, targeting should focus on improving women's access to large ruminants and cattle markets and, in the southern zones, on policies supporting scale-up of poultry and small ruminant systems.

## **7. Conclusion and Policy Recommendations**

This paper provides robust evidence that gender inequality in Nigeria's livestock sector is structural, multidimensional, and not reducible to human capital deficits alone. Across ownership, income control, and productivity dimensions, women managers are systematically disadvantaged relative to men with identical observable characteristics. The gender gap is largest for high-value species and in the livestock-dense northern zones; it persists in productivity outcomes even among owners, indicating binding constraints at the intensive margin. Household headship, not education or training, is the dominant predictor of women's income control, pointing to intrahousehold bargaining dynamics and social norms as the primary mechanism.

These findings carry three policy implications. First, livestock development programs should integrate gender-targeted asset transfer components, prioritizing women's access to cattle and small ruminants, given the large value-to-ownership gap documented in this study. Asset transfers are most effective when combined with complementary services such as veterinary support and market linkages, and when they are accompanied by norm-change programming to strengthen women's ability to retain control over transferred assets. Second, extension and training services must be redesigned to reach women managers directly, rather than routing information and technology through men household heads. The finding that agricultural training does not close the income control gap and may even exacerbate specialization away from dairy suggests that training content and delivery modalities need to be re-evaluated for gender responsiveness. Women-specific training in dairy management and poultry intensification could yield large productivity returns given the concentration of women in these sub-sectors.

Third, given the pronounced spatial heterogeneity documented across geopolitical zones, interventions should be zone-differentiated. Northern zones, where women's participation and large ruminant ownership rates are lowest and the gender gap most pronounced, require targeted programs addressing land rights, financial inclusion, and norm change around

livestock asset inheritance. Southern zones, where small-stock and poultry dominate, should focus on market development and scale-up support for women managers.

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**Table A1: Questions on ownership and control used in the study**

| Variable                                                                      | Questions asked                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Livestock Management: Who manages the livestock</b>                        |                                                                                                                                                                                                                                                  |
| female_member (sex of managing member)                                        | What is the sex of [name]?                                                                                                                                                                                                                       |
| mgr_s00C_q5 (responsible for household farm)                                  | Is [NAME] responsible for the household's farm?<br>A person responsible for the household's farm decides what shall be cultivated, which animals shall be raised and what inputs shall be used.                                                  |
| mgr_s00C_q6 (organizes daily farm work)                                       | Does [NAME] organize the daily work on the farm?                                                                                                                                                                                                 |
| <b>Livestock Ownership: Whether and how many livestock the holding keeps</b>  |                                                                                                                                                                                                                                                  |
| Own_ij (binary ownership indicator, per livestock group)                      | Q1: In the last 12 months, did your holding keep any [LIVESTOCK NAME], irrespective of who owns [LIVESTOCK NAME]?<br>Note: Owner(s) can be within and/or outside the holding.<br>Q2: How many [LIVESTOCK NAME] does your holding currently keep? |
| Primary managing member (links ownership to individual)                       | Q3: Is the person primarily responsible for managing the [LIVESTOCK NAME] currently kept by your holding a member of this household? Q3a (if No to Q3): 'What is the manager's sex?' / 'What is the manager's age?'                              |
| <b>Income Control: Who decides how earnings from livestock sales are used</b> |                                                                                                                                                                                                                                                  |
| mgr_decides_income (binary: managing member controls livestock income)        | Who in your holding decides on how to use the earnings made from [LIVESTOCK NAME] in the past 12 months (sale of live animals or other products if applicable: milk, eggs, furs...)?                                                             |

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